An Evidence-Based Approach to Minimizing Acute Procedural Pain in the Emergency Department and Beyond

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Background: Painful procedures are common in the ED setting and beyond. Although these procedures are often essential to patient management, they can also be distressing for children, parents, and health providers. As such, it is imperative that effective pain and anxiety-minimizing strategies be used consistently in all settings where painful procedures take place for children.

Objectives: This review article aims to provide a summary of several strategies, which are supported by definitive and systematically reviewed evidence, that can be implemented alone or in combination to reduce procedural pain and anxiety for children in the ED and beyond.

Results: For neonates, breastfeeding, nonnutritive sucking, swaddling, and sucrose administration have all been shown to decrease pain during painful interventions. For neonates, venipuncture is much less painful than heel lance for blood draws. For infants, there is some support for sucrose use. For infants and older children, there is strong evidence for distraction techniques. In addition, the use of fast-acting topical anesthetic creams as an alternative or adjunct to infiltrating anesthetic before laceration repair or vascular access/venipuncture is recommended. Further, buffering of lidocaine can decrease pain during injection. Lastly, if a laceration is amenable to the use of tissue adhesive, this should be preferentially used.

Conclusions: In summary, there currently remains a knowledge-to-practice gap in the treatment of children's procedure-related pain. This article has identified multiple age-specific methods to improve the treatment of procedural pain. These simple interventions can improve the care provided to ill and injured children.

Key Words: pain, procedural pain, management, distress

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TARGET AUDIENCE

This CME article is intended for physicians, nurse practitioners, nurses, and physician assistants who care for children who undergo acute, painful procedures. Medical specialists including emergency physicians, pediatric emergency physicians, neonatologists, general pediatricians, and family practitioners will find this information particularly useful.

LEARNING OBJECTIVES

After completion of this article, the reader should be able to:

1. Name several nonpharmacological strategies for minimizing pain in children during acute, painful procedures.
2. Apply evidenced-based pharmacologic interventions to reduce pain for pediatric patients undergoing painful procedures.
3. Identify published clinical practice guidelines for acute procedural pain in pediatrics that can inform day-to-day clinical practice.

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Painful procedures are abundant in all health care settings. On average, children experience 6.3 (range 1–50) "simple" painful procedures per day in pediatric inpatient units.[1] In the emergency department (ED), such procedures may include intravenous (IV) insertion, venipuncture, heel lance, and laceration repair. Although these procedures are often essential, they can also be distressing for children, parents, and health providers, alike, and can acutely result in anxiety and fear in children.[2–4] Children who experience moderate levels of pain during infancy may also have long-term physiological, psychological, and behavioral sequelae, including increased sensitivity to pain, increased avoidance behavior, social hypervigilance, and higher levels of anxiety before a painful procedure.[5–8] Familial distress surrounding painful procedures may also lead to parental nonadherence with vaccination administration and avoidance of medical care.[9,10] Of note, effective analgesia techniques may actually improve procedure success rates and prevent the need for repeat attempts.[11] As such, it is imperative that effective pain and anxiety-minimizing strategies be used consistently in all settings.

Currently, procedural pain management techniques for pediatric patients in the ED is suboptimal.[12–15] This review article aims to provide a summary of several evidence-based strategies that can be implemented alone or in combination to reduce procedural pain and anxiety for children in the ED and beyond.

PHARMACOLOGIC STRATEGIES

Sucrose and Sweet-Tasting Solutions

Although the exact pathophysiology of sucrose as a pain reliever is not fully understood, the effect is thought to be mediated by both endogenous opioid and nonopioid systems.[16] A recently updated Cochrane systematic review appraised the use of sucrose for relieving procedural pain in neonates.[17] A total of 57 studies (N = 4730 infants) were included, representing a variety of painful procedures (ie, heel lance, venipuncture).[17] In the pooled results for studies of heel lancing, sucrose groups had significantly lower Premature Infant Pain Profile scores at 30 seconds (weighted mean difference [WMD], −1.76; 95% confidence interval [CI], −2.54 to −0.97) and significantly reduced crying time (WMD, −39 seconds; 95% CI, −44 to −34).[17] There were no differences in adverse events between sucrose and control groups.[17] Overall, the authors concluded that sucrose was a safe and effective method for reducing pain from single heel lances.[17] A sucrose dose of 0.012 to 0.12 g (0.5-5 mL of 24% sucrose) was recommended to be given 2 minutes before single heel lances; however, further research is needed to determine more precise dosing.[17] Although there is no evidence to suggest that short-term use of sweet-tasting solutions has any negative impact on neonates, further research is needed to clarify the implications of prolonged sucrose dosing and long-term outcomes of use.[18]

A study by Rogers et al[19] analyzed sucrose for analgesia during bladder catheterization in the ED, in 83 infants younger than 90 days. Overall, there was no statistically significant treatment effect; however, subgroup analysis of infants aged 1 to 30 days of age receiving sucrose showed a modest change in pain scores (2.9 vs 5.3, $P = 0.035$), a lower likelihood to cry with catheterization (29% vs 72%, $P = 0.008$), and a more rapid return to baseline after catheter removal (10 vs 37 seconds, $P = 0.04$), compared with infants who received placebo.[19] This study suggests some efficacy for sucrose as analgesia in the setting of this commonly performed ED procedure.

A review of the use of sweet-tasting solutions for needle-related procedural pain in infants 1 month to 1 year of age included 14 published randomized controlled trials (n = 1551 participants).[20] Painful procedures included subcutaneous and intramuscular vaccine injections, venipuncture, and heel lance. Duration of cry was significantly reduced in infants who were administered a sweet-tasting solution (MD, −13.47; 95% CI, −16.80 to −10.15; $P < 0.00001$ compared with water).[20] However, there was significant heterogeneity (I^2 = 94%) that authors were unable to explain.[20] Overall, most of the individual studies that measured pain found sucrose to significantly reduce pain compared with the control groups.[20] Unfortunately, the variation between studies limited the author's ability to define an optimal concentration, volume, and method of administration.[20] In conclusion, although there was insufficient evidence for the authors to confidently judge the effectiveness of sweet-tasting solution in this age group, the individual trials seemed promising.[20]

A similar Cochrane review studied sweet-tasting solutions for reduction of needle-related procedural pain in children aged 1 to 16 years.[21] Four studies met inclusion criteria (n = 330 participants). The results for toddler/preschool children were conflicting in that study, which demonstrated significantly lower behavioral distress scores and cry duration compared with the control group, although the other study found no difference between groups.[21] The 2 studies involving school-aged children and chewing gum found that sweet gum did not significantly reduce pain scores.[22] Overall, there was insufficient evidence of pain relief during painful procedures in this older age group, and further well-designed randomized controlled trials are required for this population.[21]

In sum, considering the low cost, ease-of-use, accessibility, and low risk of adverse effects, it is highly recommended that neonates (<30 days) be given sucrose for acutely painful procedures. Given its low risk and likely potential for benefit, it should also be considered for infants aged 1 to 12 months. There is currently limited evidence to support the use of sucrose in children older than 1 year, and its routine use is not recommended at this time. A reasonable dosing for neonates and infants, consistent with our own institutions' guidelines, would be 2 mL of 24% glucose solution, 2 minutes before the initiation of a painful procedure.

Topical Anesthetics for Skin Puncture

Needle-related pain, regardless of indication, can generate fear of future needle interventions and can increase time required to provide the medical care needed.[6,9,23,24] Application of topical anesthetic before needle insertion is an appealing strategy to minimize pain and offers an attractive alternative to infiltrating anesthetic. There are several topical anesthetics available that act by a "numbing effect" whereby a reversible block in conduction along nerve fibers is caused in the skin for a few hours postapplication.[25]

Historically, infiltrated local anesthetic or the traditional skin wheal infiltration was the only means of providing anesthesia to the skin. Two pediatric studies showed that intradermal lidocaine infiltration of 0.1 to 0.2 mL subcutaneously with a 30-gauge needle was equally effective as topical anesthetics, and 1 study showed it to be better than placebo for providing skin analgesia for peripheral venous catheter insertion.[26–28] A systematic review of 10 clinical trials aimed to compare the efficacy of topical anesthetic cream with infiltrated intradermal local anesthesia.[29] It compared EMLA with infiltrated local anesthesia, but the results of the studies were inconsistent, findings could not be combined because of significant heterogeneity, and only 1 study included pediatric patients. If used, some technical considerations that may reduce the pain experienced include slow administration for 30 seconds, buffering lidocaine (mixing 1% lidocaine with 8.4% sodium bicarbonate in a 9:1 ratio), using a small needle size (<27 gauge), and room temperature medication.[30,31]

A Cochrane review of 6 trials (n = 534 children) of painful procedures (venipuncture or IV cannulation) compared amethocaine (tetracaine gel or Ametop) with a eutectic mixture of local anesthetics (lidocaine 2.5% and prilocaine 2.5%, EMLA).[25] Amethocaine significantly reduced pain compared with lidocaine-prilocaine, when all pain data were combined into a common pain score (relative risk, 0.78; 95% CI, 0.62 to 0.98), and this was consistent for all durations of drug application (ie, between 30–60 minutes and >60 minutes). Some erythema was observed after amethocaine use, whereas blanching was observed after lidocaine-prilocaine.[25] Overall, the authors concluded that although EMLA was an effective topic anesthetic for children, amethocaine was superior in preventing pain associated with needle procedures.[25] An earlier systematic review of 8 studies (n = 458 children), including multiple procedures (ie, venipuncture, IV cannulation, Port-a-Cath access, laser therapy) demonstrated that lidocaine-prilocaine and tetracaine were comparable for procedural pain relief when used as recommended (with 60-minute application time for the former and 30 minutes for the latter), but that tetracaine was more efficacious than lidocaine-prilocaine when both were applied for the same amount of time (30 minutes).[32]

Liposomal lidocaine (Maxilene) is a newer topical anesthetic that has been more recently adopted in the ED setting.[11] It is thought to have a superior pharmacologic effect, with a short duration of onset (30 minutes).[11] In children older than 5 years, lower pain scores were reported in children who received liposomal lidocaine ($P = 0.01$), and the mean procedure duration was shorter in all children (6.5 vs 8.7 minutes, $P = 0.04$), when compared with placebo.[11] Children receiving liposomal lidocaine had significantly higher cannulation success rates (74% vs 55%, $P = 0.03$) as well.[11] A recent trial comparing liposomal lidocaine (Maxilene) to tetracaine (Ametop) found no statistically significant difference between pain scores in children in either group.[33] Given the time constraints that face practitioners in the ED, it would seem logical to use faster-acting agents (liposomal lidocaine or tetracaine), when efficacy is the same, if not better, for different agents.

An alternative to topical anesthetic creams is the needle-free jet injection system with buffered lidocaine (J-Tip) (National Medical Products Inc, Irvine, Calif). This device uses carbon dioxide instead of a needle to deliver 0.2 mL of 1% buffered lidocaine into the skin. Local anesthesia is experienced at the site of administration in less than 1 minute. Four randomized clinical trials conducted in the ED or preoperative setting for children aged 1 to 19 years found that the J-Tip was superior for the treatment of pain during venipuncture or IV line placement, when compared with topical anesthetic or placebo.[34–37] The J-Tip device itself was not reported to be painful or associated with adverse events nor increased the odds of successful IV placement.[34,36] This device was also investigated for use before needle insertion for lumbar puncture in infants that received sucrose; the mean observed pain scores and duration of cry was shorter for the device compared with saline placebo.[38]

A Cochrane review of topical anesthetic use for laceration repair included 23 randomized controlled trials (n = 3128 adult and pediatric patients).[39] Topical anesthetic solutions included in the studies were generally a lidocaine-type agent or similar (ie, tetracaine, prilocaine, bupivacaine) combined with epinephrine or cocaine. For example, EMLA (lidocaine 2.5%, prilocaine 2.5%) or LET (lidocaine 4%, epinephrine 0.1%, tetracaine 0.5%) were commonly studied. Because of significant heterogeneity of outcome measures and a small number of trials in each comparison group, the analyses were largely descriptive in nature.[38] The general conclusion drawn from the review was that topical anesthetics were an efficacious nonskin breaking mode of analgesia before suture repair of skin lacerations in both adults and children.[39]

A number of alternative devices have been developed to reduce the pain associated with skin puncture–related pain and distress. However, evidence is limited for these options. Vapocoolant sprays (ethyl chloride, fluorohydrocarbons, and alkane mixtures) are rapid-acting evaporation-induced skin cooling, which has been shown to reduce pain for children undergoing IV cannulation compared with placebo.[40,41] The spray was also found to be superior to a bag of crushed ice slurry placed on the skin 3 minutes before IV insertion in reducing the pain experienced.[42] A novel battery-powered device, Buzzy (MMJ Labs, Atlanta, Ga) that combines cold, vibration, and distraction has also been shown to reduce the pain experienced and increased the odds of venipuncture success.[43]

The largest concern with the safety and use of topical anesthetics, specifically EMLA, has been surrounding the risk of methemoglobinemia with prolonged use of larger doses. As such, it is recommended that an EMLA dose should be limited to 1 to 2 g of cream per 10 cm^2, to infants older than 3 months and weighing at least 5 kg.[44] Similar dosage regimens are recommended to avoid toxicity with other topical anesthetics, although methemoglobinemia with these other agents is a less reported concern. Finally, although the concern has been raised regarding the possibility of topical anesthetic affecting success rate for procedures (eg, for lumbar puncture), this has been disproven.[45,46]

A "standing order" or triage nurse-initiated protocol system has been implemented in EDs for both lacerations and before IV insertion/blood draws[47] and shown to significantly reduce overall treatment time for laceration repair (effect size 31 minutes, $P = 0.0013$).[48] Application of topical anesthetics at triage would be an effective and efficient pediatric pain reduction strategy.

NONPHARMACOLOGICAL STRATEGIES

There are numerous nonpharmacologic technique options for management of procedural pain in children. In general, these techniques can be divided into the following 3 types of interventions: contextual, cognitive, and behavioral strategies.[49] Many of these strategies are simple and straightforward. It is important when considering pain management approaches that multiple nonpharmacologic strategies may be used in conjunction with pharmacologic ones.

Contextual Strategies

Interventions in this category tend to involve several components that modify the child's environment and include low noise and lighting, clustering of painful procedures, and soothing smells.[49] In recent decades, parental presence, especially for younger children, has been encouraged during painful procedures.[50] Although some studies suggest that parental presence decreases pain and distress for children,[51,52] parental presence neither improves nor hinders the success rate of procedures.[53] Further, some recent studies have suggested that parental presence does not improve pain or distress scores for children.[54,55] Interestingly, a study by Young et al[56] found that family members remained present during their child's painful procedure in the ED less often; then, they indicated that they would be in hypothetical scenarios. On the basis of the limited evidence, the writers of this review suggest that families and patients be offered the choice to stay and that patient preferences can guide the ultimate decision.

Cognitive (Psychological) Strategies

Cognitive strategies involve mechanisms that impact a child's ability to perceive the pain experience.[49] The effect of distraction is theorized to work through the reticular system in the brain stem, where inhibitory impulses prevent the transmission of pain producing impulse.[57] Hypnosis involves alteration in perception, memory, and voluntary action in response to suggestions offered by another person.[58] Psychological therapies include distraction, hypnosis, and cognitive behavioral therapy,[59] which is thought to be effective through helping children develop and use coping skills to manage pain and distress.[59]Cognitive techniques involve targeting negative or unrealistic thoughts and replacing them with positive thoughts and attitudes.[59] For example, coaching children to say "I can get through this," instead of "this is going to hurt."[59] A recently updated systematic review studied psychological interventions for needle-related procedural pain and distress.[59] Thirty-nine trials were included, with painful procedures including venipuncture (n = 13), IV catheter insertion (n = 7), and immunization (n = 6) with children aged 2 to 19 years.[59] The most common interventions studied were distraction, hypnosis, and cognitive behavioral therapy.[59]

Overall, strong evidence was found to support distraction or hypnosis for pain relief during needle-related pain.[59] The actual type of distraction techniques varied greatly (including music, watching cartoons, toys, talking, audio) as did the method of measuring pain.[59] Of all of the interventions assessed in this review, hypnosis had the largest significant effect size across several outcomes.[59] Another recent, large, systematic review and meta-analysis analyzed 26 distraction and 7 hypnosis trials for needle-related procedures in children aged 2 to 19 years.[60] None of the hypnosis trials took place in the ED.[60] It confirmed that both distraction (n = 2473 children) and hypnosis (n = 176 children) led to significant reductions in children's self-reported pain and distress and behavioral measures of distress.[60]

In sum, there are multiple psychological strategies that can be used to improve a child's pain experience in the ED that are safe, without adverse effects or drug interactions.[61] Hypnosis may be of limited use because there is a need for an individual trained in delivering the intervention present at the bedside. Distraction is a feasible psychological intervention that may easily be adopted in the ED, especially with the advent of handheld devices and portable technology. In a study by Sinha et al,[62] children aged 6 to 18 years undergoing laceration repair were given an option of age-appropriate distractors including music, video games, and cartoon videos. The use of distraction techniques was demonstrated to be effective in decreasing self-reported anxiety in older children and lowering parental perception of pain in the younger children.[62]

The use of music to reduce pain during procedures is another simple distraction technique. A systematic review of 19 trials (n = 1513 children) showed that music significantly reduced pain and anxiety during medical procedures.[63] A study by Hartling et al[64] compared the use of music via iPod with standard care for children undergoing IV placement in a pediatric ED. When children who had no distress during the procedure were removed from the analyses, there was a significantly less increase in distress

for the music group ($P < 0.05$).[64] Given the strong evidence that music can ameliorate the pediatric patient's pain experience and given the simplicity of the intervention, playing music during painful procedures can potentially be widely adopted in EDs.

Emergency departments should offer age-appropriate distractors to all children undergoing painful procedures. Having access to tablets, handheld video game devices, and music players for children would likely have a positive impact on a child's pain experience. If access to "high-tech" distractors is not available, a portable "distraction kit" with bubbles, windmills, noisemaking devices, and coloring books may be an easy and inexpensive alternative.

Behavioral Strategies

Behavioral strategies involve direct (eg, rocking) or indirect (eg, parent providing soother) manipulation of the child's body, usually by the parent.[49] A systematic review of 51 studies assessed the efficacy of such interventions for neonates, infants, and young children, with only 2 studies specifically taking place in the ED.[49] The most commonly studied painful procedures were heel lances (n = 29) and needle use (n = 10).[49] The interventions that showed the largest improvement in pain reactivity were nonnutritive sucking-related interventions (pacifier, mother's nonlactating nipple) and swaddling/facilitated tucking.[49] For improvement in immediate pain-related regulation (measured 30 seconds after the painful stimuli), the techniques showing the most benefit were nonnutritive sucking interventions, kangaroo care (skin-to-skin contact), swaddling/tucking, and rocking/holding.[49] These results applied to both preterm and term neonates; the results for older infants demonstrated limited, heterogeneous evidence for nonnutritive sucking and video-mediated distraction.[49]

OTHER PAIN-MINIMIZING STRATEGIES

Breastfeeding/Breast Milk

There are several potential mechanisms by which breast milk or breastfeeding may produce an analgesic effect: presence of mother/comforting person, physical skin-to-skin contact, diversion of attention, and sweetness of the breast milk.[65] It also contains higher tryptophan compared with artificial formulas, which, as a precursor to melatonin, may have a nociceptive effect secondary to increasing levels of beta-endorphins.[66] A Cochrane study reviewed 20 trials, evaluating breastfeeding (n = 10) and supplemental breast milk (n = 10) for heel lances (n = 16) and venipuncture (n = 4) in neonates.[65] Overall, neonates in the breastfeeding group had statistically significant lower increase in heart rate, reduced proportion of crying time, reduced duration of first cry, and total crying time compared with positioning, holding by mother, placebo, pacifier use, no intervention or oral sucrose, or both.[65] Breastfeeding was associated with a reduction in both validated and nonvalidated pain scores.[65] When supplemental breast milk was analyzed, it yielded variable results.[65] Overall, the review concluded that if available, breastfeeding or breast milk should be used to alleviate procedural pain in neonates undergoing single painful procedures. In addition to providing pain relief, it may also encourage mothers to breastfeed their infants and facilitate bonding without any additional cost to the health care system.

Tissue Adhesives

Skin lacerations are a common reason for pediatric EDs visits. Traditionally, laceration repairs involved needle infiltration of the skin with anesthetic followed by approximation of the skin with sutures.[67] In general, the injection of anesthetic can be quite painful and specifically in small children, infiltration of the wound can be quite challenging because of movement and significant emotional distress.[67] Tissue adhesive compounds (eg, Dermabond, GluStich) have been available for several years now as an alternative to suture repair of simple lacerations. The compounds are liquid monomers that quickly form a strong bond over the laceration.[67] In a Cochrane systematic review, 13 studies looked at tissue adhesive use; 11 of the studies compared tissue adhesive with standard wound closure technique, whereas 2 studies compared types of tissues adhesives.[67] All but 2 studies included children or studied children exclusively.[67] Pain scores (Parent VAS WMD, −13.4 mm; 95% CI, −20.0 to −6.9, as well as patient, physician, and nurse reported VAS) significantly favored tissue adhesives over standard wound closure.[67] Procedure time (WMD, −4.7 minutes; 95% CI, −7.2 to −2.1) also significantly favored tissue adhesive technique, and in terms of cosmesis, no significant difference was found at 1 and 12 months postrepair.[67] In conclusion, tissue adhesives are an appropriate first choice for simple traumatic lacerations in children because they offer the benefit of decreased procedure time and less pain.[67] When appropriate, the use of glue to repair simple, liner, low-tension lacerations can offer substantial benefit not only to the pediatric patient in terms of less pain, but also to the ED at large, because use of glue expedites the visit and eliminates needs for possible follow-up for suture removal.

Venipuncture Versus Heel Lance

A Cochrane systematic review of 6 studies (n = 478 patients) determined whether venipuncture or heel lace was less painful and more effective for blood sampling in term neonates.[68] Meta-analysis of these data showed significant reduction in pain for venipuncture [standardized mean difference (SMD), −0.76; 95% CI, 1.00 to −0.52].[68] Notably, even when sweet-tasting solution was given to the neonates, the SMD still demonstrated significant favoring of venipuncture over heel lance (SMD, −0.38; 95% CI, −0.43 to −0.25). As such, venipuncture, when performed by a skilled individual, is the more favorable method of blood sampling.[68] As previously discussed, the use of sucrose during skin-breaking procedures can provide analgesic effect in neonates and should be used at every opportunity.[17]

pH Adjustment of Lidocaine

Lidocaine is one of the most popular local anesthetics used in current practice, often chosen for its rapid onset, safety profile, low cost, and wide availability.[69] One well-known and undesirable adverse effect of lidocaine, however, is pain during injection.[69] The pH of most commercial lidocaine solutions is between 3.5 and 7.0, and it is this acidity that is purported to be responsible for the burning pain associated with its injection.[69] It is theorized that alkalization of lidocaine reduces this pain.[69] Cepeda et al[69] performed a systematic review of 23 studies to determine whether adjusting the pH of lidocaine had an effect on pain from non-intravascular injection in both adults and children. It was determined that pain from injection of buffered lidocaine was less than from unbuffered lidocaine. Of note, the extent of the positive effect of buffering was increased when the solution contained epinephrine.[69,70] The review authors concluded that the pH of commercial lidocaine solutions should be increased with bicarbonate to decrease pain on injection.[69] Buffering is generally achieved by adding 1 mL of 8.4% sodium bicarbonate to 9 mL of 1% or 2% lidocaine. Although alkalinization could theoretically cause precipitation or decrease of potency, this issue was not described in any of the studies reviewed, and buffered lidocaine was shown

to maintain good activity for 2 weeks when refrigerated and for 1 week at room temperature.[69,71–73]

CLINICAL PRACTICE GUIDELINES

As demonstrated in this review, there is strong evidence for multiple techniques to reduce procedural pain in children in the ED setting and beyond. Essential to the implementation of these techniques are up-to-date guidelines that are evidence based, practical, easy to follow, and applicable to clinical practice. A recent systematic review of clinical practice guidelines for acute procedural pain identified 18 possible guidelines for use. Although the guidelines scored high in the area of scope, purpose, and clarity of presentation areas, few provided information regarding the rigor of the guideline development process, the applicability, and editorial independence.[74] Currently, there are 3 clinical practice guidelines that were deemed to be good resources for the health care providers. These include the Australian and New Zealand Neonatal Network's Evidence-Based Clinical Practice Guideline for Neonatal Pain from 2010, the Pain Study Group of the Italian Society of Neonatology's Guidelines for Procedural Pain in the Newborn from 2009, and the Association of Paediatric Anaesthetists of Great Britain and Ireland's Good Practice in Postoperative and Procedural Pain Management from 2012.[24,75,76] These guidelines highlight the same strategies for minimizing acute procedural pain in neonates, infants, and children that we have reviewed in this article. They also expand on considerations that should be made before the procedure, including the necessity of the procedure, best timing, and suitability of the environment.[24]

SUMMARY

Pain is a complex experience for children and untreated pain and anxiety, especially when occurring on a frequent basis, can have short- and long-term detrimental effects on not only the child, but also parents and the health care system, as a whole. There are multiple techniques that have been definitively proven to be effective in reducing pain during painful procedures. For neonates, breastfeeding, nonnutritive sucking, swaddling, and sucrose administration have all been shown to decrease pain and distress during painful interventions. Specifically for neonates, venipuncture is less painful than heel lance for blood draws. For infants, there is some support for sucrose use and strong evidence for distraction techniques. For older children, there is strong evidence for distraction techniques. In addition, the use of fast-acting topical anesthetic creams as an alternative to infiltrating anesthetic before laceration repair or vascular access/venipuncture is recommended. Furthermore, the buffering of lidocaine can decrease pain during injection and should be done before infiltration—if infiltration via injection must be done. Lastly, if a laceration in a pediatric patient is amenable to the use of tissue adhesive, this should be preferentially used.

In summary, there currently remains a knowledge-to-practice gap in the treatment of children's procedure-related pain. This article reviews the most relevant and current literature related to the treatment of procedural pain and can serve as a starting point to help close this gap, in an effort to improve the care provided to ill and injured children.

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