Facilitated Tucking to Reduce Pain in Neonates

Evidence for Best Practice

Kelsey A. Hartley, BSN, RN; Connie S. Miller, MS, RNC-OB, CNE, CCCE; Sheila M. Gephart, PhD, RN

ABSTRACT

Background: Increasing survival rates of preterm infants and a greater understanding of the long-term consequences of early exposure to pain have generated a greater need for nonpharmacologic pain management strategies in the neonatal intensive care unit (NICU) setting. Facilitated tucking supports the preterm infant and is a valuable strategy to manage neonatal pain. Alternative nonpharmacologic approaches to pain management in neonates include nonnutritive sucking and kangaroo care.

Clinical Question: In premature and critically ill infants, what is the effect of facilitated tucking on pain behaviors in those who received the intervention compared with those who did not, and what alternative interventions for nonpharmacologic pain reduction are supported by strong research evidence?

Search Strategy: Studies were identified in the PubMed database using the search terms: facilitated tucking, NICU, pain management, preterm infant, and nonpharmacologic. Studies were included if they were peer reviewed, were published in the last 5 years (or considered classic), and if they used experimental study designs.

Results: The studies identified demonstrate that facilitated tucking reduces the expression of pain in premature infants. As a whole, existing research supports the use of facilitated tucking for infants as early as 23 weeks' gestational age, during painful procedures including: heel stick, endotracheal suctioning, and venipuncture.

Implications for Practice and Research: Pain management interventions are necessary to decrease the potentially unfavorable consequences of early exposure to pain and to promote positive outcomes. Additional research is indicated to discover the effects of nonpharmacologic interventions in neonates with severe illness, congenital abnormalities, and/or assisted breathing.

Key Words: developmental care, facilitated tucking, Neonatal Infant Pain Scale (NIPS), neonatal intensive care, neonate, nonpharmacologic pain management, nursing, pain, Premature Infant Pain Profile (PIPP), very low birth weight

Worldwide, an estimated 13 million infants are born prematurely each year.[1] On average, premature infants in the neonatal intensive care unit (NICU) are subjected to 34 painful procedures within the first 2 weeks of life; the majority of these painful procedures are repeated heel lances or heel sticks.[2,3] Exposure to pain at this young age can have long-term consequences on the development of an infant's brain, due to the deleterious effects on nociceptive neural circuits.[4] Alterations of the pain system during early development can lead to lower pain thresholds, as well as cognitive and behavioral deficits as the infant matures.[4] Stress reduction and pain management, therefore, are essential components of neonatal care.

Nonpharmacologic methods of pain management in neonates are a vital area of research, essential to reducing disruptions in an infant's developmental processes. Cong et al state that "opioids have been found ineffective against procedural pain in preterm infants and are not recommended,"[5(p636)] while interventions incorporating parental participation are encouraged. Findings of important research indicate that facilitated tucking, a nursing intervention that involves gently holding the infant in a flexed posture under the head and buttocks, "reduced deterioration of physiological parameters and enhanced infants' behavioral stabilization during procedures."[6(p307)] Other nonpharmacologic interventions, including kangaroo care, are proposed to reduce pain management in neonates.

PAIN PHYSIOLOGY

The International Association for the Study of Pain defines *pain* as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage."[7] Pain can be assessed using a variety of different approaches including changes in

Author Affiliation: *Banner Thunderbird Medical Center, Glendale, Arizona.*

The authors declare no conflicts of interest.

Correspondence: *Kelsey A. Hartley, BSN, RN, 4836 East Juana Court, Cave Creek, AZ 85331 (khartley92@gmail.com).*

Copyright © 2015 by The National Association of Neonatal Nurses

DOI: 10.1097/ANC.0000000000000193

Copyright © 2015 National Association of Neonatal Nurses. Unauthorized reproduction of this article is prohibited.

autonomic, humoral/metabolic, and behavioral responses.[8] However, infants in the NICU are often unable to mount an obvious response to pain due to illness and immaturity.[9] Factors interfering with assessment of pain in preterm infants include mechanical ventilation, swaddling, and lack of physical strength/energy.[9]

NOCICEPTION IN NEONATES

Nociceptive (pain) systems are present and functioning in early stages of fetal development, with afferent pathways reaching the cerebral cortex between 20 and 26 weeks' gestation.[10] Evidence exists to demonstrate that early activation of nociceptive systems can lead to long-term alterations in sensory perception and perception of pain.[11] Although research on this topic has primarily been conducted in rat pups, the outcomes are analogous to what has been observed in human neonates.[8] Nociception is the process by which a noxious stimulus is communicated to the central nervous system.[12] It involves 4 stages: transduction, transmission, perception, and modulation.[12] The first stage (transduction) begins with a noxious stimulus that causes the release of chemicals (prostaglandins, bradykinin, serotonin, substance P, and histamine); these chemicals activate pain receptors called nociceptors.[12] As an action potential is generated at the end of the transduction stage, stage 2 (transmission) begins. Pain impulses are transmitted from peripheral nerves to the dorsal horn of the spinal cord via rapidly conducting, myelinated A-delta fibers, and slowly conducting, unmyelinated C fibers.[12] The action potential continues to travel from the spinal cord to the brainstem and thalamus where it is then transmitted to the cerebral cortex for processing.[12] The third stage of nociception (perception) occurs when a person experiences pain; this stage of pain is highly individualized and modifiable.[12] During the last stage of nociception (modulation), descending pathways of the spinal cord are activated, and release endogenous opioid substances, which facilitate inhibition of pain.[12]

Alterations in brain structure and function have been attributed to early exposure to pain in the NICU; however, these outcomes are largely based on findings of animal studies, because of ethical issues concerning human neonatal experimentation.[13] During the early postnatal period, C fibers undergo proliferation and gradual maturation, while pathways in the dorsal horn of the spinal cord also continue to develop.[8] Researchers speculate that repetitive, painful stimulation during a time of major neonatal nociceptive pathway reorganization cause alterations in synaptic development because synaptic development is related to experience.[8] Infants who are experiencing pain use different pathways than those who are not, and those pathways become increasingly "wired" with use. These alterations could lead to long-term changes in perception of sensations such as light touch, pain, pressure, and temperature as well as changes in behavior due to an altered neurologic state.[10,12]

For example, hypersensitization is especially prone to develop in preterm infants who experience multiple painful procedures before 35 weeks' gestation.[8] Spatial summation, a contributing factor to hypersensitization, refers to an increase in the number of nerve fibers simultaneously stimulated, while hyperalgesia and allodynia indicate a lower pain threshold and an increased response to pain, respectively.[7,14] Theories such as the wind-up phenomenon propose that repeated noxious stimuli can eventually lead to nonnoxious stimuli being perceived as pain, consequently amplifying detrimental effects to neonatal brain development.[9] Thus, infants with hypersensitivity might become overly distressed during a diaper change because they perceive it as noxious and painful. The NICU can be a painful place for the preterm infant and finding nonpharmacologic measures to decrease pain is important.

Infant Pain Measurement

Clinicians use a variety of scales to measure pain in infants; each composite scale integrates both physical and autonomic aspects of pain.[15] Various elements of a pain response are individually scored and later translated into a single summary score that indicates the severity or intensity of an infant's pain.[9] With each infant pain scale, a high composite score is indicative of pain. Because rating with a composite scale is subjective, disadvantages include inconsistent and unpredictable pain ratings.[9] A review of pain scales and a comprehensive approach to manage neonatal pain is thoroughly addressed by Walden and Jorgensen in the classic neonatal text, *Developmental Care of Newborns and Infants*.[15] While several pain scales are available, the ones most frequently used in the evidence we reviewed are the Premature Infant Pain Profile (PIPP) and the Neonatal Infant Pain Scale (NIPS). We include a description of each so readers will have a better understanding of the research findings.

Premature Infant Pain Profile

The PIPP scoring system incorporates both physiologic and behavioral measures of heart rate, transcutaneous oxygen saturation, and facial action indicators. The physiologic scores are calculated on the basis of changes in heart rate and oxygen saturation compared with the patient's baseline values.[16] The final PIPP score can range from 0 to 21.[16] A higher score indicates that more pain is experienced, whereas a lower score indicates that the infant is better able to use resources to manage the pain.

Copyright © 2015 National Association of Neonatal Nurses. Unauthorized reproduction of this article is prohibited.

Neonatal Infant Pain Scale

The NIPS includes 6 indicators of pain: facial expression, cry, breathing pattern, arm movement, leg movement, and state of arousal.[4] Each of the six categories is rated on a scale of 0 to 1, except for the "cry" category, which has 3 possible descriptors and score options; total NIPS scores range from 0 to 7.[4] The scores indicate pain levels in an infant as follows: 0 to 2 mild to no pain, 3 to 4 mild to moderate pain, and greater than 4 signifies severe pain.

Facilitated tucking is an intervention that involves gently holding the infant in a flexed posture.[6] Facilitated tucking involves minimal repositioning and no transfer of the infant and therefore is ideal for infants who are mechanically ventilated. Positioning the infant in a tucked position, by placing one hand under the infant's head and the other hand under the infant's buttocks, promotes comfort and physiologic stability by simulating in utero posture, resulting in decreased pain responses.[6]

CLINICAL QUESTION

The purpose of this paper is to answer the clinical question, "In premature and critically ill infants, what is the effect of facilitated tucking on pain behaviors in those who received the intervention compared with those who did not, and what alternative interventions for nonpharmacologic pain reduction are supported by strong research evidence?"

SEARCH STRATEGY

Studies were identified in the PubMed database using the search terms: facilitated tucking, neonatal intensive care unit, pain management, preterm infant, and nonpharmacologic. Studies were included if they were peer reviewed, were published in the last 5 years (or considered classic), and if they used experimental study designs such as the randomized controlled trial. The Cochrane database of systematic reviews was also searched.

RESULTS

Six studies and 1 meta-analysis, published from 2004 to 2014, were identified that specifically evaluated the use of facilitated tucking on neonatal pain response during painful procedures. Of the 6 studies, 5 used a randomized controlled trial with a crossover design,[3,6,17-19] while 1 used a quasi-experimental design.[20] Sample sizes ranged from 20 to 42 participants, and in most cases, infants served as their own comparators. One study combined nonnutritive sucking and facilitated tucking interventions,[6] while the other 5 studies evaluated the effect of facilitated tucking, alone, on neonatal pain response.[3,17-20] Exclusion criteria were strict across studies, disallowing enrollment of the most critically ill, unstable, and complex infants (eg, with congenital abnormalities, needing surgery, with grade III or IV intraventricular hemorrhages). The studies are summarized in Table 1, and the findings are summarized later.

Neonatal response to pain was evaluated during painful procedures including heel stick,[3,6] endotracheal suctioning,[17-19] and venipuncture.[20] The PIPP tool was used to evaluate an infant's response to pain in 5 of the 6 studies presented.[3,18-20] The study conducted by Axelin and colleagues[17] used the NIPS tool to measure pain response in infants. It is important to note that, with the exception of one study, all of the research studies were conducted outside the United States. Data are presented from studies conducted in Taiwan,[6] India,[3] Turkey,[17] Iran,[18] and Malaysia.[20] The setting of the study conducted by Ward-Larson et al[19] is unspecified.

Despite the broad variation in geographic location, study findings were consistent. Among all of the studies identified, infants who received the pain management intervention(s) demonstrated lower pain scores. In one study, nonnutritive sucking reduced pain more effectively than facilitated tucking.[6] In this study, facilitated tucking showed a broader effect on enhancing behavioral and physiologic stability during the heel stick procedure.[6] These results suggest that combining the 2 interventions may produce a more significant calming effect during painful procedures.

A broad overview of nonpharmacologic interventions is addressed in a 2011 meta-analysis published in the *Cochrane Database of Systematic Reviews*. This review includes a total of 51 experimental studies, 13 unique nonpharmacologic interventions, and 3396 study participants.[21] Music therapy, breast milk, and sucrose as analgesic interventions were excluded. Overall, the meta-analysis identified a reduction in pain response when facilitated tucking was used; however, the effect was less dramatic than for infants whose pain was treated with nonnutritive sucking or kangaroo care.[21] Two of the studies we evaluated were included in the meta-analysis.[17,19]

Alternative Interventions

Kangaroo care (skin-to-skin holding), when appropriate, is an effective alternative to facilitated tucking in neonates. The meta-analysis demonstrated that kangaroo care was most effective to reduce pain among all of the nonpharmacologic interventions they evaluated.[21] Results of a study conducted by Akcan and colleagues[22] suggest that kangaroo care beginning 30 minutes prior to an invasive procedure and continuing 10 minutes afterward is an effective method of pain relief in preterm infants. Findings also demonstrated significantly lower PIPP scores in infants receiving kangaroo care, compared with

Copyright © 2015 National Association of Neonatal Nurses. Unauthorized reproduction of this article is prohibited.

TABLE 1. Summary of Evidence on Facilitated Tucking in Premature Infants

Authors, Design, Objectives	Sample/Setting, Variables, Pain Scale	Results	Strengths and Limitations
Axelin et al[17] *Design*: Randomized crossover trial *Objective*: To evaluate the effectiveness of FT as a method of pain management during endotracheal suctioning in the NICU	*Sample size*: n = 20 *Setting*: Turku University Hospital *Variables*: HR, SaO_2, breathing pattern *Pain Scale*: NIPS *Inclusion Criteria*: 24 to 33 wks' GA (<37 wks' GA), a need for endotracheal suctioning *Exclusion Criteria*: no analgesics 4 h prior to procedure	1. There was a statistically significant difference in NIPS scores between infants receiving FT (3) and those who did not (5) 2. No statistically significant differences in HR or SaO_2 found between infants receiving FT and those in the control group 3. Infants receiving FT calmed down more quickly (5 s) compared with those in the control group (17 s)	*Strength*: Peer observer was blinded to order of the conditions. *Limitations*: Small sample size.
Alinejad-Naeini et al[18] *Design*: Clinical trial study with crossover design *Objective*: To determine if facilitated tucking is an effective method of pain management during endotracheal suctioning in the NICU	*Sample size*: n = 34 *Setting*: Tehran, Iran *Variables*: HR, SaO_2, eye closing, brow bulge *Pain Scale*: PIPP *Inclusion Criteria*: 29 to 37 wks' GA, having an endotracheal tube, no congenital anomalies, no seizure diagnosis, no chest tubes, no IVH greater than degree II, no opiate or sedative medications for 4 h before the intervention (FT).	1. FT was safe 2. Only 8.8% of infants who participated in FT experienced severe pain during suctioning, compared with 38.2% of infants in the control group	*Strength*: Baseline measurements were taken before each procedure, environmental stimuli minimized for both control and intervention groups. *Limitations*: The individual responsible for scoring the infants pain on the PIPP scale was aware of study objectives.
Liaw et al[6] *Design*: Prospective, randomized controlled cross-over trial *Objective*: To compare the effectiveness of nonnutritive sucking and facilitated tucking to routine care on pain, behavioral, and physiologic responses before, during, and after heel stick procedures	*Sample size*: n = 34 *Variables*: HR, RR, SaO_2, ECG *Pain Scale*: PIPP *Setting*: Taipei, Taiwan *Inclusion Criteria*: 29-37 wks' GA, 3-28 d postbirth, stable condition *Exclusion criteria*: Congenital anomalies, neurologic impairment, documented congenital or nosocomial sepsis, surgery, severe growth restriction at birth, substance-abusing mother, severe medical condition requiring sedatives, muscle relaxants, antiepileptic or analgesic drugs	1. Infants receiving nonnutritive sucking and facilitated tucking had significantly lower pain scores during HS procedures 2. Nonnutritive sucking reduced PIPP scores more effectively than facilitated tucking 3. Facilitated tucking showed greater effects on pain and enhanced physiologic and behavioral stability during HS procedures	*Strength*: Research assistants blinded to purpose. Infants acted as their own control. *Limitations*: Sample included only infants who were stable and ≥ 29 wks' GA.

(continues)

Copyright © 2015 National Association of Neonatal Nurses. Unauthorized reproduction of this article is prohibited.

TABLE 1. Summary of Evidence on Facilitated Tucking in Premature Infants, Continued

Authors, Design, Objectives	Sample/Setting, Variables, Pain Scale	Results	Strengths and Limitations
Lopez et al[20] *Design*: Quasi-experimental study *Objective*: To determine the effectiveness of FT in reducing pain in preterm infants during a venipuncture procedure	*Sample size*: n = 42 *Setting*: Malaysia *Variables*: HR, SaO_2, nasolabial furrow *Pain Scale*: PIPP *Inclusion criteria*: 23-36 wks' GA *Exclusion criteria*: Critically ill, or unstable infants, or infants receiving sedative or analgesic medications.	1. Infants receiving FT had significantly lower pain scores during the venipuncture procedure (6.62 ± 2.60), compared with infants in the control group (8.52 ± 2.99)	*Strength*: Baseline measurements were taken before each procedure. *Limitations*: Infants did not act as their own control. Observation of each infant during venipuncture was carried out only once.
Sundaram et al[3] *Design*: Randomized controlled cross-over pilot study *Objective*: To determine the effect of FT on pain in preterm infants during heel stick procedure	*Sample size*: n = 20 *Setting*: India *Variables*: HR, SaO_2, brow bulge, eye squeeze, nasolabial furrow *Pain Scale*: PIPP *Inclusion Criteria*: between 28 and 36 weeks' GA, breathing unassisted, not receiving paralytic, analgesic or sedative medications within 48 h, without major congenital abnormalities, not suffering from grade III or IV IVH, had not undergone surgery and had parental consent	1. Infants had lower PIPP scores at 30, 60, and 120 s during FT, compared with control group 2. HR was significantly lower during the 120-s period in infants receiving FT 3. FT was effective in reducing both behavioral and physiologic pain throughout heel stick procedure	*Strengths*: Study included adequate "washout" period between procedures, infants acted as their own control, and baseline measurements were taken before each procedure. Rater was blinded. *Limitations*: Behavioral and physiologic variables were not measured 3 min after heel stick. Time to recover to baseline HR and SaO_2 was not measured either.
Ward-Larson et al[19] *Design*: Prospective randomized crossover *Objective*: To compare the efficacy of FT with standard NICU care for decreasing procedural pain (endotracheal suctioning) in VLBW infants	*Sample size*: n = 40 *Setting*: Not specified *Variables*: HR, SaO_2 *Pain Scale*: PIPP *Inclusion criteria*: 23-32 wks' GA, tracheal intubation, birth weight of 1500 g or less, parental permission *Exclusion criteria*: Congenital abnormalities, major physiologic stress within 12 h of data collection, received opioid or nonopioid analgesia or sedative within 12 h before data collection, IVH greater than grade II	1. Infants receiving FT during suctioning had significantly lower PIPP scores compared with infants not receiving FT	*Strengths*: Infants acted as their own control, same nurse assigned to the infant performed suctioning procedure at each observation. *Limitations*: The chin was not brought down to the chest during FT due to endotracheal tube placement.

Abbreviations: ECG, electrocardiogram; FT, facilitated tucking; GA, gestational age; HS, heel stick; IVH, intraventricular hemorrhage; HR, heart rate; NICU, neonatal intensive care unit; PIPP, Premature Infant Pain Profile; NIPS, Neonatal Infant Pain Scale; SaO_2, oxygen saturation; VLBW, very low birth weight.

Copyright © 2015 National Association of Neonatal Nurses. Unauthorized reproduction of this article is prohibited.

infants in the control group.[22] When nonpharmacologic strategies to reduce pain are not successful, however, pharmacologic pain management should be considered. For known painful procedures, nonpharmacologic and pharmacologic measures should be provided concurrently with each other, as it is well known that this strategy can often synergistically support best outcomes for the infant.

RECOMMENDATIONS FOR PRACTICE

The 6 studies and 1 meta-analysis presented in this brief demonstrate that facilitated tucking effectively reduces the expression of pain in premature infants. In addition, 1 of the 6 studies evaluated illustrates the positive, synergistic effect of combining nonnutritive sucking with facilitated tucking. Risks of facilitated tucking were not identified in any of the studies. Overall, strong evidence supports the safety and benefit of implementing facilitated tucking in infants across all gestational ages, as early as 23 weeks. Facilitated tucking is effective to reduce pain behaviors during painful procedures including, but not limited to, heel stick, endotracheal suctioning, and venipuncture. Other nonpharmacologic interventions, including kangaroo care and nonnutritive sucking, are also beneficial during these procedures.

According to Walden and Jorgensen,[15] pain should be assessed regularly and interpreted in the context of the energy the infant has to respond to the painful stimulus (eg, a critically ill, 24-week premature infant has less energy to mount a pain response, and their expression of pain will be reduced compared with their gestationally older counterpart). According to these authors, it is also important to assess and document an infant's baseline of pain 30 seconds prior to a potentially painful procedure. For infants who are experiencing pain for surgical reasons, assessing that baseline will be more challenging and the infant should be assumed to be in pain. Certainly, before suctioning or inducing a physical response from the infant, facilitated tucking can be used to help them regulate their response and feel more secure.

Although kangaroo care, facilitated tucking, and nonnutritive sucking have been shown to be effective in managing pain, each intervention may not be appropriate for all painful procedures. Appropriateness of each intervention depends on the environmental circumstances of the infant, and other potential barriers such as inadequate time or assistance; parental assistance should be promoted when appropriate and safe. Parents may be concerned that the infant will associate them with painful experiences, and therefore, parents may choose not to assist with the intervention(s) to avoid this negative association. However, care of the infant should be individualized, and parental presence should be encouraged. Proper implementation of the interventions may require the assistance of another healthcare professional; however, these interventions were chosen on the basis of their simplicity and, ideally, can be performed quickly and with minimal aid.

Overall, evidence supports the impact of kangaroo care, facilitated tucking, and nonnutritive sucking on reducing neonatal pain. In the hospital setting, specifically in the NICU, nurses are the most appropriate candidates to receive training on evidence-based, nonpharmacologic pain management techniques. To ensure effective implementation of these techniques, NICU nurses need formal training to increase confident delivery of the intervention(s). Proper training and education will also allow the nurse(s) to understand the advantages and rewards of encouraging the infant's parent(s) to participate in the pain management interventions, when appropriate. A sample protocol for using facilitated tucking as a nonpharmacologic strategy is presented in Table 2.

RECOMMENDATIONS FOR RESEARCH

The research reviewed in this evidence-based brief evaluated the analgesic effects of nonpharmacologic interventions in infants. Each study differed slightly in regard to inclusion/exclusion criteria, age range, variables, methods, etc; however, the results of each study concluded that pain in infants (very premature, premature, and full-term) was significantly reduced during invasive procedures when infants were supported with facilitated tucking, nonnutritive sucking, kangaroo care, or a combination of interventions. Limitations of the studies include small sample size, extensive exclusion criteria related to infants with congenital abnormalities, breathing devices, history of surgery, etc, possible bias of the observer during pain assessment, and weakened generalizability due to regional/global differences in healthcare systems. Further research on facilitated tucking should be conducted within the United States to determine whether study results are congruent with the findings of international research, despite differences in geographic location.

While the results of the studies presented provide promise for enhanced wellness in premature infants, there are still many aspects of nonpharmacologic pain interventions that are unknown. Additional research is indicated to discover the effect(s) of nonpharmacologic pain reduction in neonates with severe illness, congenital abnormalities, and/or assisted breathing, and to establish the long-term biobehavioral consequences of early exposure to pain.

CONCLUSION

Consistent and successful implementation of kangaroo care, facilitated tucking, and nonnutritive sucking will decrease an infant's exposure to pain during

Copyright © 2015 National Association of Neonatal Nurses. Unauthorized reproduction of this article is prohibited.

TABLE 2. Recommended Facilitated Tucking Protocol

Procedure	Key Points
1. If available, enlist the help of an additional nurse or the parents if they are willing to participate.	1. Additional assistance by a nurse and/or the infant's parent is optimal; however, this intervention can be performed using positioning aides when no additional help is available. Note: The infant's parents may elect not to participate in this intervention to prevent the infant from associating him or her with pain.
2. Instruct the individual performing the intervention to place one of their hands, cupped, on the posterior side of the infant's head, while placing the remaining hand, cupped, on the infant's buttocks. Using gentle pressure with both hands, the infant should be held in a flexed position for the entirety of the painful or uncomfortable procedure.	2. When using positioning aides, use according to the manufacturer's instructions to maintain the infant in a flexed, or tucked, position during the painful or uncomfortable procedure. Rationale: Facilitated tucking promotes infant comfort by simulating in utero posture.
3. Monitor the infant's vital signs, including but not limited to heart rate and respiratory rate, throughout the facilitated tucking intervention.	3. Record the start and end time of the facilitated tucking session in the patient's record. Any significant changes in the infant's vital signs that occur during the painful procedure should also be noted in the patient's chart.

his or her time in the NICU. Hypothetically, reducing an infant's exposure to pain during a critical time of brain development and maturation will reduce the likelihood of maladaptive alterations in nociceptive circuitry.[23] Ultimately, these advances in patient care may lead to more positive behavioral and neurologic outcomes for premature infants, consequently increasing overall quality of life as the infant continues to mature.[6]

Acknowledgments

Dr Gephart received training support from the Robert Wood Johnson Foundation Nurse Faculty Scholars Program and the Agency for Healthcare Research and Quality (1K08HS022908-01A1). The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality or the Robert Wood Johnson Foundation.

Summary of Recommendations for Practice and Research

What we know:	• Neonates experience pain, and actions should be taken to relieve and/or help them manage their pain • Nonpharmacologic methods, including kangaroo care and nonnutritive sucking, are shown to reduce pain expression • Facilitated tucking (also called containment) reduces pain expression, especially with procedures like suctioning
What needs to be studied:	• Nonpharmacologic pain reduction in neonates with severe illness, congenital abnormalities, and/or assisted breathing • Effects with larger, more diverse samples • Combined effects of multiple nonpharmacologic therapies delivered together • Effects of facilitated tucking in severely ill infants who were excluded from previous studies
What we can do today:	• Assess pain regularly and interpret pain response based on the infant's available energy reserves to mount a response to pain • Use facilitated tucking with nonnutritive sucking during painful procedures • Add facilitated tucking to other nonpharmacologic pain management measures used (eg, sucrose) • Encourage kangaroo care

Copyright © 2015 National Association of Neonatal Nurses. Unauthorized reproduction of this article is prohibited.

References

1. Beck S, Wojdyla D, Say L, et al. The worldwide incidence of preterm birth: a systematic review of maternal mortality and morbidity. *Bull World Health Organ*. 2010;88(1):31-38.
2. Stevens B, Johnston C, Franck L, Petryshen P, Jack A, Foster G. The efficacy of developmentally sensitive interventions and sucrose for relieving procedural pain in very low birth weight neonates. *Nurs Res*. 1999;48(1):35-43.
3. Sundaram B, Shrivastava S, Pandian JS, Singh VP. Facilitated tucking on pain in pre-term newborns during neonatal intensive care: a single blinded randomized controlled cross-over pilot trial. *J Pediatr Rehabil Med*. 2013;6:19-27.
4. Kashaninia Z, Sajedi F, Rahgozar M, Noghabi FA. The effect of kangaroo care on behavioral responses to pain of an intramuscular injection in neonates. *J Spec Pediatr Nurs*. 2008;13(4):275-280.
5. Cong X, Cusson RM, Walsh S, Hussain N, Ludington-Hoe SM, Zhang D. Effects of skin-to-skin contact on autonomic pain responses in preterm infants. *J Pain*. 2012;13:636-645.
6. Liaw JJ, Yang L, Katherine Wang KW, Chen CM, Chang YC, Yin T. Non-nutritive sucking and facilitated tucking relieve preterm infant pain during heel-stick procedures: a prospective, randomised controlled crossover trial. *Int J Nurs Stud*. 2012;49:300-309.
7. International Association for the Study of Pain. IASP taxonomy. http://www.iasp-pain.org/Taxonomy?navItemNumber=576. Published 2013. Accessed March 18, 2015.
8. Fitzgerald M, McIntosh N. Pain and analgesia in the newborn. *Arch Dis Child*. 1989;64(4 Spec. No.):441-443.
9. Whitfield MF, Grunau RE. Behavior, pain perception, and the extremely low-birth weight survivor. *Clin Perinatol*. 2000;27(2):363-379.
10. Simons SH, Tibboel D. Pain perception development and maturation. *Semin Fetal Neonatal Med*. 2006;11:227-231.
11. Grunau RE, Tu MT. Long-term consequences of pain in human neonates. In: Anand SM, ed. *Pain in Neonates and Infants*. Philadelphia, PA: Elsevier; 2007:45-55.
12. Lewis SL, Dirksen SR, Heitkemper MM, Bucher L, Camera IM. Pain. In: Horn KGJ, ed. *Medical Surgical Nursing: Assessment and Management of Clinical Problems*. St Louis, MO: Mosby Elsevier; 2011:127-152.
13. Smith GC, Gutovich J, Smyser C, et al. Neonatal intensive care unit stress is associated with brain development in preterm infants. *Ann Neurol*. 2011;70(4):541-549.
14. Mosby I. *Mosby's Medical Dictionary*. 8th ed. St Louis, MO: Elsevier Mosby; 2009.
15. Walden M, Jorgensen K. Pain assessment and nonpharmacologic management. In: McGrath CKJ, ed. *Developmental Care of Newborns and Infants*. Glenwood, IL: National Association of Neonatal Nurses; 2010:411-425.
16. Johnston CC, Filion F, Campbell-Yeo M, et al. Kangaroo mother care diminishes pain from heel lance in very preterm neonates: a cross-over trial. *BMC Pediatr*. 2008;8:13.
17. Axelin A, Salantera S, Lehtonen L. "Facilitated tucking by parents" in pain management of preterm infants—a randomized crossover trial. *Early Hum Dev*. 2006;82:241-247.
18. Alinejad-Naeini M, Mohagheghi P, Peyrovi H, Mehran A. The effect of facilitated tucking during endotracheal suctioning on procedural pain in preterm neonates: a randomized controlled crossover study. *Glob J Health Sci*. 2014;6(4):278-284.
19. Ward-Larson C, Horn RA, Gosnell F. The efficacy of facilitated tucking for relieving procedural pain of endotracheal suctioning in very low birthweight infants. *MCN Am J Matern Child Nurs*. 2004;29: 151-156; quiz 157-158.
20. Lopez O, Subramanian P, Rahmat N, Chin Theam L, Chinna K, Rosli R. The effect of facilitated tucking on procedural pain control among premature babies [published online ahead of print July 24, 2014]. *J Clin Nurs*. doi: 10.1111/jocn.12657.
21. Pillai Riddell RR, Racine NM, Turcotte K, et al. Non-pharmacological management of infant and young child procedural pain. *Cochrane Database Syst Rev*. 2011(10):CD006275.
22. Akcan E, Yigit R, Atici A. The effect of kangaroo care on pain in premature infants during invasive procedures. *Turk J Pediatr*. 2009;51(1):14-18.
23. Grunau RE, Holsti L, Peters JWB. Long-term consequences of pain in human neonates. *Sem Fetal and Neonatal Med*. 2006;11:268-275. doi: 10.1016/j.siny.2006.02.007

Call for Manuscripts for Evidence-Based Practice Briefs Section

Share your expertise with your colleagues! Have you combed the literature to answer a burning clinical question?

Please consider submitting an evidence-based practice brief.

Section Overview: This section of the journal provides brief overviews of the evidence to support common care practice for neonates or their families. Briefs often address "*why we do it this way*" or issues of care protocols or routine practices.

Examples questions include:

- What are the best strategies to support exclusive breastfeeding of the late preterm infant in the neonatal intensive care environment?
- Is there a relationship between blood transfusions and the occurrence of necrotizing enterocolitis in the preterm infant in the neonatal intensive care unit?
- Do the benefits of skin-to-skin holding outweigh the risks for the extremely preterm infant in the neonatal intensive care unit?

At the end of the introduction, the last sentence should be a statement of the clinical question (PICO is one format that can be used, P = population or problem; I = intervention; C = comparison; O = outcome). It is also important to specifically state your search strategy (key terms, databases used, inclusion/exclusion criteria, and years searched).

Please organize the paper using these subject headings: Background, Search Strategy, Summary of Evidence, Recommendations for Practice, and Recommendations for Research.

For more details on manuscript submissions, see the author guidelines for *Advances in Neonatal Care* available at http://edmgr.ovid.com/anc/accounts/ifauth.htm

For more information please contact Sheila M. Gephart, PhD, RN, Section Editor, at gepharts@email.arizona.edu.

Copyright © 2015 National Association of Neonatal Nurses. Unauthorized reproduction of this article is prohibited.