



## Emergency Nursing Resource: Needle-Related Procedural Pain in Pediatric Patients in the Emergency Department

Is there evidence of pain and distress reduction in pediatric patients who receive analgesic or anxiolytic interventions compared to those who do not during minor invasive procedures in the emergency department?

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## Background/Significance

Procedural pain is commonly associated with emergency department (ED) visits in the pediatric population. Studies have demonstrated deficiencies in ED pain assessment and management, particularly in children (MacLean, Obispo, and Young, 2007; Young, 2005). One study of pediatric patients noted pain associated with procedures, with placement of an intravenous catheter being the most common source of pain cited (Cummings, 1996). Other minor invasive procedures frequently experienced by pediatric patients include bladder catheterization, venipuncture, immunizations, and gastric tube placement. These procedures contribute to the stress and anxiety of ED treatment for pediatric patients (Babl, Mandrawa, O’Sullivan, and Crellin, 2008; Farion, Splinter, Newhook, Gaboury, and Splinter, 2008; Newbury and Herd, 2009; and Skarbek-Borowska, Becker, Lovgren, Bates, and Minugh, 2006).

There is growing recognition in pediatric emergency care that children experience avoidable pain and distress during invasive procedures (Mularoni, et al., 2009; Young, 2005), and that this pain likely plays a significant role in shaping the individual’s pain response to future events in a negative fashion (Young, 2005). Barriers to adequate pain treatment for invasive procedures include the misperception that managing procedural pain is overly time consuming and results in treatment delay, the misrepresentation of pain as anxiety, lack of pain assessment, inadequate knowledge of pharmacological and non-pharmacological pain management, and fear of adverse reactions to medications (Spanos, Booth, Koenig, Sikes, Gracely, and Kim, 2008). A gap remains between the evidence regarding effective pain treatment and actual practice (Morgan & Ramponi, 2010; Papa & Zempsky, 2010). It is further noted that Papa (2010) studied the nursing perception of pediatric peripheral venous access and the value of current techniques utilized to manage the associated pain. This study suggests that improved pediatric pain management associated with venous access can lead to enhanced job satisfaction among nurses (Papa, 2010).

This Emergency Nursing Resource (ENR) is focused on needle-related procedures. The lack of evidence related to the treatment of procedural pain associated with urinary bladder catheterization and nasogastric tube placement in pediatric emergency department patients precludes recommendations for practice.

## Methodology

This ENR was created based on a thorough review and critical analysis of the literature following ENA’s [Guidelines for the Development of the Emergency Nursing Resources](#). Via a comprehensive literature search, all articles relevant to the topic were identified. The following databases were searched: PubMed, *Google Scholar*, CINAHL, Cochrane - British Medical Journal, Agency for Healthcare Research and Quality (AHRQ; [www.ahrq.gov](http://www.ahrq.gov)), and the National Guideline Clearinghouse ([www.guidelines.gov](http://www.guidelines.gov)). Searches were conducted using the search terms “pediatrics,” “procedural pain,” “minor procedures,” “emergency department,” “intravenous cannulation,” and “pain” using a variety of search combinations. Searches were limited to English language articles on human subjects from 2005 – October 2010. In addition, the reference list includes selected articles that were scanned for pertinent research findings. Research articles from emergency department settings, non-ED settings, position statements and guidelines from other sources were reviewed. Articles that met the following criteria were chosen to formulate the ENR: research studies, meta-analyses, systematic reviews, and existing guidelines relevant

to the topic. Other types of article were also reviewed and provided as additional information. The ENR authors used [standardized worksheets](#), including Evidence-Appraisal Table Template, Critique Worksheet and AGREE Work Sheet, to prepare tables of evidence ranking each article in terms of the level of evidence, quality of evidence, and relevance and applicability to practice. Clinical findings and levels of recommendations regarding patient management were then made by the Emergency Nursing Resource Development Committee according to the ENA’s classification of levels of recommendation for practice, which include: Level A High, Level B. Moderate, Level C. Weak or Not recommended for practice (See Table 1).

Table 1. Levels of Recommendation for Practice

<p><b><u>Level A recommendations: High</u></b></p> <ul style="list-style-type: none"> <li>• Reflects a high degree of clinical certainty</li> <li>• Based on availability of high quality level I, II and/or III evidence available using Melnyk &amp; Fineout-Overholt grading system (Melnyk &amp; Fineout-Overholt, 2005)</li> <li>• Based on consistent and good quality evidence; has relevance and applicability to emergency nursing practice</li> <li>• Is beneficial</li> </ul>
<p><b><u>Level B recommendations: Moderate</u></b></p> <ul style="list-style-type: none"> <li>• Reflects moderate clinical certainty</li> <li>• Based on availability of Level III and/or Level IV and V evidence using Melnyk &amp; Fineout-Overholt grading system (Melnyk &amp; Fineout-Overholt, 2005)</li> <li>• There are some minor or inconsistencies in quality evidence; has relevance and applicability to emergency nursing practice</li> <li>• Is likely to be beneficial</li> </ul>
<p><b><u>Level C recommendations: Weak</u></b></p> <ul style="list-style-type: none"> <li>• Level V, VI and/or VII evidence available using Melnyk &amp; Fineout-Overholt grading system (Melnyk &amp; Fineout-Overholt, 2005) - Based on consensus, usual practice, evidence, case series for studies of treatment or screening, anecdotal evidence and/or opinion</li> <li>• There is limited or low quality patient-oriented evidence; has relevance and applicability to emergency nursing practice</li> <li>• Has limited or unknown effectiveness</li> </ul>
<p><b><u>Not recommended for practice</u></b></p> <ul style="list-style-type: none"> <li>• No objective evidence or only anecdotal evidence available; or the supportive evidence is from poorly controlled or uncontrolled studies</li> <li>• Other indications for not recommending evidence for practice may include: <ul style="list-style-type: none"> <li>○ Conflicting evidence</li> <li>○ Harmfulness has been demonstrated</li> <li>○ Cost or burden necessary for intervention exceeds anticipated benefit</li> <li>○ Does not have relevance or applicability to emergency nursing practice</li> </ul> </li> <li>• There are certain circumstances in which the recommendations stemming from a body of evidence should not be rated as highly as the individual studies on which they are based. For example: <ul style="list-style-type: none"> <li>○ Heterogeneity of results</li> <li>○ Uncertainty about effect magnitude and consequences,</li> <li>○ Strength of prior beliefs</li> <li>○ Publication bias</li> </ul> </li> </ul>

## Evidence Table and Other Resources

The articles reviewed to formulate the ENR are described in the [Evidence Table](#). Other articles relevant to the topic were reviewed to serve as additional resources ([Other Resources Table](#)).

## Summary of Literature Review

### Pain Scales

Measurement of pain in the pediatric population can be a challenge for nurses. Before one can proceed with adequate pain management, adequate pain assessment is required. There are three standard dimensions of pain assessment that are used: 1) self-report of pain intensity, 2) behavioral reactions, and 3) physiological reactions (Young, 2005). Because pain is always subjective, self-report is the standard assessment parameter utilized. Pain measurement should utilize a valid scale based on the child's age, cognitive level, type of pain, and situation. No single scale is useful for all children with all types of pain. Children are usually able to differentiate a few levels of pain intensity by the age of three years (Young, 2005).

Two commonly used pain assessments that incorporate the self-report of pain are the visual analog scale and the faces scale. The visual analog scale, which can be used by children as young as seven years of age, is a 10-cm line ranging from no pain to the worst pain possible. The visual analog scale is further divided from 0 to 100 mm. Young identifies a change of 10 to 13 mm is considered the minimum clinically significant change (as cited in Gallagher, Liebman, & Bijur, 2001; Powell, Kelly, & Williams, 2001). The faces scale consists of five to nine faces ranging from neutral or no pain to sad or distressed. A change of one face is considered clinically significant (as cited in Bulloch & Tenebein, 2002).

Behavioral rating scales utilize facial expression, torso movements, kicking, crying, and verbal protest. Poor correlation with self-reported pain is sometimes seen as children may be able to control their own behavior (Young, 2005). Behavioral rating scales can be utilized on non-verbal children and with developmentally delayed children. Pain management has been inadequately studied in the acute setting. There are no published data regarding the validity of pediatric pain scales specific to ED patients.

### Psychological Interventions

Psychological interventions include breathing exercises such as blowing the hurt away and suggestion, such as describing something to the child that would make them believe the procedure would hurt less (Chambers, Taddio, Uman, and McMurty, 2009; Uman, Chambers, McGrath, and Kisely, 2006). Chambers et al. (2009) continues to define distraction in terms of child-directed distraction such as video, music, or story playing, parent-led distraction where parents are instructed on how to distract the child, or nurse-led distraction where nurses are instructed on how to distract the child. Parent coaching is an intervention where parents are instructed to provide assistance to the child using techniques such as humor, nonprocedural talk, toys, pacifier, or rocking (Chambers, et al., 2009). Uman et al. (2006) defines distraction techniques including counting, music, and suggestion as a cognitive intervention. Combined cognitive-behavioral interventions are techniques aimed at modifying emotions and behaviors (Chambers, et al., 2009; Uman et al., 2006).

## **Behavioral Interventions**

Multiple studies have addressed the efficacy of cognitive behavioral interventions for needle related procedures in children and adolescents. Cognitive interventions researched include various distraction methods, music, preparation and education, and suggestion. Behavioral interventions include behavioral distraction through virtual reality, audiovisual distraction, games, muscle relaxation and breathing exercises. Chambers, Taddio, Uman, & McMurty (2009) conducted a meta-analysis of randomized and quasi-randomized controlled trials to examine the efficacy of different psychological interventions during immunizations in children 0 through 18 years of age. The researchers conclude that breathing exercises are an effective intervention for reducing distress in the patient, observer, and nurse.

Distraction can either be directed by the child (eg: watching a video or listening to music with headphones), parent (e.g., parents educated on how to provide age appropriate distraction, or nurse (e.g., a nurse educated on how to provide age appropriate distraction). Chambers, Taddio, Uman, & McMurty (2009) found sufficient evidence to support child-directed distraction as a method to reduce self-reported pain during immunizations. Both parent and nurse-directed distraction did have an effect on reducing observer-rated pain but the interventions were not considered statistically significant (Chambers et al., 2009). Uman et al. (2006) conducted a systematic review of 28 studies and supports the use of distraction as a method of reducing pain and anxiety in needle related procedures. One study looked at the emerging use of technology in providing distraction. Gold, Kim, Kant, Joseph, & Rizzo (2006) conducted research on children age 7-12 years requiring intravenous line placement. Children were randomized to facility standard of care (topical anesthetic) or to the use of a virtual reality simulator headset. Subjects randomized to virtual reality had: 1) less effective pain changes across the procedure, 2) no evidence of motion sickness related to the simulator, and 3) twice the satisfaction of pain management when compared to the control group.

Coaching is another cognitive-behavioral intervention studied by numerous researchers. Chambers et al. (2009) found that parent coaching is effective in reducing observer-rated distress, but not other measures of pain or distress during immunizations. Uman et al. (2006) found that nurse coaching combined with distraction is effective in reducing behavioral measures of distress. Specifically,

- Information and preparation are effective in reducing observer-reported child pain and pulse rate
- Hypnosis is effective in reducing self-reported pain, self-reported distress, and behavioral measures of distress
- Memory alteration is effective in reducing diastolic BP
- Combined cognitive-behavioral interventions are effective in reducing observer reported distress and behavioral measures of child distress
- Parent positioning with distraction is effective in reducing observer-reported child distress (Uman, et al., 2006)

## **Topical Pharmacological Interventions**

### ***Ethyl Vinyl Chloride***

Common use of ethyl vinyl chloride in the ED has lessened over the past decade due to handling and storage requirements that limit utilization of the product (TJC Standard, MM.03.01.01; Gebauer Company, 2005). Research on the use of ethyl vinyl chloride to reduce pain associated with pediatric needle procedures is limited and effectiveness appears to be related to patient age, as Davies & Molloy

(2006) found the opinion of nurses was that children less than nine years of age did not tolerate the 'cold sensation' associated with ethyl vinyl chloride spraying. Costello, Ramundo, and Christopher (2006) found that ethyl vinyl chloride vapocoolant spray failed to measurably reduce pain associated with IV cannulation in children ages 9-18 years. Davies & Molloy found that ethyl vinyl chloride offered a significant reduction in pain in children aged 5-13 years who required repeated needle procedures.

### ***Other Vapocoolants***

Farion, Splinter, Newhook, Gaboury, & Splinter (2008) researched the effects of vapocoolant spray Pain Ease® with children aged 6-12 years who required urgent intravenous catheterization. A reduction of 15 mm on the visual analogue scale was felt by the authors to be of clinical significance. The researchers found a modest but significant reduction in pain with the use of vapocoolant spray as well as an increased rate of success on first cannulation attempt compared to the placebo.

### **Local Application of Ice**

One study was identified investigating local application of ice. Movahedi, Rostami, Salsali, Keikhaee, & Moradi (2006) conducted research on the effect of local refrigeration prior to venipuncture on pain related responses in children aged 6-12 years. The researchers found that local application of ice is effective for relieving the pain associated with venipuncture.

### **Pacifiers and Sucrose**

One article was identified investigating the use of pacifiers and sucrose. Curtis, Jou, Ali, Vandermeer, & Klassen (2007) researched the use of pacifiers both with and without sucrose in infants up to age six months who required venipuncture in the ED. The researchers found that pacifiers are effective agents for analgesia for infants zero to three months undergoing venipuncture (Curtis, et al., 2007). The use of sucrose requires further investigation but appears to be beneficial when utilized with a pacifier.

### **Local Anesthetic Preparations**

Multiple studies have addressed the utilization of various lidocaine preparations for needle-related procedures in various pediatric age groups. Lander, Weltman, & So (2006) conducted a systematic review of six clinical trials that included children aged three months to 15 years on the effectiveness of Eutectic Mixture of Local Anesthetic (EMLA) versus amethocaine (tetracaine) for pain reduction in needle-related procedures. The reviewers found that from a patient self-reported pain rating, tetracaine was significantly favored over EMLA. However, when observers reported pain differences, they found equal efficacy between both products. Newbury & Herd (2009) studied the success rate of cannulation comparing EMLA versus amethocaine. Both preparations were found to have no statistical difference on first successful cannulation.

Sethna, et al. (2005) compared a topical lidocaine patch (S-Caine Patch™) to a placebo in children aged 3-17 years. The researchers found that 59% of those in the intervention group reported no pain compared to 20% in the placebo group. In a similar study, Singer, Taira, Chisena, Gupta, & Chipley (2008) found that the application of a topical lidocaine/tetracaine patch resulted in a modest reduction in the pain of IV cannulation in children aged 3-17 years. Taddio, Soin, Schuh, Koren, & Scolnik (2005) evaluated the success rate of cannulation with the utilization of topical lidocaine compared to a placebo. The results showed a significant difference (74% versus 55%) of cannulation on the first attempt for

those in the intervention group. The results suggest that not only are topical lidocaine preparations capable of decreasing pain, but also increasing the success rate of cannulation.

### **Subdermal Local Anesthetic with Needle- Free Delivery**

Three groups have conducted research on the use of a needle-free delivery system that delivers local anesthetic into the dermal layers with the use of a carbon dioxide injector. The devices did not affect the success rate of IV cannulation on first attempt. Spanos et al. (2008) studied the J-tip application of 1% buffered lidocaine and compared its effect with ELA Max prior to peripheral intravenous (PIV) insertion in the pediatric ED. Patient reports of pain were statistically significantly lower in the J-tip group compared to the ELA Max group. Blinded observers also identified *clinically* significant differences of less pain, defined as a difference in the visual analogue scale of 10 mm, following J-Tip jet injection although the findings were not *statistically* significant. Nurses who inserted the PIV reported similar scores for the two groups for both ease of insertion and overall satisfaction. Jimenez, Bradford, Seidel, Sousa, & Lynn (2006) studied the J-tip application of 1% buffered lidocaine and compared its effect with EMLA prior to peripheral IV cannulation. There was a significant difference between the EMLA group and the J-Tip group during IV cannulation, with 84% of patients reporting no pain at the time of J-Tip lidocaine application versus 61% in the EMLA group. It is noted, however, that 40% of the patients had application of the EMLA for less than the recommended 60 minutes. When a subset of the original group was reviewed, all of which had application times equal to or greater than the recommended 60 minutes, the difference remained significant. Migdal, Chudzynska-Pomianowska, Vause, Henry, and Lazar (2005) studied a needle-free device which delivered buffered lidocaine into the dermal layers of the skin (Zingo™). The device was well tolerated and resulted in a significant reduction in pain following peripheral IV cannulation. It is noted this product has been taken off the market in November 2008, for shelf life issues; no issues related to patient safety were identified (Anesiva, Inc., 2008).

### **Description of Decision Options / Interventions and the Level of Recommendation**

Conclusions and recommendations about management of pain and distress associated with venipuncture, IV cannulation, and immunization in pediatric patients in the emergency department:

1. Biobehavioral interventions:
  - i. There is sufficient evidence to support the efficacy of developmentally appropriate distraction, coaching with distraction, cognitive behavioral therapy, hypnosis and breathing exercises (Level A, highly recommended) in reducing pain and distress.
  - ii. The use of suggestion to reduce pain and distress is not an effective method (Not Recommended for practice).
  - iii. There is not sufficient information to make a recommendation regarding the effectiveness of patient information / preparation in decreasing pain and distress.
2. Dermal Anesthetic Preparations: Vapocoolants and Transdermal Preparations
  - i. Ethyl vinyl chloride may be effective in relieving pain associated with venipuncture (Level C: Weak).
  - ii. Pentafluoropropane and tetrafluoroethane (Pain Ease®) induced a moderate reduction in pain in patients undergoing IV cannulation (6-12 years of age) (Level B: Moderate).

- iii. All transdermal forms of lidocaine/tetracaine (amethocaine) are effective in reducing pain associated with IV cannulation, venipuncture and immunization (Level A: High). Preparation in the form of cream and patches tended to take longer (e.g., 60 minutes or more) to exact effect, which makes them less feasible to use in the ED environment.
- 3. Subdermal Local Anesthetic with Needle- Free Delivery:
  - i. The use of a needleless injection device (e.g., J-Tip®) as a delivery method for lidocaine is superior to other forms of preparation when rapid local anesthesia is desired (Level A: High).
- 4. Local Application of Ice:
  - i. Local application of ice decreased the pain and distress associated with venipuncture (Level B: Moderate).
- 5. Pacifiers and Sucrose:
  - i. Pacifiers are effective analgesia for infants 0 to 3 months of age undergoing venipuncture (Level B: Moderate).
  - ii. Evidence suggests that sucrose is beneficial as a form of analgesia in children from zero - three months of age; no benefit has been demonstrated for children older than three months. (Level C: Weak).

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