Pain Assessment and Management

Learning Objectives
On completion of this chapter the reader will be able to:
• Identify measures to assess pain in children.
• List various types of pain assessment tools for use with children.
• Outline essential pain management strategies to reduce pain in children.
• Review common types of pain experienced by children.
• Discuss evidence to support specific pain management strategies.

Pain Assessment

Although the ability to measure pain in children has improved dramatically in recent years, assessment of pain in children continues to be complex and challenging. Children’s ability to describe pain changes as they grow older and as they cognitively and linguistically mature (Box 35-1). Three types of measures—behavioral, physiologic, and self-report—have been developed to measure children’s pain, and their applicability depends on the child’s cognitive and linguistic ability.

Behavioral Measures

Distress behaviors, such as vocalization, facial expression, and body movement, have been associated with pain (Figs. 35-1 and 35-2). These behaviors are helpful in evaluating pain in infants and children with limited communication skills. However, discriminating between pain behaviors and reactions from other sources of distress, such as hunger, anxiety, or other types of discomfort, is not always easy. These factors decrease the specificity and sensitivity of behavioral measures (Table 35-1).

Behavioral assessment is useful for measuring pain in infants and preverbal children who do not have the language skills to communicate that they are in pain, or in children with mental clouding and confusion that limit their ability to communicate meaningfully (McGrath, 1998). Behavior provides important information that cannot be obtained from self-report. Behavioral assessment may provide a more complete picture of the total pain experience when administered in conjunction with a subjective self-report measure. However, behavioral pain scales may be more time-consuming than self-reports. These measures depend on a trained observer to watch and record children’s behaviors such as vocalization, facial expression, and body movements that suggest discomfort.

Behavioral measures are most reliable when measuring short, sharp procedural pain, such as during injections or lumbar punctures. They are less reliable when measuring longer-lasting pain. In older children pain scores on behavioral measures do not always correlate with the children’s own reports of pain intensity.

The four most commonly used behavioral pain measures are the FLACC, CHEOPS, TPPPS, and PPPRS. The FLACC Pain Assessment Tool is an interval scale that includes five categories of behavior: Facial expression, Leg movement, Activity, Cry, and Consolability (Manworren & Hynan, 2003) (Table 35-2). It measures pain by quantifying pain behaviors with scores ranging from 0 (no pain behaviors) to 10 (most possible pain behaviors). The FLACC observational pain tool has been revised and validated to include behaviors specific to those with cognitive impairment (Malviya et al, 2006).

Physiologic Measures

Physiologic measures are not able to distinguish between physical responses to pain and other forms of stress to the body (Sweet & McGrath, 1998). Profound physiologic changes often accompany the experience of pain. Physiologic parameters such as heart rate, respiratory rate, blood pressure, palmar sweating, cortisone levels, transcutaneous oxygen, vagal tone, and endorphin concentrations reflect a generalized and complex response to stress. They are not localized response to pain, but they provide useful information about general distress levels of children experiencing pain. Like
BOX 35-1 Developmental Characteristics of Children’s Responses to Pain

**Young Infant**
- Generalized body response of rigidity or thrashing, possibly with local reflex withdrawal of stimulated area
- Loud crying
- Facial expression of pain (brows lowered and drawn together, eyes tightly closed, mouth open and squarish)
- No association demonstrated between approaching stimulus and subsequent pain

**Older Infant**
-Localized body response with deliberate withdrawal of stimulated area
- Loud crying
- Facial expression of pain or anger
- Physical resistance, especially pushing the stimulus away after it is applied

**Young Child**
- Loud crying, screaming
- Verbal expressions such as “Ow,” “Ouch,” “It hurts”
- Thrashing of arms and legs
- Attempts to push stimulus away before it is applied
- Lack of cooperation; need for physical restraint
- Requests for termination of procedure
- Clinging to parent, nurse, or other significant person
- Requests for emotional support, such as hugs or other forms of physical comfort
- Becoming restless and irritable with continuing pain
- Behaviors occurring in anticipation of actual painful procedure

**School-Age Child**
- May see all behaviors of young child, especially during actual painful procedure, but less in anticipatory period
- Stalling behavior, such as “Wait a minute” or “I’m not ready”
- Muscular rigidity, such as clenched fists, white knuckles, gritted teeth, contracted limbs, body stiffness, closed eyes, wrinkled forehead

**Adolescent**
- Less vocal protest
- Less motor activity
- More verbal expressions, such as “It hurts” or “You’re hurting me”
- Increased muscle tension and body control


behavioral scales, physiologic measures may be useful for infants and children who are not able to communicate verbally. The physiologic parameters provide indirect estimates of pain, and the presence and strength of pain can only be inferred from the changes in these parameters. Most of the studies on the physiologic parameters involved predominantly infants.

**Self-Report Measures**

Although children who are 4 or 5 years old are able to use self-report measures (Table 35-3), their ability to use them may be influenced by the cognitive characteristics of the preoperational stage (Stanford, Chambers, & Craig, 2006). The child’s thinking tends to be egocentric, concrete, and perceptually dominated. Simple, concrete anchor words, such as “no hurt” to “biggest hurt,” are more appropriate than “least pain sensation to worst intense pain imaginable.”

The ability to discriminate degrees of pain in facial expressions appears to be reasonably established by 3 years of age (Stanford, Chambers, & Craig, 2006). Faces pain scales that were developed for young children may be a measure of pain intensity, pain affect, or both, particularly when the faces are anchored by a smiling face on one end and a face with tears on the other end (Chambers et al, 1999; Chambers et al, 2005). Although clinicians may think that the smiling face anchor confounds the emotion of “feeling happy” with being “pain free,” there is no evidence to support this notion. Researchers looked at the effects of the smiling face (e.g., the Wong-Baker [WB] FACES Pain Scale) vs. those of the neutral anchor faces (e.g., Bieri Faces Pain Scale–Revised) on measurement of pain. Chambers and colleagues (2005) demonstrated a high correlation between the two forms of faces scales, with $r = 0.91$
Table 35-1  Selected Behavioral Pain Assessment Scales for Infants and Young Children

<table>
<thead>
<tr>
<th>AGES OF USE</th>
<th>INSTRUMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 mo-18 yr</td>
<td>Objective Pain Score (OPS) (Hannallah et al, 1987)</td>
</tr>
<tr>
<td>1-5 yr</td>
<td>Children’s Hospital of Eastern Ontario Pain Scale (CHEOPS) (McGrath et al, 1985)</td>
</tr>
<tr>
<td>Newborn-16 yr</td>
<td>Nurses Assessment of Pain Inventory (NAPI) (Stevens, 1990)</td>
</tr>
<tr>
<td>3-36 mo</td>
<td>Behavioral Pain Score (BPS) (Robieux et al, 1991)</td>
</tr>
<tr>
<td>4-6 mo</td>
<td>Modified Behavioral Pain Scale (MBPS) (Taddio et al, 1995)</td>
</tr>
<tr>
<td>&lt;36 mo and children with cerebral palsy</td>
<td>Riley Infant Pain Scale (RIPS) (Schade et al, 1996)</td>
</tr>
<tr>
<td>2 mo-7 yr</td>
<td>FLACC Postoperative Pain Tool (Merkel et al, 1997)</td>
</tr>
<tr>
<td>1-7 mo</td>
<td>Postoperative Pain Score (POPS) (Barrier et al, 1987)</td>
</tr>
<tr>
<td>Average gestational age 33.5 wk</td>
<td>Neonatal Infant Pain Scale (NIPS) (Lawrence et al, 1993)</td>
</tr>
<tr>
<td>27 wk gestational age to full term</td>
<td>Neonatal Infant Pain Scale (NIPS) (Lawrence et al, 1993)</td>
</tr>
<tr>
<td>1-36 mo</td>
<td>Pain Rating Scale (PRS) (Joyce et al, 1994)</td>
</tr>
<tr>
<td>32-60 wk gestational age</td>
<td>CRIES (Krechel &amp; Bildner, 1995)</td>
</tr>
<tr>
<td>28-40 wk gestational age</td>
<td>Premature Infant Pain Profile (PIPP) (Stevens et al, 1996)</td>
</tr>
<tr>
<td>0-28 days</td>
<td>Scale for Use in Newborns (SUN) (Blauer &amp; Gerstmann, 1998)</td>
</tr>
<tr>
<td>Birth (23 wk gestational age) and full-term newborns up to 100 days</td>
<td>Neonatal Pain, Agitation, and Sedation Scale (NPASS) (Puchalski &amp; Hummel, 2002)</td>
</tr>
</tbody>
</table>

Table 35-2  FLACC Scale

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0: No particular expression or smile</td>
<td>1: Occasional grimace or frown, withdrawn, disinterested</td>
</tr>
<tr>
<td>Face</td>
<td></td>
<td>2: Experienced, content, relaxed</td>
<td>3: Kicking, or legs drawn up</td>
</tr>
<tr>
<td>Legs</td>
<td></td>
<td>0: Normal position or relaxed</td>
<td>1: Uneasy, restless, tense</td>
</tr>
<tr>
<td>Activity</td>
<td></td>
<td>3: Arching, rigid, or jerking</td>
<td>4: Arched, rigid, or jerking</td>
</tr>
<tr>
<td>Cry</td>
<td></td>
<td>0: No cry (awake or asleep)</td>
<td>1: Moans or whimper, occasional complaint</td>
</tr>
<tr>
<td>Consolability</td>
<td></td>
<td>2: Reassured by occasional touching, hugging, or talking to; distractible</td>
<td>3: Difficult to console or comfort</td>
</tr>
</tbody>
</table>


between the Bieri Faces (neutral anchor) and WB-FACES Pain Scale (smiling anchor). These data suggest that children are able to use either scale for communicating the amount of pain they experience.

Multidimensional Measures
Several cognitive skills, such as measurement, classification, and seriation (the ability to accurately place in ascending or descending order), become explicit between approximately 7 and 10 years of age. Older children are able to use the 0 to 10 numeric rating scale that is currently used by adolescents and adults. However, use of this scale is only an assessment of pain intensity, which may not change in some pain states (Jacob et al, 2003a). Other dimensions such as pain quality, pain location, and spatial distribution of pain may change without a change in pain intensity.

Two multidimensional assessment tools that have been well validated in children 8 years and older assess not only pain intensity, but also pain location and pain quality. Modeled after the McGill Pain Questionnaire (Melzack, 1975), the Adolescent Pediatric Pain Tool (APPT) is a multidimensional pain instrument for children and adolescents that is used to assess three dimensions of pain: location, intensity, and quality. The Pediatric Pain Questionnaire (PPQ) is a multidimensional pain instrument to assess patient and parental perceptions of the pain experience in a manner appropriate for the cognitive-developmental level of children and adolescents. The PPQ represents an attempt to assess the complexities of pediatric chronic, recurrent pain and targeted chronic musculoskeletal pain in children with juvenile rheumatoid arthritis. It consists of eight questions: (1) the pain history, (2) pain language, (3) the colors children associate with pain, (4) the emotions they experience, (5) their worst pain experiences, (6) the ways they cope with pain, (7) the positive aspects of pain, and (8) the location of their current pain.
Table 35-3 Pain Rating Scales for Children

<table>
<thead>
<tr>
<th>PAIN SCALE, DESCRIPTION</th>
<th>RECOMMENDED AGE, COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACES Pain Rating Scale (Wong &amp; Baker, 1988)</td>
<td>Children as young as 3 yr. Using original instructions without affect words, such as happy or sad, or brief words resulted in same range of pain rating, probably reflecting child’s rating of pain intensity. For coding purposes, numbers 0, 2, 4, 6, 8, 10 can be substituted for 0-5 system to accommodate 0-10 system. Provides three scales in one: facial expressions, numbers, and words. Research supports cultural sensitivity of FACES for Caucasian, African-American, Hispanic, Thai, Chinese, and Japanese children.</td>
</tr>
<tr>
<td><strong>PAIN SCALE</strong></td>
<td><strong>DESCRIPTION</strong></td>
</tr>
<tr>
<td>Faces</td>
<td>Smiling face for “no pain” to tearful face for “worst pain”</td>
</tr>
<tr>
<td>0</td>
<td>No hurt</td>
</tr>
<tr>
<td>1 or 2</td>
<td>Hurts little bit</td>
</tr>
<tr>
<td>2 or 4</td>
<td>Hurts little more</td>
</tr>
<tr>
<td>3 or 6</td>
<td>Hurts even more</td>
</tr>
<tr>
<td>4 or 8</td>
<td>Hurts whole lot</td>
</tr>
<tr>
<td>5 or 10</td>
<td>Hurts worst</td>
</tr>
<tr>
<td>Oucher (Beyer, Denyes, &amp; Villarruel, 1992)</td>
<td>Children 3-13 yr. Use numeric scale if child can count to 100 by ones and identify the larger of any two numbers, or by tens (Jordan-Marsh et al, 1994). Determine whether child has cognitive ability to use photographic scale; child should be able to rate six geometric shapes from largest to smallest. Determine which ethnic version of Oucher to use. Allow child to select version of Oucher, or use version that most closely matches child’s physical characteristics. Note: Child may not prefer ethnically similar scale when given choice of ethnically neutral cartoon scale (Luffy &amp; Grove, 2003).</td>
</tr>
<tr>
<td><strong>Oucher</strong></td>
<td>Uses six photographs of Caucasian child’s face representing “no hurt” to “biggest hurt you could ever have”; also includes vertical scale with numbers from 0-100; scales for African-American and Hispanic children have been developed (Villarruel &amp; Denyes, 1991)</td>
</tr>
<tr>
<td>Poker Chip Tool (Hester et al, 1998)</td>
<td>Children as young as 4 yr. Determine whether child has cognitive ability to use numbers by identifying larger of any two numbers.</td>
</tr>
<tr>
<td><strong>Poker Chip Tool</strong></td>
<td>Uses four red poker chips placed horizontally in front of child to denote varying intensities of pain</td>
</tr>
<tr>
<td>Word-Graphic Rating Scale (Tesler et al, 1991)</td>
<td>Children 4-17 yr.</td>
</tr>
<tr>
<td><strong>Word-Graphic Rating Scale</strong></td>
<td>Uses descriptive words (may vary in other scales) to denote varying intensities of pain</td>
</tr>
<tr>
<td>Numeric Scale</td>
<td>Uses straight line with end points identified as “no pain” and “worst pain” and sometimes “medium pain” in the middle; divisions along line marked in units from 0-10 (high number may vary)</td>
</tr>
<tr>
<td><strong>Numeric Scale</strong></td>
<td>Children as young as 5 yr, as long as they can count and have some concept of numbers and their values in relation to other numbers. Scale may be used horizontally or vertically. Number coding should be same as in other scales used in facility.</td>
</tr>
</tbody>
</table>
Table 35-3  Pain Rating Scales for Children—cont’d

<table>
<thead>
<tr>
<th>PAIN SCALE, DESCRIPTION</th>
<th>RECOMMENDED AGE, COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Analog Scale (VAS) (Cline et al, 1992)</td>
<td>Children as young as 4 ½ yr, preferably 7 yr. Vertical or horizontal scale may be used. Research shows that children ages 3-18 yr prefer VAS less than other scales (Luffy &amp; Grove, 2003; Wong &amp; Baker, 1988).</td>
</tr>
<tr>
<td><strong>No pain</strong></td>
<td><strong>Worst pain</strong></td>
</tr>
<tr>
<td>Color Tool (Eland &amp; Banner, 1999)</td>
<td>Children as young as 4 yr, provided they know their colors, are not color blind, and are able to construct the scale if in pain.</td>
</tr>
</tbody>
</table>

**Box 35-2 Manifestations of Acute Pain in the Neonate**

**Physiologic Responses**
- **Vital signs**—Observe for variations.
  - Increased heart rate
  - Increased blood pressure
  - Rapid, shallow respirations
- **Oxygenation**
  - Decreased transcutaneous oxygen saturation (tcPO₂)
  - Decreased arterial oxygen saturation (SaO₂)
- **Skin**—Observe color and character.
  - Pallor or flushing
  - Diaphoresis
  - Palmar sweating
- **Laboratory evidence of metabolic or endocrine changes**
  - Hyperglycemia
  - Lowered pH
  - Elevated corticosteroids
- **Other observations**
  - Increased muscle tone
  - Dilated pupils
  - Decreased vagal nerve tone
  - Increased intracranial pressure

**Behavioral Responses**
- **Vocalizations**—Observe quality, timing, and duration.
- **Facial expression**—Observe characteristics, timing, orientation of eyes and mouth.
  - Grimaces
  - Brow furrowed
  - Chin quivering
  - Eyes tightly closed
  - Mouth open and squarish
- **Body movements and posture**—Observe type, quality, and amount of movement or lack of movement; relationship to other factors.
  - Limb withdrawal
  - Thrashing
  - Rigidity
  - Flaccidity
  - Fist clenching
- **Changes in state**—Observe sleep, appetite, activity level.
  - Changes in sleep-wake cycles
  - Changes in feeding behavior
  - Changes in activity level
  - Fussiness, irritability
  - Listlessness

**Pain Assessment in Specific Populations**

**Pain in Neonates**
Assessment of pain is difficult in the preverbal child, especially the neonate, since the most reliable indicator of pain, self-report, is not possible. Evaluation must be based on physiologic changes and behavioral observations (Box 35-2). Although behaviors such as vocalizations, facial expressions, and body movements are common to all infants, they vary with different situations. Crying associated with pain is more intense and sustained (see Fig. 35-1). Facial expression is the most consistent and specific characteristic; scales are available to systematically evaluate facial features, such as eye squeeze, brow bulge, open mouth, and taut tongue (Hadjistavropoulos et al, 1997). Most infants respond with increased body movements, but the infant may be experiencing pain even when lying quietly with eyes closed. The preterm infant’s response to pain may be behaviorally blunted or absent; however, there is ample evidence that such infants are neurologically capable of feeling pain. In addition, infants in awake or alert states demonstrate a more robust reaction to painful stimuli than infants in sleep states. Also, an infant receiving a muscle-paralyzing agent such as vecuronium will be incapable of a behavioral or visible pain response.

Although regular use of pain assessment tools can assist caregivers in determining whether the infant is in pain, caregivers must consider the infant’s maturity, behavioral state,
energy resources available to respond, and risk factors for pain. In infants with diminished ability to respond robustly to pain, it is imperative to presume that pain exists in all situations that are usually considered painful for adults and children, even in the absence of behavioral or physiologic signs (Sweet & McGrath, 1998).

Several pain assessment tools have been developed for the assessment of pain in the neonate. One pain assessment tool used by nurses who work with preterm and full-term infants in the neonatal intensive care setting is called CRIES, which is an acronym for the tool’s physiologic and behavioral indicators of pain: Crying, Requires increased oxygen, Increased vital signs, Expression, and Sleeplessness (Table 35-4). Each indicator is scored from 0 to 2—similar to the Apgar score for neonates. The total possible pain score, representing the worst pain, is 10. A pain score greater than 4 should be considered significant. This tool has been tested for reliability and validity for postoperative pain in infants between the ages of 32 weeks of gestation up to 20 weeks postterm (60 weeks) (Sweet & McGrath, 1998).

The Premature Infant Pain Profile (PIPP) is unique because it has been developed specifically for preterm infants (Sweet & McGrath, 1998). The category “gestational age at time of observation” gives a higher pain score to infants with lower gestational age. Infants who are asleep 15 seconds before the painful procedure also receive additional points for their blunted behavioral responses to painful stimuli.

### Children with Communication and Cognitive Impairment

The assessment of pain in children with communication and cognitive impairment can be challenging. Children who have significant difficulties communicating with others about their pain include those with significant neurologic impairments (e.g., cerebral palsy), cognitive impairment, metabolic disorders, autism, severe brain injury, and communication barriers (e.g., critically ill children who are on ventilators or heavily sedated or have neuromuscular disorders, loss of hearing, or loss of vision). These children are at greater risk than other children for undertreatment of pain because they have medical problems that may cause pain and they undergo painful procedures. Their behaviors include moaning, inconsistent patterns of play and sleep, changes in facial expression, and other physical problems that may mask expression of pain and be difficult to interpret (Hadden & von Baeyer, 2002). These children may experience spasticity, contractures, and orthopedic surgical treatment that may be painful.

The mother or primary caregiver is an important source of information during assessment (Breau et al, 2003). Up to 60% of parents of children with severe cognitive impairment reported that their child experienced pain or severe discomfort that was not being effectively managed (Lenton et al; 2001; Stallard et al, 2002a). The most frequently reported pain behaviors are crying; being less active; seeking comfort; moaning; not cooperating; being irritable; being stiff, spastic, tense, or rigid; sleeping less; being difficult to satisfy or pacify; flinching or moving body part away; and being agitated or fidgety (Hadden & von Baeyer, 2002). Parents also reported pain during some daily living activities such as assisted stretching and walking; independent standing; toileting; putting on splints; and doing occupational therapy, range-of-motion exercises, or physical therapy.

The Non-communicating Children’s Pain Checklist is a pain measurement tool specifically designed for children with cognitive impairments (Breau et al, 2002). The scale discriminates between periods of pain and calm and can predict behavior during subsequent episodes of pain. The scale consists of six subscales (vocal, social, facial, activity, body and limbs, physiologic), which are scored based on the number of times the items are observed over a 10-minute period (0 = not at all; 1 = just a little; 2 = fairly often; 3 = very often).

Another tool, the Pain Indicator for Communicatively Impaired Children (PICIC), distinguishes between pain and nonpain in communicatively impaired children with life-threatening illness (Stallard et al, 2002a, 2002b). The PICIC has six core pain cues: (1) crying with or without tears; (2) screaming, yelling, groaning, or moaning; (3) screwed up or distressed looking face; (4) body appearing stiff or tense; (5) difficulty in comforting or consoling; and (6) flinching or moving away if touched. The items are rated using a 4-point Likert scale (1 = not at all, 2 = a little, 3 = often, 4 = all the time).

### Cultural Issues in Pain Assessment

A major challenge in the assessment and management of pain in children is the cultural appropriateness of pain assessment tools that have been validated only in Caucasian and English-speaking children. Observational scales and interview questionnaires for pain may not be as reliable for pain assessment as self-report scales in Hispanic children. In Chinese children...
who learned to read Chinese characters vertically downward and from right to left, the use of vertically oriented visual analog scales resulted in less error than horizontally oriented scales. Cultural background may therefore influence the reliability of pain assessment tools developed in a single cultural context (Bernstein & Pachter, 2003). The Oucher Pain Scale (see Table 35-3), originally developed and validated as a self-report of pain intensity for Caucasian children 3 to 12 years old, now features culturally specific photographs of children who better represent the physical characteristics of African-American and Hispanic children (Beyer & Knott, 1998). The Oucher Pain Scale consists of six photographs on the right side and a 0 to 100 scale marked off in tens on the left side. The photographs show the face of one child with the pictures arranged to show increasing levels of discomfort. Each version has been tested primarily with children in the ethnic group (Caucasian, African-American, Hispanic) depicted in the photographs. Children ages 3 to 12 years old use the Oucher by selecting a photograph or number that most closely represents the level of pain intensity they are experiencing (Beyer & Knott, 1998). This tool is designed to promote cultural sensitivity during pain assessment for minority or non-Caucasian children.

**Children with Chronic Illness and Complex Pain**

Questionnaires and pain assessment scales do not always provide the most meaningful means of assessing pain in children, particularly for those with complex pain. Some children cannot relate to a face or a number that describes their pain and may not be able to isolate pain from other symptoms they are experiencing. Children with cancer experience multiple symptoms, making it difficult to isolate the pain symptom from other symptoms. Rating the pain does not always accurately convey to others how they really feel (Woodgate & Yanofsky, 2004). In children with chronic illness, particularly those with complex pain, the most important aspect of assessment is to develop a trusting relationship with the child and the family, so that a deeper understanding of the pain experience may be obtained. The pain experience may be complicated by pain processes that occur in the central nervous system (such as hyperalgesia, central sensitization, windup), by other symptoms (such as fatigue, nausea, vomiting, diarrhea, constipation) that accompany medical treatments, and by complications (such as infections, unexpected development of fistulas, pyphilitis) from disease or treatments (Turner, 2005). The pain experience may interfere with the child's ability to eat, sleep, and perform daily activities and routines (Miaskowski & Lee, 1999; Morin, Gibson, & Wade, 1998). Other important components of assessment include the onset of pain; pain duration or pattern; the effectiveness of the current treatment; factors that aggravate or relieve the pain; other symptoms and complications concurrently felt; and interference with the child's mood, function, and interactions with family (Turner, 2005). In addition to asking the child or parent when the pain started and how long the pain lasts, the nurse can assess variations and rhythms by asking if the pain is better or worse at certain times during the day or night. If the child has had pain for a while, the child or parent may know which medications and doses are helpful. They may also have found some nonpharmacologic methods that have helped. The nurse may ask the child or parent if there are activities, positions, and other events that may increase the pain. Pain may be accompanied by other symptoms such as nausea and poor appetite.

Other factors warranting careful assessment that may pose barriers to effective management include family issues and relationships, fears and concerns about addiction (see Family-Centered Care box), the clinician's and family's lack of knowledge about pain, inappropriate use of pain medications, ineffective management of adverse effects from medications, and the use of different pain interventions (Turner, 2005).

**Pain Management**

Unrelieved pain may lead to potential long-term physiologic, psychosocial, and behavioral consequences (Goldschneider & Anand, 2003; Weisman, Bernstein, & Schechter, 1998). Management of pain should be a priority for all clinicians.

**Nonpharmacologic Management**

Pain is often associated with fear, anxiety, and stress (Kain et al., 2006). A number of nonpharmacologic techniques (see Guidelines box), such as distraction, relaxation, guided imagery, and cutaneous stimulation, provide coping strategies that may help reduce pain perception, make pain more tolerable, decrease anxiety, and enhance the effectiveness of analgesics or reduce the dosage required (Rusy & Weisman, 2000). In addition, these techniques decrease the perceived threat of pain, provide a sense of control, enhance comfort, and promote rest and sleep (Greco & Berde, 2005). Although there is a paucity of research on the effectiveness of many of these interventions, the strategies are safe, noninvasive, and inexpensive, and most are independent nursing functions. Environmental and psychologic factors may exert a powerful influence on children's pain perceptions and may be modified by using psychosocial strategies, education, parental support, and cognitive-behavioral interventions. For children undergoing repeated painful procedures, cognitive-behavioral interventions are effective for decreasing anxiety and distress (McGrath & Hillier, 2003).

If the child cannot identify a familiar coping technique, the nurse can describe several strategies and let the child select the most appealing one. Experimentation with several strategies that are suitable to the child's age, pain intensity, and abilities is often necessary to determine the most effective approach. Parents should be involved in the selection process; they may be familiar with the child's usual coping skills and can help identify potentially successful strategies. Involving parents also encourages their participation in learning the skill with the child and acting as coach. If the parent cannot assist the child, other appropriate persons may include a grandparent, older sibling, nurse, or child life specialist (McGrath & Hillier, 2003). Children should learn to use a specific strategy before pain occurs or before it becomes severe. Children are responsive to pain-controlling strategies that involve their imaginations and
One of the reasons for the unfounded but prevalent fear of addiction from opioids used to relieve pain is a misunderstanding of the differences between physical dependence, tolerance, and addiction. Health care professionals and the community often confuse addiction with the physiologic effects of opioids, when in reality physical dependence, tolerance, and addiction are unrelated. The American Society of Addiction Medicine defines these terms as follows:

**Physical dependence** on an opioid is a physiologic state in which abrupt cessation of the opioid, or administration of an opioid antagonist, results in withdrawal syndrome. Physical dependence on opioids is an expected occurrence in all individuals who continuously use opioids for therapeutic or nontherapeutic purposes. It does not, and of itself, imply addiction.

**Tolerance** is a form of neuroadaptation to the effects of chronically administered opioids (or other medications) that is indicated by the need for increasing or more frequent doses of the medication to achieve the initial effects of the drug. A person may develop tolerance both to the analgesic effects of opioids and to some of the unwanted side effects, such as respiratory depression, sedation, or nausea. Tolerance is variable in occurrence, but it does not, in and of itself, imply addiction.

**Addiction** in the context of pain treatment with opioids is characterized by a persistent pattern of dysfunctional opioid use that may involve any or all of the following:

- Adverse consequences associated with the use of opioids
- Loss of control over the use of opioids
- Preoccupation with obtaining opioids, despite the presence of adequate analgesia

Unfortunately, individuals who have severe, unrelieved pain may become intensely focused on finding relief. Sometimes behaviors such as “clock watching” make patients appear to others to be preoccupied with obtaining opioids. However, this preoccupation centers on finding relief of pain, not on using opioids for reasons other than pain control. This phenomenon has been termed *pseudoaddiction* and must not be confused with real addiction.

Nurses must educate older children, parents, and health professionals about the extremely low risk of real addiction (less than 1%) from the use of opioids to treat pain. Infants, young children, and comatose or terminally ill children simply cannot become addicted because they are incapable of a consistent pattern of drug-seeking behavior, such as stealing, drug dealing, prostitution, or use of family income, to obtain opioids for nonanalgesic reasons.

Several studies have documented the effectiveness of nonpharmacologic analgesia, such as containment, positioning, nonnutritive sucking (Fig. 35-3), and kangaroo holding during painful procedures in neonates. *Containment* is achieved through positioning and blanket rolls (Cole & Jorgensen, 1997). It provides a “nest” that enhances the infant’s feelings of security and decreases stress. Comforting measures and *swaddling* have been demonstrated to reduce crying and heart rate after procedures such as heel punctures and injections. In infants between 27 and 34 weeks of gestational age, those infants who were swaddled after a routine heel stick procedure were able to calm crying immediately, decrease heart rate, and return to a sleep state; in comparison, infants who were not swaddled took a minimum of 10 minutes to return to baseline physiologic and behavioral levels (Fearon et al, 1997). Proper positioning with the infant held in a midline orientation, hand to mouth activity, and proper flexion can promote self-soothing behaviors. *Facilitated tucking*, which is holding the infant’s extremities flexed and contained close to the trunk, during heel lance procedures has been demonstrated to decrease heart rate, decrease crying time, and promote stability in the sleep-wake cycles after the lance.

*Nonnutritive sucking* (pacifier) attenuates behavioral, physiologic, and hormonal responses to pain from procedures, such as heel punctures, venipuncture, and immunization injections. The administration of concentrated sucrose with or without nonnutritive sucking has been demonstrated to have calming and pain-relieving effects for invasive procedures in

**Virtual reality** has been identified as a potentially effective tool for pain distraction (Gold et al, 2006). The participant’s attention is drawn away from the “real world” and into the “virtual world” with the incorporation of visual, auditory, and tactile stimuli.

Fig. 35-3 Sucking following oral sucrose can enhance analgesia before a heel stick in a preterm infant.
**GUIDELINES**  Nonpharmacologic Strategies for Pain Management

### General Strategies
- Use nonpharmacologic interventions to supplement, not replace, pharmacologic interventions, and use for mild pain and pain that is reasonably well controlled with analgesics.
- Form a trusting relationship with child and family.
- Express concern regarding their reports of pain and intervene appropriately.
- Take an active role in seeking effective pain management strategies.
- Use general guidelines to prepare child for procedure.
- Prepare child before potentially painful procedures, but avoid “planting” the idea of pain.
  - For example, instead of saying, “This is going to (or may) hurt,” say, “Sometimes this feels like pushing, sticking, or pinching, and sometimes it doesn’t bother people. Tell me what it feels like to you.”
  - Use “nonpain” descriptors when possible (e.g., “It feels like heat” rather than “It’s a burning pain”). This allows for variation in sensory perception, avoids suggesting pain, and gives the child control in describing reactions.
  - Avoid evaluative statements or descriptions (e.g., “This is a terrible procedure” or “It really will hurt a lot!”).
- Stay with child during a painful procedure.
  - Allow parents to stay with child if child and parent desire; encourage parent to talk softly to child and to remain near child’s head.
  - Involve parents in learning specific nonpharmacologic strategies and in assisting child with their use.
- Educate child about the pain, especially when explanation may lessen anxiety (e.g., that pain may occur after surgery and does not indicate something is wrong); reassure the child that he or she is not responsible for the pain.
- For long-term pain control, give child a doll, which represents “the patient,” and allow child to do everything to the doll that is done to the child; pain control can be emphasized through the doll by stating, “Dolly feels better after the medicine.”
- Teach procedures to child and family for later use.

### Specific Strategies

#### Distraction
- Involve parent and child in identifying strong distracters.
- Involve child in play; use radio, tape recorder, CD player, or computer game; have child sing or use rhythmic breathing.
- Have child take a deep breath and “go limp as a rag doll” while exhaling slowly; then ask child to yawn (demonstrate if needed).
- Help child assume a comfortable position (e.g., pillow under neck and knees).
- Begin progressive relaxation: starting with the toes, systematically instruct child to let each body part “go limp” or “feel heavy”; if child has difficulty relaxing, instruct child to tense or tighten each body part and then relax it.
- Allow child to keep eyes open, since children may respond better if eyes are open rather than closed during relaxation.

#### Guided Imagery
- Have child identify some highly pleasurable real or imaginary experience.
- Have child describe details of the event, including as many senses as possible (e.g., “feel the cool breezes, “see the beautiful colors,” “hear the pleasant music”).
- Have child write down or tape record script.
- Encourage child to concentrate only on the pleasurable event during the painful time; enhance the image by recalling specific details through reading the script or playing the tape.
- Combine with relaxation and rhythmic breathing.

#### Positive Self-Talk
- Teach child positive statements to say when in pain (e.g., “I will be feeling better soon,” “When I go home, I will feel better, and we will eat ice cream”).

#### Thought Stopping
- Identify positive facts about the painful event (e.g., “It does not last long”).
- Identify reassuring information (e.g., “If I think about something else, it does not hurt as much”).
- Condense positive and reassuring facts into a set of brief statements and have child memorize them (e.g., “short procedure, good veins, little hurt, nice nurse, go home”).
- Have child repeat the memorized statements whenever thinking about or experiencing the painful event.

### Behavioral Contracting

#### Informal—May be used with children as young as 4 or 5 years of age:
- Use stars, tokens, or cartoon character stickers as rewards.
- Give a child who is uncooperative or procrastinating during a procedure a limited time (measured by a visible timer) to complete the procedure.
- Proceed as needed if child is unable to comply.
- Reinforce cooperation with a reward if the procedure is accomplished within specified time.

#### Formal—Use written contract, which includes:
- Realistic (seems possible) goal or desired behavior
- Measurable behavior (e.g., agreeing not to hit anyone during procedures)
- Date and signature of all persons involved in any of the agreements
- Identified rewards or consequences that are reinforcing
- Goals that can be evaluated
- Commitment and compromise requirements for both parties (e.g., while timer is used, nurse will not nag or prod child to complete procedure)
neonates. The amount of time crying was decreased with the oral administration of 2 ml of a 12% to 24% sucrose solution, 2 minutes before a heel lance or venipuncture (Stevens, Yamada, & Ohsisson, 2005).

**Kangaroo care** is skin-to-skin holding of infants dressed only in diapers against their mother’s or father’s chest (Gray, Watt, & Blass, 2000; Johnston et al, 2003). Infants who spent 1 to 3 hours in kangaroo care showed increased frequency in quiet sleep, longer duration of quiet sleep, and decreased crying in the neonatal intensive care unit. They also cried less at age 6 months when compared with neonates who did not receive skin-to-skin contact. Significant differences were found in pain responses during heel lancing between infants who were kangaroo held and those who were not. In the study by Gray, Watt, and Blass (2000), heart rate increased by 8 to 10 beats/min in the kangaroo care group vs. an increase by 36 to 38 beats/min in the control group of neonates who were swaddled in bassinets. Grimacing was 64% less, and crying was 82% less frequent.

In another study, infant responses to pain during heel lance procedures were compared using kangaroo holding (Fig. 35-4), with the neonate held upright at a 60-degree angle between the mother’s breasts for maximal skin-to-skin contact (Johnston et al, 2003). A blanket was placed over the neonate’s back, and the mother’s clothes were wrapped around the neonate for 30 minutes before the lancing procedure, during, and at least 30 minutes after the heel stick. Another group remained in the isolette in a prone position, swaddled with a blanket and the heel accessible, for 30 minutes before the heel lancing procedure. Pain scores were significantly lower in kangaroo-held infants.

**Complementary Pain Medicine**

Many terms are used to describe approaches to health care that are outside the realm of conventional medicine as practiced in the United States. Complementary and alternative medicine (CAM), as defined by the National Center for Complementary and Alternative Medicine, is a group of diverse medical and health care systems, practices, and products that are not currently considered part of conventional medicine (Myers et al, 2005). Although some scientific evidence exists regarding the efficacy of some CAM therapies, questions are yet to be answered through well-designed scientific studies, such as whether these therapies are safe and whether they work for the diseases or medical conditions for which they are used.

CAM therapies may be grouped into five classes:

1. **Biologically based**—Foods, special diets, herbal or plant preparations, vitamins, other supplements
2. **Manipulative treatments**—Chiropractic, osteopathy, massage
3. **Energy based**—Reiki, bioelectric or magnetic treatments, pulsed fields, alternating and direct currents
4. **Mind-body techniques**—Mental healing, expressive treatments, spiritual healing, hypnosis, relaxation
5. **Alternative medical systems**—Homeopathy; naturopathy; ayurvedic; and traditional Chinese medicine, including acupuncture and moxibustion

Current estimates of pediatric CAM use range from 10% to 15%, derived from children sampled at health care facilities, with chronic conditions, and/or from countries other than the United States. For the U.S. population, pediatric CAM use was estimated to be 31% to 84% (Myers et al, 2005; Rusy & Weisman, 2000). Those who used CAM were found in each age group, and the mean age was 10.3 years. The majority used unconventional therapy for chronic, as opposed to life-threatening, medical conditions. The therapies that are increasingly used include herbal medicine, massage, megavitamins, self-help groups, folk remedies, energy healing, and homeopathy (Myers et al, 2005; Rusy & Weisman, 2000).

**Pharmacologic Management**

**Nonopioids**, including acetaminophen (Tylenol, Paracetamol) and nonsteroidal antiinflammatory drugs (NSAIDs), are suitable for mild to moderate pain (Table 35-5); opioids are needed for moderate to severe pain (Table 35-6). A combination of the two analgesics acts on the pain system on two levels: nonopioids primarily act at the peripheral nervous system, and opioids primarily act at the central nervous system. The combination of NSAIDs and opioids provides increased analgesia without increased side effects. Several combinations, such as acetaminophen with codeine, may have increasing doses of the opioid but a constant dose of the nonopioid. Before increasing the opioid, it may be preferable to increase the nonopioid component, for example, by adding one regular-strength acetaminophen tablet (325 mg) to acetaminophen 300 mg with codeine 15 mg (Tylenol No. 2) before advancing to acetaminophen 300 mg with codeine 30 mg (Tylenol No. 3) or codeine 60 mg (Tylenol No. 4). However, if this approach is not successful, pain management will require a stronger opioid (see Table 35-6). Oxycodone is available without a nonopioid in an immediate release and con-
Nonsteroidal Antiinflammatory Drugs (NSAIDs) Approved for Children*

<table>
<thead>
<tr>
<th>DRUG</th>
<th>DOSAGE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaminophen (Tylenol)</td>
<td>10-15 mg/kg/dose q4-6hr not to exceed 5 doses</td>
<td>Available in numerous preparations</td>
</tr>
<tr>
<td></td>
<td>in 24 hr or 75 mg/kg/day, PO</td>
<td>Nonprescription</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Higher dosage range may provide increased analgesia</td>
</tr>
<tr>
<td>Choline magnesium trisalicylate (Trilisate)</td>
<td>Children &lt;37 kg (81.5 pounds)—50 mg/kg/day divided into 2 doses</td>
<td>Available in suspension, 500 mg/5 ml Prescription</td>
</tr>
<tr>
<td></td>
<td>Children &gt;37 kg (81.5 pounds)—2250 mg/day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>divided into 2 doses</td>
<td></td>
</tr>
<tr>
<td>Ibuprofen (children’s Motrin, children’s Advil)</td>
<td>Children &gt;6 mo—5–10 mg/kg/dose q6-8hr; maximum: 40 mg/kg/day</td>
<td>Available in numerous preparations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Available in suspension (100 mg/5 ml) and drops (100 mg/2.5 ml) Nonprescription</td>
</tr>
<tr>
<td>Naproxen (Naprosyn)</td>
<td>Children &gt;2 yr—10 mg/kg/day divided into 2 doses</td>
<td>Available in suspension (125 mg/5 ml) and several different dosages for tablets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nonprescription</td>
</tr>
<tr>
<td>Tolmetin (Tolectin)</td>
<td>Children &gt;2 yr—20 g/kg/day divided into 3-4 doses</td>
<td>Available in 200-mg, 400-mg, and 600-mg tablets Prescription</td>
</tr>
</tbody>
</table>

*All NSAIDs in this table (except acetaminophen) have significant antiinflammatory, antipyretic, and analgesic actions. Acetaminophen has a weak antiinflammatory action, and its classification as an NSAID is controversial. Patients respond differently to various NSAIDs; therefore changing from one drug to another may be necessary for maximum benefit.

Acetylsalicylic acid (aspirin) is also an NSAID but is not recommended for children because of its possible association with Reye’s syndrome. The NSAIDs in this table have no known association with Reye’s syndrome. However, caution should be exercised in prescribing any salicylate-containing drug (e.g., choline magnesium trisalicylate) for children with known or suspected viral infection.

Side effects of ibuprofen, naproxen, and tolmetin include nausea, vomiting, diarrhea, constipation, gastric ulceration, bleeding nephritis, and fluid retention.

Acetaminophen and choline magnesium trisalicylate are well tolerated in the gastrointestinal tract and do not interfere with platelet function. NSAIDs (except acetaminophen) should not be given to patients with allergic reactions to salicylates. All the NSAIDs should be used cautiously in patients with renal impairment.

The use of placebos to determine whether the patient is having pain is unjustified and unethical. A positive response to a placebo, such as a saline injection, is common in patients who have a documented organic basis for pain. Therefore the deceptive use of placebos does not provide useful information about the presence or severity of pain. The use of placebos can cause side effects similar to those of opioids, can destroy the patient’s trust in the health care staff, and raises serious ethical and legal questions. The American Society for Pain Management Nursing has issued a position statement against the use of placebos to treat pain (McCaffery & Pasero, 1999).

NURSING ALERT The optimum dosage of an analgesic is one that controls pain without causing severe side effects. This usually requires titration, the gradual adjustment of drug dosage (usually by increasing the dose) until optimum pain relief without excessive sedation is achieved. Dosage recommendations are only safe initial dosages (see Tables 35-5 and 35-6), not optimum dosages.

Children (except infants younger than about 3 to 6 months) metabolize drugs more rapidly than adults; younger children may require higher doses of opioids to achieve the same analgesic effect. Therefore the therapeutic effect and duration of analgesia vary. Children’s dosages are usually calculated according to body weight, except in children with a weight
Table 35-6 Dosage of Selected Opioids for Children

<table>
<thead>
<tr>
<th>DRUG</th>
<th>APPROPRIATE EQUIANALGESIC</th>
<th>APPROXIMATE EQUIANALGESIC PARENTERAL DOSE</th>
<th>Recommended Starting Dosage (Children &lt;50 kg [110 Pounds]) Body Weight)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphin (Sublimate) (oral mucosal form [Actiq])†</td>
<td>30 mg q3-4hr</td>
<td>10 mg q3-4hr</td>
<td>0.2-0.4 mg/kg q3-4hr 0.01-0.2 mg/kg IM q3-4hr 0.02-0.1 mg/kg IV bolus q2hr 0.015 mg/kg q8min PCA</td>
</tr>
<tr>
<td>Codeine‡</td>
<td>200 mg q3-4hr</td>
<td>130 mg q3-4hr</td>
<td>5-15 mg q3-4hr maximum dose: 400 mg 0.5-1.5 mg/kg IV bolus q30min 1-2 mg/hr IV infusion</td>
</tr>
<tr>
<td>Hydrocodone (Dilaudid)§</td>
<td>7.5 mg q3-4hr</td>
<td>1.5 mg q3-4hr</td>
<td>0.04-0.1 mg/kg q3-4hr 0.02-0.1 mg/kg q3-4hr 0.005-0.2 mg/kg IV bolus q2hr</td>
</tr>
<tr>
<td>Hydrocodone and acetaminophen (Lorcet, Lortab, Vicodin)</td>
<td>30 mg q3-4hr</td>
<td>Not available</td>
<td>0.2 mg/kg q3-4hr Not available</td>
</tr>
<tr>
<td>Levoorphanol (Levo-Dromoran)</td>
<td>4 mg q6-8hr</td>
<td>2 mg q6-8hr</td>
<td>0.04 mg/kg q6-8hr 0.02 mg/kg q4h-8hr</td>
</tr>
<tr>
<td>Methadone (Dolophine)</td>
<td>20 mg q6-8hr</td>
<td>10 mg q6-8hr</td>
<td>0.2 mg/kg q4h-8hr 0.1 mg/kg q6-8hr</td>
</tr>
<tr>
<td>Oxycodone (Roxicodone, OxyContin; also in Percocet, Percodon, Tylox)</td>
<td>20 mg q3-4hr</td>
<td>Not available</td>
<td>2 mg/kg q3-4hr Not available</td>
</tr>
</tbody>
</table>


IM, Intramuscular; IV, intravenous; PCA, patient-controlled analgesia; q, every.

Note: Published tables vary in suggested doses that are equianalgesic to morphine. Clinical response is criterion that must be applied for each patient; titration to clinical response is necessary. Because there is not complete cross-tolerance among these drugs, it is usually necessary to use a lower than equianalgesic dose when changing drugs and to retitrate to response.

Caution: Recommended dosages do not apply to patients with renal or hepatic insufficiency or other conditions affecting drug metabolism and kinetics.

*Caution: Dosages listed for patients with body weight <50 kg (110 pounds) cannot be used as initial starting doses in infants <6 mo of age. For nonventilated infants younger than 6 mo, the initial opioid dose should be about one fourth to one third of the dose recommended for older infants and children. For example, morphine could be used at a dose of 0.03 mg/kg instead of the traditional 0.1 mg/kg.

†Actiq is indicated only for management of breakthrough cancer pain in patients with malignancies who are already receiving and are tolerant to opioid therapy, but it can be used for preoperative or preprocedural sedation and analgesia.

‡Codeine doses above 65 mg often are not appropriate because of diminishing incremental analgesia with increasing doses along with continually increasing constipation and other side effects.

§For morphine, hydromorphone, and oxymorphone, rectal administration is an alternate route for patients unable to take oral medications, but equianalgesic doses may differ from oral and parenteral doses because of pharmacokinetic differences.

|| Caution: Doses of aspirin and acetaminophen in combination with opioid or nonsteroidal antiinflammatory drug preparations must also be adjusted to patient’s body weight. Daily dose of acetaminophen should not exceed 75 mg/kg or 4000 mg.

greater than 50 kg (110 pounds), where the weight formula may exceed the average adult dosage. In this case the adult dosage is used.

A reasonable starting dose of opioid for infants under 6 months who are not mechanically ventilated is one fourth to one third of the recommended starting dose for older children. The infant is monitored closely for signs of pain relief and respiratory depression. The dose is titrated to effect. Because tolerance can develop rapidly, large doses may be needed for continued severe pain (Greco & Berde, 2005). If pain relief is inadequate, the initial dose is increased (usually by 25% to 50% if pain is moderate, or by 50% to 100% if pain is severe) to provide greater analgesic effectiveness. Decreasing the interval between doses may also provide more continuous pain relief. A major difference between opioids and nonopioids is that nonopioids have a ceiling effect, which means that dosages higher than the recommended dosage will not produce greater pain relief. Opioids do not have a ceiling effect other than that imposed by side effects; therefore larger dosages can be safely given for increasing severity of pain.

Parenteral and oral dosages of opioids are not the same. Because of the first-pass effect, an oral opioid is rapidly absorbed from the gastrointestinal tract and is partially metabolized in the liver before reaching the central circulation. Therefore oral dosages must be larger to compensate for the partial loss of analgesic potency to achieve equianalgesia (equal analgesic effect). Conversion factors (Table 35-8) for selected opioids must be used when a change is made from IV (preferred) or IM to oral administration. Immediate conversion from IM or IV to the suggested equianalgesic oral dose may result in a substantial error. For example, the dose may be significantly more or less than what the child requires. Small changes ensure small errors. Several routes of analgesic administration can be used (Box 35-3); the most effective and least traumatic should be selected.
### Table 35-7  Coanalgesic Adjuvant Drugs

<table>
<thead>
<tr>
<th>DRUG</th>
<th>DOSAGE</th>
<th>INDICATIONS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antidepressants</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amitriptyline</td>
<td>0.2-0.5 mg/kg PO hs</td>
<td>Continuous neuropathic pain with burning, aching, dysesthesia with insomnia</td>
<td>Provides analgesia by blocking reuptake of serotonin and norepinephrine, possibly slowing transmission of pain signals</td>
</tr>
<tr>
<td></td>
<td>Titrate upward by 0.25 mg/kg q 5-7 days pm Available in 10- and 25-mg tablets Usual starting dose—10-25 mg</td>
<td></td>
<td>Helps with pain related to insomnia and depression (use nortriptyline if patient is oversedated) Analgesic effects seen earlier than antidepressant effects Side effects include dry mouth, constipation, urinary retention</td>
</tr>
<tr>
<td>Nortriptyline</td>
<td>0.2-1.0 mg/kg PO am or bid Titrate up by 0.5 mg q 5-7 days Maximum—25 mg/dose</td>
<td>Neuropathic pain as above without insomnia</td>
<td></td>
</tr>
<tr>
<td>Anticonvulsants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gabapentin</td>
<td>5 mg/kg PO hs Increase to bid on day 2, tid on day 3 Maximum—300 mg/day</td>
<td>Neuropathic pain</td>
<td>Mechanism of action unknown Side effects include sedation, ataxia, nystagmus, dizziness</td>
</tr>
<tr>
<td></td>
<td>&lt;6 years: 2.5-5 mg/kg PO bid initially Increase 20 mg/kg/24 hr, divide bid every week pm Maximum—100 mg bid</td>
<td>Sharp, lancinating neuropathic pain Peripheral neuropathies Phantom limb pain</td>
<td>Similar analgesic effect to amitriptyline Monitor blood levels for toxicity only Side effects include decreased blood counts, ataxia, gastrointestinal irritation</td>
</tr>
<tr>
<td>Carbamazepine</td>
<td>6-12 years: 5 mg/kg PO bid initially Increase 10 mg/kg/24 hr, divide bid every week pm to usual maximum—100 mg bid</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;12 years: 200 mg PO bid initially Increase 200 mg/24 hr, divide bid every week pm to maximum—1.6-2.4 g/24 hr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiolytics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lorazepam</td>
<td>0.03-0.1 mg/kg q 4-6 hr PO or IV Maximum—2 mg/dose</td>
<td>Muscle spasm</td>
<td>May increase sedation in combination with opioids Can cause depression with prolonged use</td>
</tr>
<tr>
<td>Diazepam</td>
<td>0.1-0.3 mg/kg q 4-6 hr PO or IV Maximum—10 mg/dose</td>
<td>Anxiety</td>
<td></td>
</tr>
<tr>
<td>Corticosteroids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>Dose dependent on clinical situation; higher bolus doses in cord compression, then lower daily dose Try to wean to NSAIDs if pain allows Cerebral edema—1–2 mg/kg load then 1–1.5 mg/kg/day divided q 6 hr Maximum—4 mg/dose</td>
<td>Pain from increased intracranial pressure Bony metastasis Spinal or nerve compression</td>
<td>Side effects include edema, gastrointestinal irritation, increased weight, acne Use gastroprotectants such as H2-blockers (ranitidine) or proton pump inhibitors such as omeprazole for long-term administration of steroids or NSAIDs in end-stage cancer with bony pain</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clonidine</td>
<td>2–4 mcg/kg PO q 4–6 hr May also use a 100 mcg transdermal patch q 7 days for patients &gt;40 kg (88 pounds)</td>
<td>Neuropathic pain Lancinating, sharp, electrical, shooting pain Phantom limb pain</td>
<td>α2-Adrenoceptor agonist modulates ascending pain sensations Routes of administration: oral, transdermal, and spinal Management of withdrawal symptoms Monitor for orthostatic hypertension, decreased heart rate Sedation common</td>
</tr>
<tr>
<td>Mexiletine</td>
<td>2–3 mg/kg/dose PO tid, may titrate 0.5 mg/kg 2–3 wk pm Maximum—300 mg/dose</td>
<td></td>
<td>Similar to lidocaine, longer acting Stabilizes sodium conduction in nerve cells, reduces neuronal firing Can enhance action of opioids, antidepressants, anticonvulsants Side effects include dizziness, ataxia, nausia, vomiting May measure blood levels for toxicity</td>
</tr>
</tbody>
</table>

*bid*, Twice a day; *hs*, at bedtime; *iv*, intravenous; *NSAIDs*, nonsteroidal antiinflammatory drugs; *PO*, by mouth; *pm*, as needed; *q*, every; *tid*, three times a day.
Unit 8  Assessment of the Child and Family

Patient-Controlled Analgesia

A significant advance in the administration of IV, epidural, or subcutaneous analgesics is the use of patient-controlled analgesia (PCA). As the name implies, the patient controls the amount and frequency of the analgesic, which is typically delivered through a special infusion device. Children who are physically able to "push a button" (i.e., 5 to 6 years of age) and who can understand the concept of pushing a button to obtain pain relief can use PCA (Maxwell & Yaster, 2000). Although it is controversial, parents and nurses have used the IV PCA system for the child. Nurses can efficiently use the infusion device on a child of any age to administer analgesics to avoid signing for and preparing opioid injections every time one is needed (Fig. 35-5). When PCA is used as "nurse- or parent-controlled" analgesia, the concept of patient control is negated, and the inherent safety of PCA needs to be monitored. Research has reported safe and effective analgesia in children when the PCA was controlled by patient, parent, or nurse (Algren et al, 1998; Maxwell & Yaster, 2000).

PCA infusion devices typically allow for three methods or modes of drug administration to be used alone or in combination:

1. Patient-administered boluses that can only be infused according to the preset amount and lockout interval (time between doses). More frequent attempts at self-administration usually mean the patient may need the dose and time adjusted for better pain control.
2. Nurse-administered boluses that are typically used to give an initial loading dose to increase blood levels rapidly and to relieve breakthrough pain (pain not relieved with the usual programmed dose).

Table 35-8  Equianalgesia of Selected Analgesics

<table>
<thead>
<tr>
<th>DRUG*</th>
<th>EQUAL TO ORAL MORPHINE (mg)</th>
<th>EQUAL TO IM OR IV MORPHINE (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydromorphone (Dilaudid) 1 mg</td>
<td>4</td>
<td>1.3</td>
</tr>
<tr>
<td>Codeine 30 mg</td>
<td>4.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Meperidine (Demerol) 50 mg</td>
<td>4.8</td>
<td>1.6</td>
</tr>
<tr>
<td>Codeine 30 mg, acetaminophen 300 mg (Tylenol No. 3)</td>
<td>7.2</td>
<td>2.4</td>
</tr>
<tr>
<td>Oxycodone 5 mg, acetaminophen 325 mg (Percocet)</td>
<td>7.2</td>
<td>2.4</td>
</tr>
<tr>
<td>Oxycodone 5 mg, aspirin 325 mg (Percodan)</td>
<td>7.2</td>
<td>2.4</td>
</tr>
<tr>
<td>Hydrocodone 5 mg, acetaminophen 500 mg (Vicodin, Lortab)</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Oxycodone 5 mg, acetaminophen 500 mg (Tylox)</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Methadone (Dolophine) 10 mg</td>
<td>15</td>
<td>7.5</td>
</tr>
<tr>
<td>Acetaminophen 325 mg (Tylenol)</td>
<td>2.7</td>
<td>0.9</td>
</tr>
<tr>
<td>Aspirin 325 mg</td>
<td>2.7</td>
<td>0.9</td>
</tr>
<tr>
<td>Acetaminophen 500 mg (Tylenol Extra Strength)</td>
<td>4</td>
<td>1.3</td>
</tr>
<tr>
<td>Codeine 60 mg, acetaminophen 300 mg (Tylenol No. 4)</td>
<td>11.7</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Fentanyl transdermal patch (Duragesic) (based on 25 mcg/hr patch applied q3days = 50 mg oral morphine q24hr or divided into 6 doses = 8.3 mg) or use: Recommended Initial Duragesic Dose Based on Daily Oral Morphine Dose†

<table>
<thead>
<tr>
<th>ORAL 24-HR MORPHINE (mg/day)</th>
<th>DURAGESIC DOSE (mg/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45-134</td>
<td>25</td>
</tr>
<tr>
<td>135-224</td>
<td>50</td>
</tr>
<tr>
<td>225-314</td>
<td>75</td>
</tr>
<tr>
<td>315-404</td>
<td>100</td>
</tr>
<tr>
<td>405-494</td>
<td>125</td>
</tr>
<tr>
<td>495-584</td>
<td>150</td>
</tr>
<tr>
<td>585-674</td>
<td>175</td>
</tr>
<tr>
<td>675-764</td>
<td>200</td>
</tr>
<tr>
<td>765-854</td>
<td>225</td>
</tr>
<tr>
<td>855-944</td>
<td>250</td>
</tr>
<tr>
<td>945-1034</td>
<td>275</td>
</tr>
<tr>
<td>1035-1124</td>
<td>300</td>
</tr>
</tbody>
</table>

*Oral medication with exception of fentanyl.

Fig. 35-5 Nurse programming a patient-controlled analgesia pump to administer analgesic.

Note: When converting to oral oxycodone from oral morphine, an appropriate conservative estimate is 15-20 mg oxycodone per 30 mg morphine; however, when converting to oral morphine from oral oxycodone, an appropriate conservative estimate is 30 mg morphine per 30 mg oxycodone (McCaffery M, Pasero C: Pain: a clinical manual, ed 2, St Louis, 1999, Mosby).

*Oral medication with exception of fentanyl.

IM, Intramuscular; IV, intravenous; q, every.

Courtesy Betty R. Ferrell, PhD, FAAN, 1999. Used with permission.
**BOX 35-3 Routes and Methods of Analgesic Drug Administration**

**Oral**
- Oral route preferred because of convenience, cost, and relatively steady blood levels
- Higher dosages of oral form of opioids required for equivalent parenteral analgesia
- Peak drug effect after 1 to 2 hours for most analgesics
- Delay in onset a disadvantage when rapid control of severe pain or of fluctuating pain is desired

**Sublingual, Buccal, or Transmucosal**
- Tablet or liquid placed under tongue (sublingual), between cheek and gum (buccal), or through the mucous membrane in general
- Highly desirable because more rapid onset than oral route
  - Produced less first-pass effect through liver than oral route, which normally reduces analgesia from oral opioids (unless sublingual or buccal form is swallowed, which occurs often in children)
- Few drugs commercially available in this form
- Many drugs able to be compounded into sublingual troche or lozenge*
  - Actiq—Oral transmucosal fentanyl citrate in hard confection base on a plastic holder; indicated only for management of breakthrough cancer pain in patients with malignancies who are already receiving and are tolerant to opioid therapy, but can be used for preoperative or preprocedural sedation and analgesia

**Intravenous (Bolus)**
- Preferred for rapid control of severe pain
- Provides most rapid onset of effect, usually in about 5 minutes
- Advantage for acute pain, procedural pain, and breakthrough pain
- Needs to be repeated hourly for continuous pain control
- Preferable for drugs with short half-life (morphine, fentanyl, hydromorphone) to avoid toxic accumulation of drug

**Intravenous (Continuous)**
- Preferred over bolus and intramuscular injection for maintaining control of pain
- Provides steady blood levels
- Easy to titrate dosage

**Subcutaneous (Continuous)**
- Used when oral and intravenous (IV) routes not available
- Provides equivalent blood levels to continuous IV infusion
- Suggested initial bolus dose to equal 2-hour IV dose; total 24-hour dose usually requires concentrated opioid solution to minimize infused volume; use smallest gauge needle that accommodates infusion rate

**Patient-Controlled Analgesia**
- Generally refers to self-administration of drugs, regardless of route
- Typically uses programmable infusion pump (IV, epidural, subcutaneous [SC]) that permits self-administration of boluses of medication at preset dose and time interval (lockout interval is time between doses)
- Patient-controlled analgesia (PCA) bolus administration often combined with initial bolus and continuous (basal or background) infusion of opioid

<table>
<thead>
<tr>
<th>Route</th>
<th>Method</th>
<th>Dosing</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oral</strong></td>
<td>Preferred because of convenience, cost, and relatively steady blood levels</td>
<td>Higher dosages of oral form of opioids required for equivalent parenteral analgesia</td>
<td>Peak drug effect after 1 to 2 hours for most analgesics; delay in onset a disadvantage when rapid control of severe pain or of fluctuating pain desired</td>
</tr>
<tr>
<td><strong>Sublingual, Buccal, or Transmucosal</strong></td>
<td>Tablet or liquid placed under tongue, between cheek and gum, or through the mucous membrane in general</td>
<td>Highly desirable because more rapid onset than oral route; produced less first-pass effect through liver than oral route</td>
<td>Few drugs commercially available in this form; many drugs able to be compounded into sublingual troche or lozenge*</td>
</tr>
<tr>
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</tr>
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<td>Patient-controlled analgesia (PCA) bolus administration often combined with initial bolus and continuous (basal or background) infusion of opioid</td>
</tr>
</tbody>
</table>

*Note:* Not recommended for pain control; not current standard of care

**Intranasal**
- Available commercially as butorphanol (Stadol NS); approved for those older than 18 years of age
- Should not be used in patient receiving morphinelike drugs because butorphanol is partial antagonist that will reduce analgesia and may cause withdrawal

**Intradermal**
- Used primarily for skin anesthesia (e.g., before lumbar puncture, bone marrow aspiration, arterial puncture, skin biopsy)
- Local anesthetics (e.g., lidocaine) cause stinging, burning sensation

**Nurse-Activated Analgesia**
- Child’s primary nurse designated as primary pain manager and is only person who presses PCA button during that nurse’s shift

**Guidelines for selecting primary pain manager for family-controlled analgesia:**
- Spends a significant amount of time with the patient
- Is willing to assume responsibility of being primary pain manager
- Is willing to accept and respect patient’s reports of pain (if able to provide) as best indicator of how much pain the patient is experiencing; knows how to use and interpret a pain rating scale
- Understands the purpose and goals of patient’s pain management plan
- Understands concept of maintaining a steady analgesic blood level
- Recognizes signs of maintaining a steady analgesic blood level

**Nurse-Activated Analgesia**
- Child’s primary nurse designated as primary pain manager and is only person who presses PCA button during that nurse’s shift

**Guidelines for selecting primary pain manager for family-controlled analgesia:**
- Spends a significant amount of time with the patient
- Is willing to assume responsibility of being primary pain manager
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- Understands concept of maintaining a steady analgesic blood level
- Recognizes signs of maintaining a steady analgesic blood level
**Box 35-3 Routes and Methods of Analgesic Drug Administration—cont’d**

**Intradermal—cont’d**

Duration of stinging dependent on type of “caine” used

To avoid stinging sensation associated with lidocaine:
- Buffer the solution by adding 1 part sodium bicarbonate (1 mEq/ml) to 9 or 10 parts 1% or 2% lidocaine with or without epinephrine (see Guidelines box, p. ••)

Normal saline with preservative, benzyl alcohol, used to anesthetize venipuncture site

Use same dose as for buffered lidocaine (see Guidelines box, p. ••)

**Topical or Transdermal**

EMLA (eutectic mixture of local anesthetics [lidocaine and prilocaine]) cream and anesthetic disk or LMX4 (4% lidocaine cream)

- Eliminates or reduces pain from most procedures involving skin puncture
- Must be placed on intact skin over puncture site and covered by occlusive dressing or applied as anesthetic disk for 1 hour or more before procedure (see Guidelines box, p. ••)

LAT (lidocaine-adrenaline-tetracaine) or tetracaine-phenylephrine (tetraphen)

- Provides skin anesthesia about 15 minutes after application on nonintact skin
- Gel (preferable) or liquid placed on wounds for suturing
- Adrenaline not for use on end arterioles (fingers, toes, tip of nose, penis, earlobes) because of vasoconstriction

**Numby Stuff**

- Uses iontophoresis to transport lidocaine 2% and epinephrine 1:100,000 (lontocaine) into the skin
- Current delivered by small battery-powered device that has an electrode with lontocaine and a ground electrode
- Produces local dermal anesthesia in about 10 minutes to a depth of approximately 10 mm at maximum setting
- May be frightening to young children when they see the device and feel the current
- Observe child during iontophoresis and remove all metal, such as jewelry, from application site to prevent burns

**Transdermal fentanyl (Duragesic)**

- Available as patch for continuous pain control
- Safety and efficacy not established in children younger than 12 years of age
- Not appropriate for initial relief of acute pain because of long interval to peak effect (12 to 24 hours); for rapid onset of pain relief, give an immediate-release opioid
- Orders for “rescue doses” of an immediate-release opioid recommended for breakthrough pain (a flare of severe pain that breaks through the medication being administered at regular intervals for persistent pain)
- Has duration of up to 72 hours for prolonged pain relief
- If respiratory depression occurs, possible need for several doses of naloxone

**Vapocoolant**

- Use of prescription spray coolant, such as fluorimethane (Spray and Stretch) or ethyl chloride (Pain Ease)
- Applied to the skin for 10 to 15 seconds immediately before the needle puncture; anesthesia lasts about 15 seconds
- Cold disliked by some children; may be more comfortable to spray coolant on a cotton ball and then apply this to the skin
- Application of ice to the skin for 30 seconds found to be ineffective

**Rectal**

Alternative to oral or parenteral routes

Variable absorption rate

Generally disliked by children

Many drugs able to be compounded into rectal suppositories**

**Regional Nerve Block**

Use of long-acting local anesthetic (bupivacaine or ropivacaine) injected into nerves to block pain at site

Provides prolonged analgesia postoperatively, such as after inguinal herniorrhaphy

May be used to provide local anesthesia for surgery, such as dorsal penile nerve block for circumcision or for reduction of fractures

**Inhalation**

Use of anesthetics, such as nitrous oxide, to produce partial or complete analgesia for painful procedures

Side effects (e.g., headache) possible from occupational exposure to high levels of nitrous oxide

**Epidural or Intrathecal**

Involves catheter placed into epidural, caudal, or intrathecal space for continuous infusion or single or intermittent administration of opioid with or without a long-acting local anesthetic (e.g., bupivacaine, ropivacaine)

Analgesia primarily from drug’s direct effect on opioid receptors in spinal cord

Respiratory depression rare but may have slow and delayed onset; can be prevented by checking level of sedation and respiratory rate and depth hourly for initial 24 hours and decreasing dose when excessive sedation is detected

Nausea, itching, and urinary retention common dose-related side effects from the epidural opioid

Mild hypotension, urinary retention, and temporary motor or sensory deficits common unwanted effects of epidural local anesthetic

Catheter for urinary retention inserted during surgery to decrease trauma to child; if inserted when child is awake, anesthetize urethra with lidocaine


For further information about compounding drugs in troche or suppository form, contact Professional Compounding Centers of America (PCCA), 9901 S. Wilcrest Drive, Houston, TX 77099; 800-331-2498; http://www.pccanx.com.
3. Continuous basal rate infusion that delivers a constant amount of analgesic and prevents pain from returning during those times, such as sleep, when the patient cannot control the infusion.

As with any type of analgesic management plan, continued assessment of the child’s pain relief is essential for the greatest benefit from PCA. Typical uses of PCA are for controlling pain from surgery, sickle cell crisis, trauma, and cancer. Morphine is the drug of choice for PCA and is usually prepared in a concentration of 10 mcg/ml (Table 35-9). Other options are hydromorphone (2 mcg/ml) and fentanyl (0.1 mcg/ml). Hydromorphone is often used when patients are not able to tolerate side effects such as pruritus and nausea from the morphine PCA (Algren et al, 1998; Maxwell & Yaster, 2000).

Some physicians may still prescribe meperidine. However, meperidine is the least potent and shortest-acting of the synthetic opioids and the least effective in providing analgesia for severe pain. More important, it may increase the risk of seizures when administered chronically because of the excitatory effects on the nervous system of its metabolite, normeperidine.

### Epidural Analgesia

Epidural analgesia may also be used to manage pain in selected cases. Although an epidural catheter may be inserted at any vertebral level, it is usually placed into the epidural space of the spinal column at the lumbar or caudal level (Fig. 35-6). The thoracic level is usually reserved for older children or adolescents who have had an upper abdominal or thoracic procedure, such as a lung transplant. An opioid (usually fentanyl, hydromorphone, or preservative-free morphine, which is often combined with a long-acting local anesthetic such as bupivacaine or ropivacaine) is instilled via single or intermittent bolus, continuous infusion, or patient-controlled epidural analgesia. Analgesia results from the drug’s effect on opiate receptors in the dorsal horn of the spinal cord, rather than the brain. As a result, respiratory depression is rare, but if it occurs, it develops slowly, typically 6 to 8 hours after administration (Golianu et al, 2000). Properly securing the epidural catheter with an occlusive dressing decreases the possibility of soiling or inadvertently displacing the catheter. Careful monitoring of sedation level and respiratory status is critical to prevent opioid-induced respiratory depression. Assessment of pain and the skin condition around the catheter site is an important aspect of nursing care.

### Transmucosal and Transdermal Analgesia

Fentanyl is also available as a transdermal patch (Durasgesic). Although contraindicated for acute pain management, it may be used for older children and adolescents who have cancer pain or sickle cell pain or for patients who are opioid tolerant.

One of the most significant improvements in the ability to provide atraumatic care to children is the anesthetic cream LMX (a 4% liposomal lidocaine cream) or EMLA (an eutectic mixture of local anesthetics) (Abdelkefi et al, 2004; Choi et al, 2003; Eggekvist & Bjerring, 2000; Gad et al, 2005; Rogers & Ostrow, 2004; Santiago et al, 2000; Uziel et al, 2003). The eutectic mixture (lidocaine 2.5% and prilocaine 2.5%), whose melting point is lower than that of the two anesthetics alone, permits effective concentrations of the drug to penetrate intact skin (see Evidence-Based Practice box and Fig. 35-7). A needle-free system containing 0.5 mg of sterile lidocaine powder (Zingo) is now available and provides a rapid onset of action to reduce pain associated with peripheral IV insertions or blood draws. Two randomized, double-blind, placebo-controlled studies conducted at 15 centers across the United States found significant reduction in procedural pain compared with placebo in children 3 to 18 years of age (Migdal et al, 2006; Zempsky et al, 2008).

In some situations refrigerant sprays such as ethyl chloride and fluoromethane can be used (Reis & Holubkov, 1997). When sprayed on the skin, these sprays vaporize, rapidly cooling the area and providing superficial anesthesia. Hospital formularies may have other products with lidocaine, prilocaine, or amethocaine topical preparations that require less time for application.

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**Table 35-9 Suggested Intravenous Patient-Controlled Analgesia Opioid Infusion Orders**

<table>
<thead>
<tr>
<th>DRUG</th>
<th>BASAL RATE (mcg/kg/hr)</th>
<th>BOLUS RATE (mcg/kg/dose)</th>
<th>LOCKOUT PERIOD (min)</th>
<th>MAXIMUM DOSE/HOUR (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>10-30</td>
<td>10-30</td>
<td>6-10</td>
<td>0.1-0.15</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>3-5</td>
<td>6-10</td>
<td>0.015-0.02</td>
<td>3-5</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>0.5-1.0</td>
<td>0.5-1.0</td>
<td>6-10</td>
<td>0.002-0.004</td>
</tr>
</tbody>
</table>

From Yaster M et al: Pediatric pain management and sedation handbook; St Louis, 1997, Mosby.
The LidoSite Topical System is another method to help reduce needlestick pain associated with procedures such as IV cannulation, venipuncture, or laser ablation of superficial skin lesions for patients ages 5 years and older. The LidoSite system delivers numbing medication to the procedure site quickly and effectively after a 10-minute application. The system consists of a single-use, prefilled LidoSite patch, filled with lidocaine hydrochloride 10% and epinephrine 0.1%, and the LidoSite controller, an easy-to-use preprogrammed device that activates the patch. It provides pain reduction equivalent to that of a lidocaine (Xylocaine) injection without the needlestick. Through iontophoresis, a mild current from the controller activates the patch to accelerate delivery of lidocaine—the anesthetic medication—to the injection site. Epinephrine contained in the LidoSite patch helps focus the anesthetic effect directly under the patch and extends the duration of the effect for an hour.

The intradermal route is sometimes used to inject a local anesthetic, typically lidocaine, into the skin to reduce the pain from a lumbar puncture, bone marrow aspiration, or venous or arterial access. One problem with the use of lidocaine is the stinging and burning that initially occur. However, the use of buffered lidocaine with sodium bicarbonate (see Evidence-Based Practice box) reduces the stinging sensation (Wong & Pasero, 1997a, 1997b). Warming the lidocaine to 37° C (98.6° F) may accomplish the same effect.

Timing of Analgesia

The right timing for administering analgesics depends on the type of pain. For continuous pain control, such as for postoperative or cancer pain, a preventive schedule of medication around the clock (ATC) is effective. The ATC schedule avoids the low concentrations of medications in plasma that permit breakthrough pain. If analgesics are administered only when

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**EVIDENCE-BASED PRACTICE** Buffered Lidocaine for Pain Reduction During Peripheral Intravenous Access in Children

—Angela C. Morgan

**Ask the Question**

In children, is buffered lidocaine an appropriate anesthetic for reducing pain during peripheral intravenous (PIV) access?

**Search for Evidence**

**Search Strategies**

English publications within the past 5 years, research-based articles (level 3 or lower) on children undergoing PIV access; two articles more than 5 years old included based on the limited literature in this area

**Databases Searched**

PubMed, Cochrane Collaboration, MD Consult, Joanna Briggs Institute, National Guideline Clearinghouse (AHQR), TRIP Database, PedsCCM, Best BETs

**Critically Analyze the Evidence**

A review of the literature revealed 10 studies evaluating buffered lidocaine given before PIV access from 1991 through 1999 (Murphy, 2000). Four of the studies were specific to pediatrics. Findings from the pediatric studies support buffered lidocaine as a pain reduction measure in children before PIV access.

- A randomized clinical trial of 59 children requiring PIV access in the ED evaluated the use and nonuse of subcutaneous lidocaine before PIV access. PIV access without lidocaine was significantly more painful than PIV access with lidocaine regardless of catheter size. Trial weaknesses included a small sample size with wide confidence levels and no randomization (Klein et al, 1995).

**Apply the Evidence: Nursing Implications**

- **Age**—More than 2 years
- **Time of onset**—Immediate
- **Duration**—1 hour
- **Multiple sites**—Yes
- **Use with abraded skin**—No
- **Impact on PIV access difficulty**—Possibility of some vasoconstriction
- **Timing**—Do not use within 2 hours before vesicants
- **Dose**—0.1 to 0.5 ml buffered 1% lidocaine, to a maximum of 0.45 ml/kg/dose; can repeat dose after 2 hours

**Considerations**—An “extra stick” and ineffective buffered lidocaine administration may result in pain during both local administration and PIV access. Expertise in administering buffered lidocaine is an important factor related to its effectiveness.

**References**


Sacchetti AD, Carraccio C: Subcutaneous lidocaine does not affect the success rate of intravenous access in children less than 24 months of age, *Acad Emerg Med* 3(11):1016-1019, 1996.
Pain returns (a typical use of the prn, or “as needed,” order), pain relief may take several hours. This may require higher doses, leading to a cycle of undermedication of pain alternating with periods of overmedication and drug toxicity. This cycle of erratic pain control also promotes “clock watching,” which may be erroneously equated with addiction. Nurses can effectively use prn orders by giving the drug at regular intervals, since “as needed” should be interpreted as “as needed to prevent pain,” not “as little as possible.”

Preventive pain control is best provided through continuous IV infusion rather than intermittent boluses. If intermittent boluses are given, the intervals between doses should not exceed the drug’s expected duration of effectiveness. For extended pain control with fewer administration times, drugs that provide longer duration of action (e.g., some NSAIDs, time-released morphine or oxycodone, methadone, levorphanol) can be used.

Continuous analgesia is not always appropriate, since not all pain is continuous. Frequently, temporary pain control or conscious sedation is needed to provide analgesia before a scheduled procedure. When pain can be predicted, the drug’s peak effect should be timed to coincide with the painful event. For example, with opioids the peak effect is approximately a half hour for the IV route; with nonopioids the peak effect occurs about 2 hours after oral administration. For rapid onset and peak of action, opioids that quickly penetrate the blood-brain barrier (e.g., IV fentanyl) provide excellent pain control.

**Monitoring Side Effects**
Both NSAIDs and opioids have side effects, although the major concern is with those from opioids (Box 35-4). *Respiratory depression* is the most serious complication and is most likely to occur in sedated patients. The respiratory rate may decrease gradually, or respirations may cease abruptly. Lower limits of normal are not established for children, but any significant change from a previous rate calls for increased vigilance. A slower respiratory rate does not necessarily reflect decreased arterial oxygenation; an increased depth of ventilation may compensate for the altered rate. If respiratory depression or arrest occurs, the nurse must be prepared to intervene quickly (see Guidelines box).

Although respiratory depression is the most feared side effect, *constipation* is a common, and sometimes serious, side effect of opioids, which decrease peristalsis and increase anal sphincter tone. Prevention with stool softeners and laxatives is more effective than treatment once constipation occurs. Dietary treatment, such as increased fiber, is usually not sufficient to promote regular bowel evacuation. However, dietary measures, such as increased fluid and fruit intake, and physical activity are encouraged. *Pruritus* from epidural or IV infusion can be treated with low doses of IV naloxone, nalbuphine, or diphenhydramine. *Nausea, vomiting, and sedation* usually subside after 2 days of opioid administration; however, oral or rectal antiemetics may be necessary.

Both tolerance and physical dependence can occur with prolonged use of opioids (see Family-Centered Care box,
Unit 8  Assessment of the Child and Family

GUIDELINES  Managing Opioid-Induced Respiratory Depression

If Respirations Are Depressed
Assess sedation level.
Reduce infusion by 25% when possible.
Stimulate patient (shake shoulder gently, call by name, ask to breathe).

If Patient Cannot Be Aroused or Is Apneic
Administer naloxone (Narcan).
- For children weighing less than 40 kg (88 pounds), dilute 0.1 mg naloxone in 10 ml sterile saline to make 10 mcg/ml solution, and give 0.5 mcg/kg.
- For children weighing more than 40 kg, dilute 0.4-mg ampule in 10 ml sterile saline, and give 0.5 ml.
Administer bolus by slow intravenous push every 2 minutes until effect is obtained.
Closely monitor patient. Naloxone’s duration of antagonist action may be shorter than that of opioid, requiring repeated doses of naloxone.
Note: Respiratory depression caused by benzodiazepines (e.g., diazepam [Valium] or midazolam [Versed]) can be reversed with flumazenil (Romazicon). Pediatric dosing experience suggests 0.01 mg/kg (0.1 ml/kg); if no (or inadequate) response after 1 to 2 minutes, administer same dose and repeat as needed at 60-second intervals for maximum dose of 1 mg (10 ml).


Physical dependence is a normal, natural, physiologic state of neuroadaptation. When opioids are abruptly discontinued without weaning, withdrawal symptoms occur. Symptoms of withdrawal occur at 24 hours after abrupt discontinuation and reach a peak within 72 hours. Symptoms of withdrawal include signs of neurologic excitability (irritability, tremors, seizures, increased motor tone, insomnia), gastrointestinal dysfunction (nausea, vomiting, diarrhea, abdominal cramps), and autonomic dysfunction (sweating, fever, chills, tachypnea, nasal congestion, rhinitis). Withdrawal symptoms can be anticipated and prevented by weaning patients from opioids that were administered for more than 5 to 10 days. Adherence to a weaning protocol to prevent or minimize withdrawal symptoms from opioids will be required. A weaning flow sheet may be used to assess the efficacy of opioid weaning in neonates (Franck & Vilardi, 1995; Franck et al, 1998) (Fig. 35-8).

Tolerance occurs when the dose of an opioid needs to be increased to achieve the same analgesic effects that was previously achieved at a lower dose. Tolerance may develop after 10 to 21 days of morphine administration. Treatment of tolerance involves increasing the dose or decreasing the duration between doses. Treatment of physical dependence involves gradually reducing the dose over several days to prevent withdrawal symptoms. The following are guidelines for treating physical dependence from morphine:

- Gradually reduce dose (similar to tapering of steroids).
- Give one half of previous daily dose every 6 hours for first 2 days.
- Then reduce dose by 25% every 2 days. Continue this schedule until total daily dosage of 0.6 mg/kg/day of morphine (or equivalent) is reached. After 2 days on this dose, discontinue opioid.
- A switch to oral methadone may also be done, using one fourth of equianalgesic dose as initial weaning dose and proceeding as described above.

Parents and older children may fear addiction when opioids are prescribed. The nurse should address these concerns with assurance that any such risk is extremely low. It may be helpful to ask the question, “If you did not have this pain, would you want to take this medicine?” The answer is invariably no, which reinforces the solely therapeutic nature of the drug. It is also important to avoid making statements to the family such as “We don’t want you to get used to this medicine,” or “By now you shouldn’t need this medicine,” which may reinforce the fear of becoming addicted. Whereas both physical dependence and tolerance are physiologic states, addiction or psychologic dependence is a psychologic state and implies a “cause-effect” mode of thinking, such as “I need the drug because it makes me feel better.” Infants and children do not have the cognitive ability to make the cause-effect association and therefore cannot become addicted. The use of opioid analgesics early in life has not been demonstrated to increase the risk for addiction later in life. Nurses need to explain to parents the differences among physical dependence, tolerance, and addiction and allow parents to express concerns about the use and duration of use of opioids. Infants and children, when treated appropriately with opioids, may be at risk for physical tolerance and physical dependence, but not psychologic dependence or addiction (Turner, 2005; Greco & Berde, 2005).

Evaluation of Effectiveness of Pain Regimen
The effectiveness of analgesics can be enhanced by a supportive attitude toward the child. By reinforcing the cause and effect of the medication and analgesia, the nurse can condition the child to expect pain relief, provided the regimen is likely to be effective. A pain relief scale or periodic ratings of pain intensity should be used for evaluation of effectiveness of pain regimens.

The response to therapy should be evaluated 15 to 30 minutes after each dose, and titration should continue to the highest achievable amount of relief. Even though The Joint Commission required documentation of pain assessments with vital signs, evidence of pain relief was not documented in 41.4% of the episodes. Titration methods in the emergency department or during the course of hospitalization, if used, were not reflected in the amount of medications received by the children (Jacob et al, 2003a, 2003b).

Several harmful effects occur with unrelieved pain, particularly when pain is prolonged. A number of physiologic stress responses in the body are triggered during pain, and they lead to negative consequences that involve multiple systems. Unrelieved pain may prolong the stress response and adversely...
Affect an infant or child’s recovery, whether it is from trauma, surgery, or disease. In a landmark study by Anand and Hickey (1992), 30 neonates received deep intraoperative anesthesia with high doses of the opioid sufentanil, followed postoperatively by an infusion of opioids for 24 hours, and 15 neonates received lighter anesthesia with halothane and morphine followed postoperatively by intermittent morphine and diazepam. The 15 neonates who received the lighter anesthesia and intermittent postoperative opioids had more severe hyperglycemia and lactic acidemia, and four postoperative deaths occurred in the group. The 30 neonates who received deep anesthesia had a lower incidence of complications (sepsis, metabolic acidosis, disseminated intravascular coagulation) and no deaths.

Poorly controlled acute pain can predispose patients to chronic pain syndromes. A guiding principle in pain management is that prevention of pain is always better than treatment (Benjamin, Swinson, & Nagel, 2000). Pain that is established and severe is often more difficult to control. When pain is unrelieved, sensory input from injured tissues reaches spinal cord neurons and may enhance subsequent responses. Long-lasting changes in cells within spinal cord pain pathways may occur after a brief painful stimulus and may lead to the development of chronic pain conditions. Basbaum (1999a, 1999b)
reported a series of studies that emphasize a distinct neurochemistry of acute and persistent pain and concluded that persistent pain is not merely a prolonged acute pain symptom of some other disease. Underlying physiologic mechanisms lead to the persistence of pain (Marx, 2004; Woolf & Salter, 2000).

In a study of nursing practice related to pain assessment and management in different pediatric specialty units, Jacob and Puntillo (2000) noted nurses were aware of complaints of pain but seldom documented patient-specific pain scores or notations about responses to analgesics after administration. Pain scores were not available before and after analgesics, and it was therefore not possible to conclude whether analgesics were effective. Nurses need to evaluate and monitor pain in a timely fashion after administration of analgesics; titrate dosage to effect; or make recommendations for an alternate analgesic, for addition of another analgesic, or for a combination of analgesics, adjuvants, and nonpharmacologic strategies.

Key Points

- Although the ability to measure pain in children has improved dramatically in recent years, assessment of pain in children continues to be complex and challenging.
- Behavioral assessment is useful for measuring pain in infants and preverbal children who do not have the language skills to communicate that they are in pain, or when mental clouding and confusion limit a child’s ability to communicate.
- Physiologic measures are not able to distinguish between physical responses to pain and other forms of stress to the body.
- The number of pain measures that are available for use in infants and young children has increased dramatically and adds a layer of complexity to the assessment of pain in children.
- Important components of assessment include the onset of pain; pain duration or pattern; effectiveness of the current treatment; factors that aggravate or relieve the pain; other symptoms and complications concurrently felt; and interference with the child’s mood, function, and interactions with family.
- The administration of sucrose with or without nonnutritive sucking has been demonstrated to have calming and pain-relieving effects for invasive procedures in neonates.
- One of the most significant improvements in the ability to provide atraumatic care to children is the anesthetic creams LMX and EMLA.

Nonopioids, including acetaminophen and NSAIDs, are suitable for mild to moderate pain; opioids are needed for moderate to severe pain.

- Several drugs, known as coanalgesics or adjuvant analgesics, may be used alone or with opioids to control pain symptoms and opioid side effects.
- A significant advance in the administration of IV, epidural, or subcutaneous analgesics is the use of PCA.
- Although respiratory depression is the most feared side effect of opioids, constipation is a common, and sometimes serious, side effect, which decreases peristalsis and increases anal sphincter tone.
- Several harmful effects occur with unrelieved pain, particularly when pain is prolonged.
- Surgery and traumatic injuries generate a catabolic state as a result of increased secretion of catabolic hormones and lead to alterations in blood flow, coagulation, fibrinolysis, substrate metabolism, and water and electrolyte balance, and increase the demands on the cardiovascular and respiratory systems.

References


