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Behavioral Approaches for Infant Pain Relief

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### Abstract

Infants experience a host of painful medical procedures including heel sticks, venipuncture, and immunizations. Historically, little attention was given to infant pain management due to misconceived myths and beliefs about the experience and long-term effects of pain in infants. Recent data suggest that there are both short- and long-term negative repercussions associated with unmanaged infant pain. In response, a number of non-pharmacological approaches have been developed to provide infants with pain relief associated with medical events. This paper will review these behavioral approaches including positioning, parent training, distraction, sucrose, and skin-to-skin contact. Recommendations for best practices will be provided and future direction for infant pain management will be outlined.

### Behavioral Approaches for Infant Pain Relief

Following birth, healthy infants experience many painful medical procedures, such as heel sticks when they are first born and immunizations as they move through infancy. The Centers for Disease Control and Prevention (CDC) recommend that healthy children receive 25 intra-muscular immunization injections by the age of 15 months (Center for Disease Control and Prevention, 2008). Though these procedures are necessary and the benefits vast, they are also painful. Infants who are born prematurely, who have been diagnosed with a disease, or who experience accidents or injuries will endure additional painful procedures. Stevens, Yamada, and Ohlsson (1999) estimate that neonates born between 27 and 31 weeks of age undergo a staggering average of 134 painful procedures within the first two weeks of their lives. For the 10% of newborns that are the lowest birth weights and have the most medical problems, Stevens found that they receive an average of more than 300 painful procedures within the same period of time.

More than 20 years ago it was established that many infants in the United States were not receiving anesthesia while undergoing painful medical procedures (Chamberlain, 1999). It is concerning that the pain and distress associated with these immunizations was not often addressed given that research has shown that infants feel pain similarly, if not more intensely than adults (Porter, Wolf, & Gold, 1997; Porter, Grunau, & Anand, 1999; Felt et al., 2000). Research suggests that pain left untreated in infants may have long-term negative implications including lasting effects on sensitivity, pain threshold, neuronal development, pain perceptions, emotionality, and coping strategies (for review, see Young, 2005).

This chapter will discuss the importance of prevention and treatment of procedural pain in infants. It will then detail some of the evidenced-based behavioral interventions for reducing

infant pain and distress during invasive medical procedures, highlighting some key research studies in each area. The techniques discussed will include behavioral interventions tailored for infants as well as recommendations for how parents might best help their distressed infants. Future directions for research in the area of infant distress management will also be examined.

### *Negative Effects of Pain*

Medical procedures, including more minor procedures such as needle sticks, produce immediate pain and distress in infants. Research indicates that if pain is not prevented and treated during these procedures, the pain may have long-term negative effects on infants' future pain responses (Young, 2005). Research by Anand and Scalzo (2000) examined how early exposure to pain might influence infant brain development and subsequent development. The bulk of the research in this area focuses on infants in the neonatal intensive care unit (NICU), due to the frequent number of medical procedures performed on premature infants during the first few weeks and months of life. In their studies of premature infants, Anand and Scalzo postulate that repeated exposure to painful procedures may lead to damage of developing neurons resulting in behavioral changes. They suggest these changes could include altered pain sensitivity, increased anxiety, stress disorders, attentional problems, impaired social skills, and increased self-destructive behavior such as suicide and drug use, illustrating the importance of preventing and treating pain in infants.

Researches have also examined long-term effects of early pain by examining the development of neonates into childhood. For example, Grunau, Oberlander, Whitfield, Fitzgerald, and Lee (2001) examined how early exposure to repeated heel lances for blood collection impacted later response to acute pain. They found that these neonates showed a dampened behavioral pain response during a later heel lance but had an increased cardiac

response, suggesting that early pain led to a perpetual state of stress. Not surprisingly, the authors advocated for pain-relief intervention for early infants' medical procedures.

Although some of the studies do focus on relatively short-term (e.g., months) effects (e.g., Grunau, Oberlander, Whitfield, Fitzgerald, and Lee, 2001), others suggest that negative consequences of untreated infant pain might persist into adulthood. In a retrospective study comparing adolescents who had been NICU patients to adolescents who had been full-term infants, the adolescents who were previously NICU patients were found to be more sensitive to pain (Buskila, Neumann, & Zemora, 2003). The authors suggested that this information would be particularly helpful for physicians caring for neonates, who might be at greater risk for developing pain syndromes in the future.

Long-term negative effects of pain have also been examined in full-term infants. Taddio, Katz, Ilersich, and Koren (1997) examined the behavioral distress response of 87 healthy infants being immunized months after birth, comparing male infants who were not circumcised, infants circumcised with topical anesthetic, and those circumcised with placebo. Results indicated that there was a significant group effect with infants who had been circumcised with a placebo having a stronger pain response during a subsequent immunization than infants whose pain had been treated for their circumcision. This stronger pain response was reflected in infant facial action, cry duration, and visual analog scale pain scores. This study, along with the others described above, suggests that untreated pain in both premature and full-term infants has long-term negative effects and provides clear support for providing treatment to prevent neonatal pain during painful procedures.

### *Behavioral Interventions for Infant Medical Pain*

Given that infants experience frequent and intense medical pain that may lead to detrimental long-term effects, behavioral interventions are warranted. Fortunately, there are a number of low-cost and easy to implement behavioral approaches for pain relief (Powers, 1999; for review see Cohen, 2007). Some of these interventions, such as relaxation, imagery, and training children in coping skills, have been shown to be effective in pediatric populations but are not appropriate interventions for infants given infant's limited cognitive capacity. Although these particular interventions may not be appropriate for infants, there are a number of interventions that have been shown to be effective in this population.

*Distraction.* Although there is not one accepted theory that explains how distraction is helpful in reducing pain, researchers agree that there are multiple components involved in its effectiveness (DeMore & Cohen, 2005). DeMore and Cohen explain how distraction uses a combination of cognitive, behavioral, and physiological mechanisms to reduce pain during medical procedures. Some argue that distraction is the most effective behavioral intervention for managing young children's pain and anxiety (Bount, Piira, & Cohen, 2003).

Although it has been used more with older children, distraction has been shown to be effective in reducing infant pain during medical procedures (Cohen and colleagues, 2002, 2006). Distraction is an intervention that is developmentally appropriate for infants as it does not require advanced skills. Distraction during painful procedures in infants involves orienting them to a distracter, such as a toy, instead of allowing them to attend to the painful stimulus. Research suggests that distraction is effective because the brain has a limited capacity for attention (McCaul & Malott, 1984). Thus, if an infant is engaged in a distracting activity, there are fewer cognitive resources available to perceiving and experiencing a pain signal.

A study by Cohen (2002) found that 2-month- to 3-year-olds receiving immunizations exhibited less pain during both the anticipatory and recovery phases when participating in nurse-led movie distraction. In 2006, Cohen, MacLaren, Fortson, and Friedman replicated this study with 1- to 26-month-olds and found consistent results. In contrast, Cramer-Berness and Friendman (2005) found parent selected distraction did not result in pain reduction in 2- to 24-month-olds undergoing immunizations. As discussed by Cramer-Berness (2007), it is essential to select an age-appropriate and engaging distraction, which is challenging with infants who have limited verbal skills. In a study by Cohen et al., 2006, 84 1-year-old infants were randomized to three different groups: typical care, a group where they received a local anesthetic applied topically (i.e. EMLA), and distraction. The main aim of this study was to evaluate the effectiveness of distraction in this population. Distraction was found to be helpful only in the recovery phase following the intervention with those children showing lower behavioral distress. Examination of the data showed that nurses, when given the role of distraction administrators, were not as consistent or constant with their distraction behavior as seen in other studies, which may have tempered the effectiveness of distraction as an intervention. Researchers from this study suggest that the medical staff may not have been fully invested in adhering to this study protocol. Further, consideration must be given not only to the type of distracter used but also to its presentation.

*Physical Contact/Kangaroo Care.* Another area of intervention that can be effective in reducing infant pain and distress is providing physical comfort. Parents typically prefer to be in the room for their child's medical procedures, such as immunizations, and can be helpful in holding the infants during the actual procedure (Piira, Sugiura, Champion, Donnelly, & Cole, 2005). Not only does this help the medical staff logistically, but it can provide some reduction in

distress to the infant. Given that maternal holding has been shown to have an analgesic effect of its own, it should be considered either in and of itself or in combination with another intervention during infant medical procedures (Phillips, Chantry, & Gallagher, 2005).

Much of the research on comfort has looked at skin-to-skin contact, or “kangaroo care” (KC), with infants. The term KC comes from its similarity to how marsupials are cared for in early life (Johnston et al., 2003). According to Johnston et al. (2003), this practice of using skin-to-skin contact to sooth infants is becoming more and more widely used around the world and has been shown to effectively reduce pain and distress in newborns.

Studies examining the effectiveness of kangaroo care (KC) often compare the distress behaviors of infants who are being held in whole body, skin-to-skin contact with their mother or father to infants being swaddled in a crib during a painful procedure such as a heel lance (Gray, Watt, & Blass, 2000; Johnston, et al., 2003). In a study done by Gray et al., (2000), 30 newborn infants were randomly assigned to either KC or treatment as usual. Infants in the KC condition spent 10 to 15 minutes alone with their mothers lying chest to chest, with mothers applying light pressure to the infant’s back before the heel lance procedure occurred. Infant crying, grimacing, and heart rate differences were examined and showed significantly lower pain intensity in the KC group.

A pilot study done by Kostandy et al., (2008), examined the impact of KC on crying response to pain in preterm neonates. Ten preterm infants ranging from two to nine days old participated in the study. Infants were assigned to sequence A (heel stick with KC followed by heel stick in incubator a day later) or sequence B (heel stick in incubator followed by heel stick with KC). KC consisted of the infant being held skin-to-skin for 30 minutes upright against the mother’s breasts before the heel stick. Crying time was significantly less for the heel stick done

with KC, and KC reduced crying during both the heel stick and recovery phases. Although this study had a fairly small number of participants, it supports KC as a method to decrease infant pain during medical procedures.

*Non-nutritive Sucking.* An additional intervention that has been shown to be effective in decreasing pain in neonates and young infants under six months of age is non-nutritive sucking (NNS; Barr et al, 1995). NNS involves an infant sucking on a pacifier or bottle nipple before, during, or after a painful procedure. Mathai, Natrajan, and Rajalakshmi (2006) conducted a randomized study of 104 stable neonates and examined a variety of different interventions. Results suggested that at two and four minutes following the heel stick procedure, pain scores were lowest in both the NNS and rocking groups as compared to distilled water, sucrose, expressed breast milk, and massage groups. The NNS and rocking groups also had the lowest total duration of crying.

*Sucrose.* Sucrose water (12-50%; typically 1 packet of sugar in 10mL of water) can be given to infants just before an acute painful procedure to decrease pain (Cohen, in press). Sucrose administration can be with or without non-nutritive sucking (pacifiers). With sucking, the sucrose is given to the infant by dipping a pacifier in a solution, where as without sucking the sucrose solution is instilled directly into the infant's mouth via a syringe. A systematic review of the literature has shown sucrose to be effective in providing pain relief to infants under six months of age during venous access (Stevens, Yamada, & Ohlsson, 2004). Research suggests that sucrose may be effective because it serves as a mechanism for attention redirection; thus, infants may be particularly attentive to sweet tastes and turn their attention away from the painful procedure (Blount et al., in press).

Harrison, Johnston, and Loughnan (2003) examined the effectiveness of one mL of a 33% sucrose solution administered orally compared to one mL of unsweetened water in a blinded randomized-controlled trial that did not involve non-nutritive sucking. The sample in this study included 128 infants undergoing a heel lance procedure. Infants in the treatment group (sucrose) showed lower facial scores at time of heel lance and at one and two minutes following the procedure than infants in the placebo (unsweetened water) group. When looking at the three-minute recovery period following the heel lance procedure, the treatment group displayed a significantly lower incidence and duration of crying.

Some research has suggested that combining non-nutritive sucking with a sucrose solution is most effective in reducing infant pain and distress. A study by Blass and Watt (1999) compared two mL of 12% sucrose administered over two minutes with a syringe, two mL of water via syringe over two minutes, a pacifier dipped in 12% sucrose solution every 30 seconds for two minutes, and a pacifier dipped in water every 30 seconds for two minutes prior to a heel lance procedure. The data from this sample of 40 newborn infants 34 – 55 hours old suggested that the sucrose solutions, despite administration method, was more effective in reducing infant pain and distress overall than water administered via syringe or via pacifier. Blass and Watt also found that although the two sucrose administration methods were equal in terms of reduction in grimacing, sucrose combined with non-nutritive sucking was significantly better in reducing cry duration than sucrose alone.

*Breastfeeding/Expressed Breast Milk.* Breastfeeding done during single infant painful procedures has been shown to reduce pain in infants and although research has been focused primarily on neonates, it is suggested that breastfeeding may be helpful for a wider range of infants than sucrose administration (Gray, Watt, & Blass, 2002; Shah, Aliwalas, & Shah, 2006).

The effectiveness of breastfeeding and expressed breast milk as interventions to reduce infant pain and distress have been shown to be more effective than swaddling or a pacifier alone but overall may be comparable to sucrose administration (for review see Shaw et al., 2006). More research is needed to determine the effectiveness of breastfeeding and expressed milk for pain and distress reduction in repeated painful procedures (Shah, 2006).

Although there is quite a bit of research on the administration of breast milk to aid in infant pain reduction, it can be difficult to obtain clear results because of the numerous variables involved. Specifically, it is difficult to tease apart which elements of breastfeeding are responsible for its analgesic effects (Phillips, Chantry, & Gallagher, 2005). For example, the literature shows that both the act of holding itself and the manner in which a baby is held during a painful procedure impacts their level of distress. Since babies are held when being breastfed, the positive effects of breastfeeding may be due, in part, to holding. Despite some methodological differences between studies, it appears that overall breastfeeding has been shown to be helpful. Whereas, some research supports the administration of expressed breast milk as an analgesic of its own, data are mixed as it has been shown to be less effective than sucrose administration in some studies (Blass & Miller, 2001; Skogsdal, Eriksson, & Schollin, 1997).

One study aimed to determine whether breastfeeding was helpful above and beyond non-nutritive sucking while being held and whether a non-maternal holder was as effective as the mother herself (Phillips et al, 2005). This research team conducted a randomized controlled trial with 96 stable full term newborn infants undergoing a heel lance as part of a routine newborn screening. The infants were randomly assigned to one of the three following groups: breastfeeding, held by mother with use of pacifier, or held by research assistant with use of pacifier. Data collected included percentage of infants that cried, proportion of cry time, and

physiological change information (i.e., heart rate, blood pressure, and oxygen saturation). The study found that breastfeeding produced the greatest analgesic effect but that there was also a significant difference in proportion of cry time between maternal and non-maternal holding in infants given a pacifier with maternal holding resulting in less distressed infants.

#### *Parents' Experience during Infants' Procedures*

It is not surprising that parents also find pediatric medical procedures stressful (Blount, Piira, & Cohen, 2003; Berenbaum & Hatcher, 1990; Boyer & Barakat, 1996; Cohen, Blount, & Panopoulos, 1997). Parent distress as well as their behavior has a significant impact on child responses to medical procedures (e.g., Melnyk, 1994). Not only have many researchers found that parent anxiety and child distress during procedures are highly correlated (LaMontagne, Hepworth, Byington, & Chang 1997; Wright, Alpern, & Leake, 1973), it has been suggested that parent anxiety may be one of the highest predictors of child distress during medical procedures (Jay et al., 1983). A study by Bernard and Cohen (2006) examined the role of parent anxiety on infant procedural pain by examining 37 parent-infant dyads during infant immunizations. Results showed that several measures of parent distress correlated with infant distress. Whereas parents' own anxiety might directly impede their ability to soothe and calm their children, parents' indirect behaviors are also an important consideration. In fact, parent behavior accounts for over half of the variance in child distress (Cohen, Benard, Greco, & McClellan, 2002).

*Impact of a Coaching Role.* Parents of preschoolers and older children who are given a coaching role during painful procedures seem to benefit from this role, reporting lower levels of distress during their children's procedures (Cohen, Blount, & Panopoulos, 1997; Manne et al., 1990). Children also benefit from the coaching as they do not typically engage in coping behaviors unless given direct instruction from adults. Specifically, parents that are not trained to

coach initiate very little coping behavior and report not knowing what they should do (Weisman, 2001; Manimala, Blount, & Cohen, 2000). Given that coaching lowers children's distress, it is not clear whether coaching lowers parent distress through helping of the child or simply because it gives the parents an active role. Although coaching has been shown to be effective for older children who are, as a product of their age, verbal, parent coaching has never been examined in infants. Given the positive effect of parental coaching roles in preschoolers, it is possible that the parents are feeling less anxious and that this would, in turn, positively impact their nonverbal infants as well.

*Impact of Parent Behavior.* As discussed in this last section, parent anxiety during painful medical procedures appears to be related to child anxiety. Although there is a paucity of research examining this relationship between parents and their infants, additional parent behaviors and their respective impacts on infant pain and distress have been more widely studied. Understanding which parent behaviors are helpful during medical procedures (ie. decrease infant distress) and which are harmful (ie. increase infant distress) can lead to the development of interventions that allow parents to participate in calming their child and relieving their distress. Involving parents not only results in decreased infant pain and distress but also makes the jobs of healthcare providers a bit easier.

Parent behaviors seen during procedures with preschoolers have been studied using observational coding scales. In recent years, similar coding methods have been more widely used with infants. This body of research has looked at the specific behaviors that parents typically exhibit during painful procedures. A study by Cohen et al. (2002), examined the role of distraction for infants receiving injections. The sample consisted of 136 infants ranging in age from 1 to 21 months and included the infant's caregiver. These infant-parent dyads were

randomly assigned to either a “typical care” or “distraction” group. Parents in the typical care condition had a normal visit and were allowed to engage in any of the behaviors they usually did during procedures. Parents in the distraction group were briefly instructed in use of distraction techniques and the nurses received distraction training as well. Results suggested that infants in the distraction group had lower levels of behavioral distress in both the anticipatory and recovery phases of the immunization. This finding regarding distraction is consistent with studies done with preschoolers.

Cohen, Bernard, McClellan, and MacLaren (2005), studied the relationship between parent and nurse behavior and infant distress further as they validated the Measure of Adult and Infant Soothing and Distress (MAISD) with this population. The MAISD was used to code the behavior of 62 infants, parents, and nurses during infant immunizations. The results suggested that distraction behaviors exhibited by parents and nurse were positively correlated with infants engaging in distraction. This information was helpful in moving infant pain management forward in that research had previously shown that distraction was helpful and this study provided a method for getting infants to participate in distraction. The second finding was that parent and nurse reassurance behaviors were positively associated with infant distress. Reassurance behaviors include both verbal reassurance and physical comfort. This finding is consistent with research done with older children that has shown reassurance to increase child distress.

This area of research in management of procedural pain is promising in that parents are typically very motivated to reduce their child’s distress. Learning about the specific behaviors that impact infant distress can help professionals include parents in the most effective way. Given that some studies, such as the one just referenced, are correlational and cannot show

causation, it will be important to continue to work in this area and incorporate in more randomized clinical trials.

### *Future Directions for Infant Pain Management*

Infants today undergo more painful procedures than ever before. As we move forward in our medical knowledge, our health system requires more immunizations and as our treatments for infants born preterm improves, they are likely to be exposed to more invasive procedures in the NICU. As illustrated, it is essential that medical professionals do all they can to prevent and minimize infant pain during these procedures as it can have serious detrimental effects. Research is clear that behavioral interventions can greatly reduce infant pain and distress during painful medical procedures.

Although the area of infant pain management is receiving more attention now than ever before there is still a significant gap in both building the body of research and, further, in applying those findings in medical settings. Researchers have done some very important work in beginning to understand the mechanisms behind the effectiveness of behavioral interventions, but future research examining the specific mechanisms behind the pain reduction is warranted. Typically, studies have focused on isolated techniques and/or interventions. For real change to be actualized, it will be important for researchers to examine how these different non-pharmacological interventions work both singularly and with one another. If the field can isolate the efficacy of different interventions, future interventions can become more focused and increasingly helpful.

Additionally, it will be important for health care providers to become increasingly aware of the importance of infant pain management. Medical professionals have the role, not only, of planning for and delivering any pain management interventions an infant receives but of

providing guidance and recommendations to parents regarding the care of their child. As discussed above, parents' actions and behavior can be extremely important in non-pharmacological treatments for painful procedures. Given this knowledge, it is important for parents to receive education about their role and their child's treatment prior to any painful medical procedure. An increased awareness of efficacious behavioral interventions among health care providers will insure that infants receive the best pain management possible

In summary, behavioral interventions should become standard of care for both healthy infants as they receive immunizations and undergo routine medical procedures and for preterm infants who spend time in the neonatal intensive care unit where they face dozens of painful events. Breastfeeding, non-nutritive sucking, providing sucrose, distraction, and skin-to-skin contact are all recommended.

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