Pediatric Pain Management In The Emergency Department

Abstract

Analgesia is a critical part of the management of pediatric patients in the emergency department. Pain is multifactorial and is influenced by its etiology as well as the patient’s age, temperament, beliefs, and past experiences. Suboptimal treatment of pain can have deleterious effects in the short term, and it can also affect a patient’s reaction to future painful experiences and development. Tools exist to reliably quantify a patient’s pain level regardless of age or developmental stage. Both pharmacologic and nonpharmacologic methods can be effective in the management of pediatric pain. Emergency clinicians must remain vigilant in the recognition and treatment of pediatric pain, as patients’ developmental level may limit their ability to adequately express their pain experience. This review discusses several pain scales that are suitable for pediatric patients (including the Faces Pain Scale, the Oucher™, and the Wong-Baker FACES® Pain Rating Scale) and discusses pediatric pain management using nonpharmacologic methods, topical, local, and regional anesthesia, and systemic agents.

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CME Objectives

Upon completing this article, you should be able to:
1. Explain the potential harms of undertreating pain in pediatric patients.
2. Select and utilize an appropriate pain scale for a pediatric patient given his or her age and developmental level.
3. Treat acute and procedural pain in pediatric patients using the best available therapies.

Prior to beginning this activity, see “Physician CME Information” on the back page.

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Case Presentations

An 8-year-old boy is brought from triage after falling at a local playground. His mother, who was with him at the time of the injury, states that he was climbing down from the monkey bars when he slipped and fell. He landed on his outstretched hands and is now complaining of right wrist pain. He has no open wounds on exam and has a normal neurovascular exam, but he has an obvious deformity of his right forearm. The patient describes his pain as 9/10. You ask the nurse to obtain IV access, but after 3 attempts, the team is unsuccessful in securing an IV. You ponder how best to manage your patient’s pain...

The ED is still busy when a 7-year-old boy is brought in with 1 day of fever and right-lower-quadrant pain. His examination is significant for rebound and guarding of his right lower quadrant. He rates his pain as 9/10. You order initial laboratory studies, but the patient’s mother pulls you aside to tell you that her son has had bad experiences with IV placement in the past, and she is very concerned about the associated pain. Meanwhile, one of the nurses mentions to you that the on-call surgery resident had just passed through the ED and noticed that there was a child with possible appendicitis in the ED. The nurse tells you that the surgeon was needed on the wards, but that she would be back down to the ED shortly to see your patient. The surgeon requested that you defer pain medication until her return to the ED, since pain medication will “ruin” her examination. You consider what to do next...

Introduction

Pain, as defined by the International Association for the Study of Pain, is “an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage.” Emergency clinicians treat pain of various etiologies on a regular basis. Pain is a common sequela of many complaints seen in the emergency department (ED), such as otitis media, constipation, migraine headaches, sickle cell disease, and trauma. The quality and location of pain may be the emergency clinician’s diagnostic ally, alerting to the presence of disease processes. Finally, pain is an unfortunate side effect of many of the diagnostic studies and treatments performed in the ED, ranging from a simple IV placement to a complex fracture reduction.

Pain has traditionally been undertreated in all populations, but this is especially true in pediatric patients. The purpose of this issue is to help emergency clinicians recognize pain in children, develop strategies to successfully manage pediatric and neonatal pain, and address specific areas where controversy in pain management exists. This issue of Pediatric Emergency Medicine Practice complements the August 2012 issue, “An Evidence-Based Approach To Pediatric Procedural Sedation,” and together they provide a comprehensive overview of both acute and procedural pain management in children.

Adequate treatment of pain can be one of the most frustrating aspects of emergency medicine practice, for a variety of reasons. First, pain is subjective. Despite the development of sophisticated pain scales, clinicians are still generally reliant on a patient’s self report to quantify pain. This can often lead to frustration when patient pain reports do not match emergency clinician expectations. Second, the pressures resulting from the volume of critical patients seen in the ED can make optimum pain management a seemingly impossible goal and a low priority. Third, young patients’ developmental levels can make quantifying and qualifying their pain difficult and can reduce their ability to advocate for the treatment of their pain. Fourth, concerns from both emergency clinicians and consultants regarding “masking” pain and interfering with accurate diagnoses may pressure emergency clinicians to undertreat pain. Finally, the concerns emergency clinicians and patients’ families have regarding side effects and the potential for addiction may make emergency clinicians more reluctant to use certain effective pain medications.

Despite these barriers, there are compelling reasons to treat pain in the ED. The relief of suffering is one of the fundamental goals of medicine. Additionally, the adequate treatment of pain increases patient satisfaction and often decreases the demands on staff and resources from dissatisfied patients. Finally, despite longstanding myths, all patients (including neonates) feel pain, and there is convincing evidence that exposing young patients to painful stimuli can have long-term negative consequences.

Critical Appraisal Of The Literature

An extensive literature search was performed in Ovid MEDLINE® and PubMed using multiple combinations of the search terms pain, pain management, analgesia, adverse events, side effects, children, pediatric, and emergency department. The Cochrane Database of Systematic Reviews was also consulted. Articles relevant to pediatric pain management were selected, reviewed, and included in the references, as were citations that appeared in review articles, clinical practice guidelines, and policy statements. Articles were chosen for inclusion if they were published after 1995; however, important articles published before this date were included for completeness. Over 300 articles were reviewed, 142 of which were chosen for inclusion in this review.

History Of Pain Treatment

Despite the ethical imperative physicians have to treat pain and reduce patient suffering, both adult and pediatric pain has, traditionally, been under-
treated. Underutilization of pain medication has been particularly pronounced in children, since children have been thought to “…seldom need medication for relief of pain. They tolerate discomfort well.” This has led to children frequently not receiving analgesics. In the past, many believed that infants did not experience pain; cardiac surgeries have even been performed on neonates without analgesia. Numerous studies during the 1980s quantitatively demonstrated a pronounced lower usage of analgesics in children versus adults in definitively painful conditions. In 1990, Selbst and Clark documented this phenomenon in the ED, showing significantly lower use of pain medications in a pediatric ED than an adult ED in patients with comparable diagnoses.

With increasing understanding of pediatric pain as well as the introduction of newer, safer agents, the use of sedation and analgesia has gradually increased. As a greater understanding of the negative effects of pain developed during this period, many in the medical community began to refute the misperceptions surrounding pediatric pain, and a concerted effort to make the ED an “ouchless place” for children began to develop. Today, a variety of modalities, both pharmacologic and nonpharmacologic, are available for pediatric patients to help minimize the pain and trauma associated with an ED visit.

**Etiology And Pathophysiology**

The physiology of the pain response is complex and multifactorial. The traditional model of pain transmission is “bottom-up,” with a specific level of painful stimulus causing a proportional signal from the periphery, through the spinal cord to the brain, and leading to a specific, predictable level of pain. New insights into the pathophysiology of pain, however, have led scientists to reconsider this model. A new, “top-down” conception of pain has developed, in which painful stimuli are thought to be subject to significant levels of modification in both the spinal cord and the brain. Patient temperament, past experience, and genetics are a few of the factors that may alter the final perception of a single painful stimulus.

In both infants and children, painful stimuli can result in tangible, long-term, and harmful effects. Full-term infants who had circumcisions in the immediate neonatal period have been shown to have significantly greater pain response to vaccinations at 4 and 6 months than infants who were not circumcised. This difference was partially attenuated with the use of lidocaine-prilocaine cream (ie, eutetic mixture of local anesthetics [EMLA®]) during circumcision. In a study of pediatric cancer patients receiving a lumbar puncture, pain scores were significantly lower for patients who had received oral transmucosal fentanyl instead of placebo before a prior lumbar puncture (even though all patients received fentanyl for the study lumbar puncture). Another study found that the number of invasive procedures performed during a hospital stay was directly associated with ongoing posttraumatic stress responses 6 weeks after discharge, and increased medical fears 6 weeks and 6 months after discharge. Psychological outcomes of painful procedures extend into adulthood, with people who experienced more medical fear and pain as children having more medical fear as adults.

**Prehospital Care**

Prehospital care traditionally focuses on the stabilization of potential life-threatening issues; however, prehospital pharmacologic pain management and nonpharmacologic pain management (ie, with ice packs, immobilization of fractures, elevation of extremities, and distraction techniques) have been recognized and recommended by both the National Association of Emergency Medical Services Physicians and the American Academy of Pediatrics. Despite these recommendations, pediatric pain is frequently underrecognized and undertreated in the prehospital and ED settings.

Pain is a common prehospital symptom, with 37% to 69% of children estimated to experience acute pain and 48% to 67% of these children classified as having “intense to severe” pain. Rogovik and Goldman found that most children (78%) receive prehospital analgesia either at home or from emergency medical services (EMS); however, the majority of children (65%) with moderate-to-severe pain do not receive any prehospital pharmacologic analgesia. In the prehospital setting, Hennes et al demonstrated that children and adolescents are much less likely than adults to have a pain score documented (4% vs 67%) and also less likely to receive an analgesic intervention. Pediatric trauma patients have also been identified as lacking adequate prehospital documentation of pain assessments and interventions. EMS providers cite the inability to assess pain in children and adolescents as the most common reason for withholding analgesia. In the prehospital setting, several adult studies and 1 pediatric study have demonstrated that opioids can be safely given for analgesia.

**Emergency Department Evaluation**

The Joint Commission (www.jointcommission.org) mandates pain assessments for all hospital patients. Pain should be assessed for all patients upon initial presentation to the ED and reassessed during the visit. Early and frequent pain assessment
encourages and assists providers in the recognition and treatment of pain.

**Pain Scales**

The gold standard and most desirable method for pain assessment is based upon self-report of pain by the patient. Validated pain assessment scales for self-reporting of pain exist for children as young as 3 years of age. These include the Faces Pain Scale - Revised (see Figure 1), the Oucher™ pain scale (www.oucher.org) (see Figure 2), the Wong-Baker FACES® Pain Rating Scale (www.wongbakerFACES.org) (see Figure 3), the visual analog pain scale, the color analog scale, and the verbal numeric scale. For younger children or for children unable to use self-report pain scales, behavioral scales such as the Faces, Legs, Activity, Cry, and Consolability (FLACC) Scale may be utilized in conjunction with the child’s history and physical examination. (See Table 1.) Of these pain scales, the best-validated and most widely utilized faces pain scales are the Faces Pain Scale - Revised, the Oucher™, and the Wong-Baker FACES® Pain Rating Scale. The faces pain scales have undergone extensive testing and have been utilized in the assessment of both acute and chronic pain in children. (For instructions on the application of these self-report pain scales, consult the websites of the organizations, noted in the figure captions.) A summary of the intended age groups, advantages, and disadvantages are listed in Table 2.

Regardless of which pain scale is chosen, the absolute value of the pain score is not as important as the change in the score for each individual child. Pain is an individual experience, and perception of pain varies between individuals. Changes in pain scores can help emergency clinicians gauge the effectiveness of interventions. Also, though pain scales all measure the same phenomenon, they may not be interchangeable. Bailey et al found little agreement between 4 pain scales (visual analog scale, color analog scale, Wong-Baker FACES® Pain Rating Scale, and verbal numeric scale) in the pediatric ED. Reassessment of pediatric pain should be completed using the same scale throughout the child’s ED visit.

**Figure 1. Faces Pain Scale - Revised**


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**Figure 2. Oucher™ Pain Scale**

The Caucasian version of the Oucher™ (shown here) was developed and copyrighted in 1983 by Judith E. Beyer, PhD, RN, (University of Missouri-Kansas City School of Nursing, retired), USA. www.oucher.org. Additional versions representing other ethnicities are also available. Reprinted with permission.

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**Figure 3. Wong-Baker FACES® Pain Rating Scale**


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**Treatment**

**Nonpharmacologic Management Of Pediatric Pain**

When pain is recognized, nonpharmacologic techniques can begin even before medications are given. Studies have shown that up to 86% of pediatric anesthesia and pain fellowships are using alternatives or adjuvants for pain control, including biofeedback (86%), guided imagery (49%), relaxation therapy (33%), massage (35%), hypnosis (44%), acupuncture (33%), art therapy (21%), and medita-
The use of a multidisciplinary approach to pain management in pediatrics has been shown to decrease pain scores, improve parental satisfaction, improve compliance, and decrease hospitalization rates for pain in disorders such as sickle cell disease and pediatric oncology. Despite the report of pain by pediatric patients, nurses do not commonly administer prescribed pain medications to pediatric patients, and they often perceive that pediatric patients are overreporting their pain, thereby decreasing the efficacy of pharmacologic pain regimens. Availability of alternative methods of improving pain management is extremely important in the pediatric population.

While these techniques are only beginning to be evaluated in the ED setting, there is strong evidence that nonpharmacologic techniques can reduce patient procedural pain. In 2006, a Cochrane review of cognitive and behavioral interventions to decrease needle-related procedure pain in 2- to 19-year-olds was performed. It found preliminary evidence that a combination of cognitive techniques (eg, distraction and imagery) and behavioral techniques (eg, breathing exercises, modeling, and rehearsal) are

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### Table 1. Face, Legs, Activity, Cry, Consolability Scale

<table>
<thead>
<tr>
<th>Category</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Face</td>
<td>No particular expression or smile</td>
</tr>
<tr>
<td>Legs</td>
<td>Normal position or relaxed</td>
</tr>
<tr>
<td>Activity</td>
<td>Lies quietly, normal position, moves easily</td>
</tr>
<tr>
<td>Cry</td>
<td>No cry (awake or asleep)</td>
</tr>
<tr>
<td>Consolability</td>
<td>Content, relaxed</td>
</tr>
</tbody>
</table>

Each of the 5 categories is scored from 0-2, which results in a total score between 0 and 10.


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### Table 2. Summary Of Recommended Faces Pain Scales Used In Children

<table>
<thead>
<tr>
<th>Name of Scale</th>
<th>Intended Age Group, y</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faces Pain Scale</td>
<td>3-12</td>
<td>• Quick and simple to use</td>
<td>• Uses 0-6 metric; cannot be scored 0-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Minimal instruction required</td>
<td>• Less preferred than the Wong-Baker FACES® Pain Rating Scale when given a choice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Demonstrates a lack of upper-end bias</td>
<td></td>
</tr>
<tr>
<td>Faces Pain Scale-Revised</td>
<td>4-12</td>
<td>• Scored 0-10</td>
<td>• Less preferred than the Wong-Baker FACES® Pain Rating Scale when given a choice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Quick and simple to use</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Minimal instruction required</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Translated into &gt; 35 languages</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Available free of charge</td>
<td></td>
</tr>
<tr>
<td>The Oucher™</td>
<td>3-12</td>
<td>• Ethnically/culturally specific photographic versions have been developed</td>
<td>• Reliability and validity measures required for 3- to 4-year-olds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Includes numerical rating scale that may be used by older children</td>
<td>• Numerical rating may be difficult for younger children</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Children must be screened to determine ability to count by 10s or 2s to 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• More expensive to reproduce multiple versions of color photographs</td>
</tr>
<tr>
<td>Wong-Baker FACES® Pain Rating Scale</td>
<td>3-18</td>
<td>• Quick and simple to use</td>
<td>• Limited psychometric testing of translations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Minimal instruction required</td>
<td>• Confounds affect (smiles, tears) with pain intensity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Translated into &gt; 10 languages</td>
<td>• Ratings are higher than on scales with a neutral “no-pain” face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Preferred (relative to other pain scales) by children of all ages and by nurses</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Available free of charge</td>
<td></td>
</tr>
</tbody>
</table>

effective in reducing pain and distress.\textsuperscript{45} Effect sizes, however, were variable, and study results often varied, depending on the measures used. In younger patients, interventions such as nonnutritive sucking and swaddling have also been shown to reduce pain.\textsuperscript{46} These techniques, utilized by either child-life professionals or thoughtful emergency clinicians and nurses, can reduce pain and increase parental satisfaction in an efficient manner.

**Topical Anesthesia**

There are multiple options for topical anesthesia that are both safe and effective for use in the pediatric population. Topical anesthetics can decrease pain, improve procedure success, and increase cooperation by pediatric patients.\textsuperscript{47}

Ethyl chloride spray, or vapocoolant, is used for cryoanalgies for IV placement as well as incision and drainage procedures in pediatric patients. Its use has decreased with the advent of other forms of topical analgesia, but it is still commonly used in many settings. In a double-blind randomized placebo-controlled trial enrolling 80 patients, there was a small but significant decrease in pain scores as well as a significant increase in the rate of cannulation success using vapocoolant.\textsuperscript{48} Other similarly designed and sized trials, however, found no difference between vapocoolant and placebo.\textsuperscript{49,50}

EMLA\textsuperscript{®} cream, with each gram of cream containing 25 mg lidocaine and 25 mg prilocaine as an oil and water emulsion, is commonly used prior to invasive local procedures in the pediatric population. It is typically only used with intact skin, to minimize systemic absorption,\textsuperscript{51} although a nonsystematic review of studies using EMLA\textsuperscript{®} on lacerations found that it was successful without significant side effects.\textsuperscript{52} EMLA\textsuperscript{®} has been used clinically for over 25 years, and numerous studies have shown its effectiveness.\textsuperscript{53} A meta-analysis of 20 studies showed it to have a large effect on both venipuncture pain and IV insertion pain.\textsuperscript{54} One disadvantage to EMLA\textsuperscript{®}, however, is its long onset of action. EMLA\textsuperscript{®} must be applied for 45 to 60 minutes to achieve the desired effect, with maximal effect after 1 hour. A potential complication of neonates receiving topical EMLA\textsuperscript{®} cream is methemoglobinemia from the metabolites of prilocaine secondary to low levels of methemoglobin reductase.\textsuperscript{55,56} The incidence seems to be most common in patients under 3 months of age and related to the duration of skin application. When used properly, however, EMLA\textsuperscript{®} is both efficacious and safe, even in neonates.\textsuperscript{57}

The gel formulation of high-concentration lidocaine, LMX\textsuperscript{®} (formerly known as ELA-Max), is similar to EMLA\textsuperscript{®}. It is used topically to anesthetize intact skin, and effects are seen slightly more quickly than with EMLA\textsuperscript{®}, sometimes as quickly as 20 minutes after application. A number of studies assessing pain with IV placement have found equivalent pain relief between a 30-minute application of LMX\textsuperscript{®} and a 60-minute application of EMLA\textsuperscript{®}, although these trials did not have a placebo control.\textsuperscript{58,59}

Needle-free or jet-injection of lidocaine locally has been used for IV catheter placement in children to reduce pain and facilitate patient cooperation. The single-use system uses a carbon dioxide gas cartridge under high pressure to deliver 1% buffered lidocaine through a micro-orifice into the subcutaneous layers of the skin. It provides almost immediate anesthesia and has been shown to be more effective than EMLA\textsuperscript{®} for IV placement, without EMLA\textsuperscript{®}'s vasoconstrictive side effects.\textsuperscript{60,61} Another study, however, showed no difference between jet injection of lidocaine and jet injection of placebo, although both were superior to controls receiving no anesthesia with IV placement.\textsuperscript{62} Jet injection of lidocaine has been shown to be superior to jet injection of placebo prior to lumbar puncture.\textsuperscript{63}

Lidocaine, epinephrine, and tetracaine (LET) is a topical anesthetic that can supplement or replace local infiltration of lidocaine for laceration repair. Use of LET can facilitate cooperation and decrease anxiety because the topical application of the medications avoids needles. LET has been shown to be effective for laceration repair, with few side effects.\textsuperscript{56,64} LET has an equal anesthetic effect compared to injected lidocaine, with less pain on application.\textsuperscript{65} Additionally, application of LET reduces the pain associated with lidocaine injection should it subsequently become necessary.\textsuperscript{66}

**Local Anesthesia**

Local anesthetics can be delivered via needle into the area of (or the area surrounding) a wound or area where a procedure is to take place. Lidocaine is the most commonly used agent. It has a rapid onset of action, with a duration of action of 60 to 90 minutes (without epinephrine). The onset and duration of action of several common local anesthetics is found in Table 3. Commonly, lidocaine is used in combination with epinephrine, providing vasoconstriction, decreased bleeding, and delayed systemic absorption of lidocaine. This can increase the duration of anesthesia the injection produces to between 120 to 360 minutes. Maximal recommended doses of lidocaine are 5 mg/kg without epinephrine and 7 mg/kg with epinephrine.\textsuperscript{67-69} Although side effects are rare with lidocaine administration at these doses, they can occur. It can be difficult to tell if infiltration of the injection is intravascular or intraosseous, and dysrhythmias, seizures, and cardiovascular collapse have been reported with the use of local anesthetic agents.\textsuperscript{68}

Because lidocaine has a low pH, studies have shown that using 10 mL of 1% lidocaine diluted with 1 mL of 8.4% sodium bicarbonate (10:1 ratio)
can decrease the burning often associated with its administration.70 A Cochrane review of 23 studies showed that adjusting the pH of lidocaine both decreased observed pain scores and improved patient satisfaction.71 Using 25-gauge or smaller needles, infiltrating slowly, and stimulating the skin just proximal to the site of injection can decrease pain sensation.72 Finally, in a systematic review and meta-analysis, warming lidocaine prior to injection was also shown to improve pain scores upon administration.73 Other agents, such as mepivacaine, prilocaine, bupivacaine, and etidocaine can be useful in painful procedures because of their longer duration of action as compared to lidocaine. These anesthetics are sometimes used in combination with lidocaine to prolong the duration of anesthesia, but many agents can be used singularly. Some disadvantages of these medications include a longer duration until onset of pain relief and a worse toxicity profile, compared to lidocaine.

Regional Anesthesia

Regional anesthesia and peripheral nerve blocks may also be used to address pain associated with fractures and laceration repair in the ED. Regional anesthesia involves the injection of a local anesthetic in the area of a nerve in order to provide anesthesia to a particular nerve distribution. Advantages of regional anesthesia, when compared to local infiltration, include reduced pain, less anesthetic use, lower risk for systemic toxicity, and less tissue distortion.74 Disadvantages include the need for a high degree of patient cooperation, a risk of systemic toxicity due to inadvertent intravascular injection, and a small risk of peripheral nerve damage.74 Typical anesthetics used for regional anesthesia and nerve blocks include lidocaine, bupivacaine, and ropivacaine. Common peripheral nerve blocks described for use in the ED are digital, femoral, axillary, and facial nerve blocks. The addition of ultrasound guidance has been shown to be more effective than traditional landmark techniques.75

### Systemic Agents

#### Acetaminophen

Acetaminophen (paracetamol, Tylenol®, Tempra®, Acephen®, etc.) is the most widely used analgesic and antipyretic in children. Its exact mechanism of action is unknown. Unlike nonsteroidal anti-inflammatory drugs (NSAIDs), acetaminophen does not have anti-inflammatory or antiplatelet properties. While acetaminophen has an excellent safety profile overall, a risk of severe hepatotoxicity and necrosis in patients receiving supratherapeutic doses of acetaminophen exists, especially in those receiving repeated dosing.76,77 Since families frequently give patients incorrect doses of acetaminophen at home, it is important to give explicit, appropriate dosing instructions to families.78,79 Acetaminophen is typically dosed orally or rectally, with maximum daily dosing varying by weight or age.80 The oral dose of acetaminophen is 10 to 15 mg/kg, which may be repeated every 4 hours. While the usual recommended rectal dosing of acetaminophen is 20 mg/kg/dose, there is support for using an initial rectal dose of 40 mg/kg to achieve therapeutic serum drug levels, with a maximum dose of 90 mg/kg/day.81 Given its variable bioavailability, caution should be used when dosing rectal acetaminophen, especially in children in a catabolic state due to their underlying illness.82 There is an IV formulation of acetaminophen, which was approved in 2010 by the United States Food and Drug Administration (FDA) for children ≥ 2 years of age. In children, it is dosed at 7.5 to 15 mg/kg/dose every 6 hours. While its adoption is limited and it remains expensive, it has been used successfully in a pediatric ED setting.83

#### Nonsteroidal Anti-Inflammatory Drugs

NSAIDs are frequently used in the treatment of mild-to-moderate pain in the pediatric ED, and they have both analgesic and anti-inflammatory effects. Aspirin was the first NSAID developed for clinical use; however, its association with Reye syndrome has led to the discontinuation of its use in children for pain or fever.84 Ibuprofen (Motrin®, Advil®) is the most frequently administered NSAID in pediatric patients. Although an IV formulation of ibuprofen exists and has been used to hasten patent ductus arteriosus closure in neonates, only the oral formulation is FDA approved for the treatment of pain in children.85 Naproxen (Aleve®) has similar efficacy to ibuprofen but has the advantage of a longer half-life. It has not been studied for use in infants. Ketorolac (Toradol®) is the only NSAID with an IV formulation approved for analgesia in pediatric patients. It should be used cautiously, as it has been associated with renal failure86 and gastrointestinal bleeding87 in pediatric patients. Its use is limited to 5 days duration. A tablet form of ketorolac exists, but there have been few studies regarding its use in the pediatric

### Table 3. Onset And Duration Of Action Of Common Local Injectable Anesthetic Agents

<table>
<thead>
<tr>
<th>Agent</th>
<th>Onset, min</th>
<th>Duration, min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procaine (Novocaine®)</td>
<td>2-5</td>
<td>15-30</td>
</tr>
<tr>
<td>Tetracaine (Pontocaine®, Viractin®)</td>
<td>4</td>
<td>140</td>
</tr>
<tr>
<td>Lidocaine (Xylocaine®)</td>
<td>1</td>
<td>60-90</td>
</tr>
<tr>
<td>Lidocaine with epinephrine</td>
<td>1</td>
<td>120-360</td>
</tr>
<tr>
<td>Mepivacaine (Carbocaine®, Polocaine®)</td>
<td>3-5</td>
<td>70-140</td>
</tr>
<tr>
<td>Bupivacaine (Marcaine®)</td>
<td>5</td>
<td>120-240</td>
</tr>
<tr>
<td>Bupivacaine with epinephrine</td>
<td>5</td>
<td>180-420</td>
</tr>
<tr>
<td>Prilocaine</td>
<td>1</td>
<td>70-140</td>
</tr>
<tr>
<td>Etidocaine (Duranest®)</td>
<td>3-5</td>
<td>300-600</td>
</tr>
</tbody>
</table>
Clinical Pathway For Pediatric Pain Management

Pediatric patient with acute pain

Life-threatening condition?

YES

• Address life-threatening condition
• Address pain when patient condition allows

NO

Obtain age-appropriate pain score (Class II)

Consider regional anesthesia/nerve block if pain is localized and it is technically feasible (Class I/II)

Continued patient reassessment

Severe pain
• IV opioids OR
• IN fentanyl/IM opioids if unable to rapidly obtain IV access (longer time of onset with IM opioids)

Mild/moderate pain
• Oral NSAIDs
• Oral opioids for refractory pain

Will a potentially painful procedure need to be performed on the patient?

YES

• Consider both procedure and patient characteristics
• Use nonpharmacological methods (ie, distraction) whenever possible

NO

Anxiolysis (eg, IN midazolam (Class II)) for young/anxious patients and mildly painful procedures

Local anesthesia for mild procedural pain (Class I)
• IV placement
• Laceration repair
• Lumbar puncture

Procedural sedation for significant procedural pain (Class I)
• Fracture reduction
• Deep abscess incision and drainage

Abbreviations: IM, intramuscular; IN, intranasal; IV, intravenous; NSAID, nonsteroidal anti-inflammatory drug.

Class Of Evidence Definitions

Each action in the clinical pathways section of Pediatric Emergency Medicine Practice receives a score based on the following definitions.

Class I
• Always acceptable, safe
• Definitely useful
• Proven in both efficacy and effectiveness

Level of Evidence:
• One or more large prospective studies are present (with rare exceptions)
• High-quality meta-analyses
• Study results consistently positive and compelling

Class II
• Safe, acceptable
• Probably useful

Level of Evidence:
• Generally higher levels of evidence
• Non-randomized or retrospective studies: historic, cohort, or case control studies
• Less robust randomized controlled trials
• Results consistently positive

Class III
• May be acceptable
• Possibly useful
• Considered optional or alternative treatments

Level of Evidence:
• Generally lower levels of evidence
• Case series, animal studies, consensus panels
• Occasionally positive results

Indeterminate
• Continuing area of research
• No recommendations until further research

Level of Evidence:
• Evidence not available
• Higher studies in progress
• Results inconsistent, contradictory
• Results not compelling


This clinical pathway is intended to supplement, rather than substitute for, professional judgment and may be changed depending upon a patient's individual needs. Failure to comply with this pathway does not represent a breach of the standard of care.

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population. Indomethacin has not been studied in patients < 14 years of age, but it has been used in patients with rheumatic diseases.

With typical usage, NSAIDs are well tolerated in children, although side effects do exist. Case reports exist of NSAID-associated renal failure in pediatric patients using NSAIDs for short periods, although all cases were self-limited with drug discontinuation. Despite a high prevalence of NSAID-induced bronchospasm in adults, at least 1 randomized controlled trial showed a reduced risk of outpatient visits for asthma in pediatric patients with a history of asthma and an acute febrile illness who were prescribed ibuprofen versus those given acetaminophen. Similarly, a Cochrane review showed no increase in postsurgical bleeding in tonsillectomy patients receiving NSAIDs perioperatively versus other tonsillectomy patients. A large randomized double-blind office-based study enrolling over 80,000 patients showed no difference in rates of hospitalization for gastrointestinal bleeding, renal failure, or anaphylaxis in patients prescribed ibuprofen versus those prescribed acetaminophen.

A number of meta-analyses have compared the efficacy and safety profile of acetaminophen and ibuprofen in children. Perrott et al concluded that both agents had similar efficacy against pain and were as safe as placebo. In a meta-analysis on the efficacy of the 2 agents as antipyretics, Goldman et al concluded that they had similar safety profiles, although they acknowledged that data on safety were limited. Finally, Pierce and Voss performed a later meta-analysis on the comparative efficacy and safety of acetaminophen and ibuprofen in both children and adults, and they concluded that while the safety profiles of the 2 agents were similar, ibuprofen may be more efficacious in treating pediatric pain. Dosing of nonopioid analgesics is summarized in Table 4.

### Opioids

Opioids are the mainstays of treatment of moderate-to-severe pain in the pediatric ED. Opioids have a significant side-effect profile that must be recognized, although side effects can be minimized when opioids are used correctly. Respiratory depression is the most significant of these effects. Binding of opioids to receptors in the medullary respiratory center can lead to hypoventilation and apnea. Peak effect is 20 minutes after an IV dose of morphine and 3 to 5 minutes after an IV dose of fentanyl. Cardiovascular monitoring of all patients receiving IV narcotics is, therefore, mandatory, to obviate this potentially fatal complication.

Hypotension secondary to opioids is uncommon, but it can occur secondary to histamine release. Gastrointestinal side effects of narcotics include ileus, constipation, and vomiting. Severe pruritus is occasionally a side effect of morphine. Chest-wall rigidity is a known complication of fentanyl, and it is associated with higher dosing and rapid IV administration of the medication. Finally, despite past perceptions, there are very little data to support the concern for addiction to opioids when they are utilized in an appropriate acute setting.

Codeine is a commonly used opioid that is often used in combination with acetaminophen. It has a number of characteristics, however, that make it less than ideal. Codeine itself has an extremely weak affinity for opioid receptors. Its analgesic effect comes from the approximately 10% of ingested codeine that gets metabolized by the CYP2D6 enzyme in the liver into morphine. CYP2D6, however, has a number of genetic polymorphisms that affect its rate of catalysis. In North America, 7% to 10% of whites have a polymorphism of CYP2D6, which causes the enzyme to have little function; thus, these patients receive virtually no analgesic effect from codeine. Conversely, 1% to 7% of whites and > 25% of Ethiopians, among others, have a polymorphism of CYP2D6 leading to ultrafast metabolism of codeine, creating a high potential for toxicity. This polymorphism has been definitively linked to at least 1 fatality. With better alternatives available, codeine use for analgesia can be avoided.

Oxycodone is frequently used and prescribed in pediatric EDs. Unlike codeine, it does not need to be metabolized to an active form. Caution should be used in dosing oxycodone in patients

<table>
<thead>
<tr>
<th>Table 4. Dosing Of Nonopioid Analgesics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication Name</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Acetaminophen</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Ibuprofen</td>
</tr>
<tr>
<td>Naproxen</td>
</tr>
<tr>
<td>Ketorolac</td>
</tr>
</tbody>
</table>

Neonate: < 1 month of age  
Infant: < 12 months of age  
Child: 1 to 18 years of age  
Abbreviations: IV, intravenous; mg, milligrams.
with renal failure, since they may develop toxic levels of metabolites.\textsuperscript{102} Hydrocodone is another oral narcotic with similar potency to oxycodone; however, it is only available in formulations combined with acetaminophen and ibuprofen, which may limit its utility in children.

Morphine is a mainstay of treatment of severe pain in the pediatric ED. It is metabolized in the liver to the inactive morphine-3-glucuronide and the active morphine-6-glucuronide, both of which are excreted by the kidneys. Caution should be used in giving morphine to patients in renal failure, since the active toxic metabolite can accumulate.\textsuperscript{96} Morphine is metabolized predominantly into the active metabolite in infants. It has both a smaller volume of distribution and a longer clearance time in these patients; therefore, the dosing should be reduced.\textsuperscript{103,104}

(See Table 5.)

Hydromorphone is a synthetic opiate with a longer duration of action (4-6 h) than morphine. It is thought to have less associated nausea and pruritus than morphine. It also has no active metabolites, making it especially attractive for use in patients with liver or renal dysfunction.\textsuperscript{105} Fentanyl is another synthetic opiate with rapid onset and offset, making it an excellent agent for immediate pain treatment. It is highly lipid soluble and, therefore, rapidly penetrates the central nervous system. It then diffuses from the central nervous system into the systemic circulation, allowing for rapid termination of effect. Peak effect for IV fentanyl is 3 to 5 minutes, with a duration of effect of 30 to 60 minutes.\textsuperscript{97}

There are a number of ways to administer fentanyl, several of which offer particular advantages in the ED setting. Intranasal fentanyl has been used for pain relief successfully in the pediatric ED\textsuperscript{108} and in the prehospital setting.\textsuperscript{109} In a randomized controlled trial, Borland et al found that intranasal fentanyl had similar efficacy and time to onset as IV morphine in treating pediatric fracture pain.\textsuperscript{108} This study did not account for time to administration, which would presumably favor fentanyl given intranasally, since there is no need for IV placement. Using an atomizer and maximizing drug concentration are important to optimizing drug delivery of intranasal fentanyl,\textsuperscript{109} although in 1 study, similar analgesia was achieved with either standard IV concentration or high-concentration intranasal fentanyl.\textsuperscript{110} Holdgate et al showed that use of intranasal fentanyl for all pediatric patients presenting with pain from any cause led to decreased wait time to pain medication administration by approximately 30 minutes, compared to IV morphine, although the study did not look at time to pain relief.\textsuperscript{111}

### Special Circumstances

There are a number of frequently encountered situations in the ED where controversy in the treatment of pain in children has created significant research interest. A few of these situations are highlighted here.

### Abdominal Pain

Traditional surgical teaching in abdominal pain is that analgesia should be deferred in patients with acute abdominal pain so that clinical progression can be better monitored. This practice has been challenged, since deferring analgesia causes significant harm without any evidence of benefit. Kim et al were the first to examine the question of use of pain medicine and the masking of clinically significant abdominal symptoms by comparing pain scores, examination findings, and the time to clinical decision making in children > 5 years old presenting with acute abdominal pain. Sixty patients were randomized to receive either morphine or placebo; patients and investigators were blinded to which the patients

<table>
<thead>
<tr>
<th>Medication Name</th>
<th>Route</th>
<th>Dosing</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codeine</td>
<td>Oral</td>
<td>0.5-1 mg/kg/dose (max 60 mg)</td>
<td>Every 4-6 h</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>Oral</td>
<td>0.05-0.15 mg/kg/dose (initial max 5-10 mg)</td>
<td>Every 4-6 h</td>
</tr>
<tr>
<td>Hydrocodone</td>
<td>Oral</td>
<td>0.15 mg/kg/dose (max 10 mg)*</td>
<td>Every 4-6 h</td>
</tr>
<tr>
<td>Morphine</td>
<td>IV</td>
<td>0.05-0.1 mg/kg/dose (initial max 4 mg, titrate as needed)</td>
<td>Every 2-4 h</td>
</tr>
<tr>
<td></td>
<td>Oral</td>
<td>0.2-0.4 mg/kg/dose (max 10-30 mg)</td>
<td>Every 4 h</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>IV</td>
<td>0.01-0.02 mg/kg/dose (max 0.2-0.8 mg)</td>
<td>Every 4 h</td>
</tr>
<tr>
<td></td>
<td>Oral</td>
<td>0.04-0.08 mg/kg/dose (max 1-4 mg)</td>
<td>Every 4-6 h</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>IV/IM</td>
<td>0.5-3.0 mcg/kg/dose (max 50 mcg)</td>
<td>May repeat every 30-60 min</td>
</tr>
<tr>
<td></td>
<td>IN</td>
<td>1.5 mcg/kg/dose (max 100 mcg)</td>
<td>Additional 0.3-0.5 mcg/kg every 5 min, if needed</td>
</tr>
<tr>
<td></td>
<td>Nebulized</td>
<td>3-4 mcg/kg/dose (max 200 mcg)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Usually paired with acetaminophen; dosing hydrocodone component.

\textsuperscript{1}Initial dosing for neonates, 0.025 mg/kg/dose

Abbreviations: IM, intramuscular; IN, intranasal; IV, intravenous.
received. The study found improvement in pain scores with no changes in abdominal tenderness on examination or clinical diagnostic accuracy.112 However, this study was limited in size, power calculations were performed post hoc, and the same physicians examined the patients both before and after the study medicine was given. A study by Green et al looked at children presenting with abdominal pain requiring a surgical consultation. It compared patients receiving placebo to those receiving morphine in a randomized, blinded fashion. Again, pain was improved in the morphine group, with no change in either the pediatric emergency physicians’ or the surgeons’ confidence in the diagnosis, and there was no difference in patient outcome. Nonetheless, as the authors point out, the study was limited in its ability to account for the potential of missed appendicitis; such a study would require over 1000 participants in order to detect any potential difference.113 Similar results were found in a study comparing oxycodone to placebo114 as well as a study looking at time to surgical decision making, although the latter showed no difference in pain scores between patients receiving morphine and placebo.115

Despite the absence of evidence for analgesia masking examination findings or altering outcomes in pediatric patient with abdominal pain, there is still skepticism that patients can safely receive pain medicine prior to surgical decision making. In an editorial by Vane accompanying the study by Green et al, the author questions the absence of a study decision-making algorithm, and states “this article has not definitively demonstrated the best algorithm or timing for [analgesia’s] administration in children with acute abdominal events.”116 Nevertheless, accumulating evidence continues to support the use of analgesia in patients with acute abdominal pain. A meta-analysis of adult and pediatric studies published in The Journal of the American Medical Association showed that, although there was a change in physical examination findings with analgesia, there existed no increase in clinical errors with its use.117 Similar results were also found in a Cochrane review of adult patients.118 Given all of the current evidence, it is increasingly difficult to justify withholding analgesics in pediatric patients with acute abdominal pain.

**Lumbar Puncture**

Lumbar puncture is one of most frequently performed procedures in the pediatric ED. Because it is often performed on infants who have limited ability to express pain and discomfort, there is a potential for undertreatment of procedural pain. In a survey of pediatric and emergency medicine residents, residents thought that lumbar puncture pain was less in neonates than toddlers, children, and teens.119 In a separate survey of emergency medicine attendings and pediatric emergency medicine fellows, only 19% of respondents felt that pain experienced by infants during a lumbar puncture would have any long-term developmental effects.120 These attitudes may lead to less use of analgesia in infants. At 1 tertiary care children’s hospital, pharmacologic procedural pain relief during lumbar puncture was used in only 6.5% of neonates and 14.3% of infants, compared to 60.0% of preschoolers and 85.9% of older children.121

Despite attitudes and practices avoiding analgesia in infants, there is evidence suggesting its benefit. In a randomized double-blind placebo-controlled neonatal intensive care unit study, lumbar puncture was associated with increases in heart rate and behavioral pain scores, but these increases in scores were attenuated with use of EMLA cream.122 In a prospective unblinded study, use of injectable lidocaine was associated with decreased behavioral pain scores without affecting lumbar puncture success rate.123 A similar success rate was found in a second study of injectable lidocaine for lumbar punctures, although there was a slight but significant increase in the rate of traumatic lumbar punctures in the lidocaine group.124 Finally, a more recent study by Baxter et al found that lumbar punctures were significantly more likely to be successful if local analgesia, either topical or injected, was used.125

In summary, strong evidence exists that local anesthesia ameliorates pain during lumbar puncture in infants. Additionally, using local anesthesia does not decrease – and may improve – lumbar puncture success rate. Given our knowledge of the detrimental effects of pain in infants and young children, local anesthesia should be utilized in all patients undergoing a lumbar puncture, regardless of patient age.

**Fracture Management**

Extremity fractures are often extremely painful injuries. Despite this, pain in pediatric patients with a fracture is not always recognized and addressed. In a retrospective study of 773 patients presenting to a level I pediatric trauma center with isolated long-bone fracture requiring hospital admission, only 10% of patients received adequate analgesia while 59% received no pain medication.126 Younger patients (who are less able to express themselves) were less likely to receive analgesia than older children.

When fracture pain is recognized, there is a wide range of potential treatment options. One of the first decisions to be made is whether to use IV or oral medications. In 1 study, patients > 6 years of age who did not have an IV but were to receive IV morphine for analgesia from a musculoskeletal injury were randomized to receive either IV morphine or oral oxycodone. Despite longer times to morphine administration, pain scores were lower and patient
There is evidence that COX-2 inhibition caused by NSAIDs may delay fracture healing in animal models; however, no definitive clinical effects of this phenomenon have been found in humans. In summary, it is important to recognize the need for pain management in fracture patients, particularly in younger patients. For severe pain, IV morphine appears to be superior to oral medications. Intranasal fentanyl, as discussed previously, appears to be equivalent to IV morphine for pain relief, and it may provide more rapid analgesia in patients with difficult or no IV access. Oxycodone and ibuprofen appear to be superior to acetaminophen with codeine in initial pain management as well as outpatient pain management. Given the risks and side-effect profiles, ibuprofen should probably be the initial medication of choice for mild fracture pain.

Risk Management Pitfalls For Pediatric Pain Management
(continued on page 13)

1. “The patient was wide awake after I pushed his IV morphine, so I thought it was OK to leave him off the monitor.”
   All patients given IV narcotics should be placed on a cardiovascular monitor. The time to peak onset of IV morphine is at least 20 minutes. Failure to properly monitor a patient on IV narcotics could lead to hypoventilation, apnea, and death.

2. “The patient’s mother called to say he was somnolent after taking a dose of Tylenol® with codeine. I prescribed the right dose, so she must be overdosing him.”
   Codeine is metabolized into its active form, morphine, by the CYD2P6 enzyme in the liver. A small—but significant—percentage of the population are ultrafast metabolizers of codeine, potentially causing supratherapeutic levels of morphine in the bloodstream. If a patient is reported to be overly sensitive to codeine, he or she should be switched to another medication, such as oxycodone or an NSAID.

3. “I don’t need to explain how to dose acetaminophen; it is an over-the-counter drug.”
   Multiple studies have shown that parents are often inaccurate in their dosing of common analgesics to their children. This can result in both underdosing and overdosing of these medications. Therefore, it is vital to take the time to make sure parents understand the correct dosing of medications you recommend, even those that are over-the-counter.

4. “He’s only 3 and can barely talk. I thought he was just scared; how was I supposed to know he was in pain?”
   The gold standard and most desirable method for pain assessment is based upon self-report of pain by the patient. Nonetheless, all children should have pain measured, and pain scales have also been validated and developed to assist with pain measurement in preverbal children. The FLACC (see page 5) is used to assess preverbal children or children unable to communicate pain. The Wong-Baker FACES® Pain Rating Scale and the Oucher™ pain scale (see page 4) are 2 examples of validated pain assessment scales that exist for children as young as 3 years of age; both scales allow a child to point at a face representing his or her level of pain.

5. “I placed my dialysis patient on every-4-hour dosing of morphine, and now he is somnolent and hypoventilating.”
   One of the molecules morphine is metabolized into is morphine-6-glucuronide, which is an active metabolite. Typically, it is renally excreted, so patients in renal failure may build up toxic levels of this metabolite. It is important to renally dose morphine in patients with significant renal failure.
6. “No one told me the patient I placed on ketorolac has a history of a gastrointestinal bleed.”
   Although NSAIDs are frequently employed in pediatric patients, they are not without potential side effects. Additionally, as the efficacy of an NSAID increases, so too does its propensity to cause side effects. Make sure to take a thorough medical history before deciding what medication to administer to a patient.

7. “That vomiting, dehydrated patient is still febrile; let’s repeat the dosing of rectal acetaminophen.”
   Acetaminophen has a highly variable bioavailability when administered rectally. Additionally, patients in catabolism may be deficient in glutathione, an antioxidant critical in preventing acetaminophen toxicity. Caution should be used to make sure rectal acetaminophen is dosed properly in these patients.

8. “Why should we sedate the patient? A dose of ‘brutane’ will be sufficient for the procedure.”
   Due both to their size and their developmental limitations, children have limited ability to express pain and advocate for themselves. Although it may be physically possible to perform a painful procedure without analgesia or sedation, this pattern of practice can harm them both immediately and into the future. For this reason, it is imperative that emergency clinicians be thoughtful in choosing how to minimize pain during pediatric procedures.

9. “That kid is faking it. I had a patient with the same problem last week, and she didn’t complain nearly as much!”
   Pain is a multifactorial process. It is influenced not only by the stimulus that is causing the pain but also by the patient’s age, temperament, past experiences, and understanding. All of these factors may lead to real, physiologic amplification of a given painful stimulus. It is important to recognize these differences and not minimize patients’ self-report of pain.

10. “Even though I saw the obvious extremity fracture, I thought I should get x-rays and see the extent of the fracture before I gave her pain medication or placed a nerve block.”
    Children with pain associated with suspected injuries and/or fractures should be given pain medication prior to imaging. Also, placing a peripheral nerve block can improve pain associated with obtaining radiographs and splinting.

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**Risk Management Pitfalls For Pediatric Pain Management**

(continued from page 12)

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    Children with pain associated with suspected injuries and/or fractures should be given pain medication prior to imaging. Also, placing a peripheral nerve block can improve pain associated with obtaining radiographs and splinting.
Commission. Techniques have been developed to quantify pain in all age groups and developmental levels. Nonpharmacologic methods have been refined and studied to reduce patients’ pain and anxiety in a safe and effective way. The development of newer agents, a greater understanding of older medications, improved experience and use of procedural sedation, and newer treatment modalities such as ultrasound-guided regional anesthesia have all expanded the armamentarium and approach of emergency clinicians in treating pain in the pediatric population. By being both mindful of the need to treat pain and thoughtful in developing strategies to do so, we may move closer to the goal of the “ouchless ED” for pediatric patients.

Case Conclusions

For the 8-year-old boy in whom IV access could not be obtained, you ordered a dose of intranasal fentanyl at 1.5 mcg/kg. You instructed the nurse to draw up the IV formulation of fentanyl in a syringe and then attached an atomizer to the syringe. The nurse then administered half the dose into each of the patient’s nostrils. When you reevaluated the patient 5 minutes later, his pain was significantly improved to 3/10. Eventually, the team was able to place an IV, and the patient’s fracture was successfully reduced while the patient was sedated with ketamine. The boy was discharged to home, and dosing instructions were given to his parents for ibuprofen as needed for pain, along with a prescription for oxycodone for breakthrough pain.

For the 7-year-old boy with right lower quadrant pain, you decided that, since there is no evidence that giving analgesia for pain secondary to an acute abdomen alters either diagnostic confidence or patient outcomes, you could give your patient 0.1 mg/kg of IV morphine. You asked the nurse to give him lidocaine at the IV site via a needleless syringe prior to IV placement. The IV was placed, and within 5 minutes of morphine administration, his pain improved to 2/10. Later, the surgical team came to evaluate him, and the surgical attending agreed with your decision to treat your patient’s pain. The patient was eventually diagnosed with acute appendicitis and underwent a successful removal of a nonperforated appendix.

References

Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study, such as the type of study and the number of patients in the study will be included in bold type following the references, where available.

9. Selbst S, Clark M. Analgesic use in the emergency depart-


punctures: a help not a hindrance. Arch Pediatr Adolesc Med. 1996;150:1044-1046. (Randomized controlled trial; 200 subjects)


### CME Questions

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1. Which of the following pain scales should be used to assess pain in a preverbal 2-year-old child?
   - a. Wong-Baker FACES® Pain Rating Scale
   - b. Oucher™ Pain Scale
   - c. FLACC Scale
   - d. Visual analog scale

2. The most important factor in accurate pain assessment of a verbal child is:
   - a. Choosing the best pain scale tool
   - b. Reassessing the change in score during treatment
   - c. Parent reports
   - d. Nurse reports

3. A potential complication of the use of EMLA® in infants is which of the following?
   - a. Methemoglobinemia
   - b. Carboxyhemoglobinemia
   - c. Aspirin toxicity
   - d. Lidocaine toxicity
4. All of the following are side effects of lidocaine administration or overdose EXCEPT:
   a. A burning sensation at the site of injection
   b. Seizures
   c. Dysrhythmias
   d. Hypoxia

5. In which of the following patients should ketorolac be avoided?
   a. 4-year-old male with severe asthma
   b. 6-year-old male posttonsillectomy
   c. 8-year-old male with gastric ulcers
   d. 10-year-old male with idiopathic hypertension

6. Which of the following analgesics is most appropriate for patients with liver or renal dysfunction?
   a. Morphine
   b. Hydrocodone
   c. Hydromorphone
   d. Ketorolac

7. Which of the following medications has been shown to be safe and efficacious in children when given intranasally?
   a. Morphine
   b. Ibuprofen
   c. Hydromorphone
   d. Fentanyl

8. Which of the following analgesics has the greatest potential for adverse effects, due to common mutations in metabolic enzymes?
   a. Ibuprofen
   b. Codeine
   c. Oxycodone
   d. Morphine

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