Presented in a concise, systematic format, this clinically oriented book provides nurses and physicians quick access to up-to-date information on how to assess and manage pain in infants and children, including adolescents who suffer from acute and chronic pain conditions. This book provides a comprehensive review of medications for infants and children as well as nonpharmacological interventions to achieve optimal pain management for young patients undergoing needle-related procedures as well as painful conditions related to surgery, trauma, cancer, sickle cell disease, and chronic pain.

**KEY FEATURES:**

- Describes the consequences of untreated pain on development of children
- Summarizes pain assessment tools recommended for verbal and preverbal patients as well as those who are critically or terminally ill
- Describes the indications, medications, and ongoing care and monitoring related to the increasing use of epidural and continuous peripheral nerve block infusions for pediatric patients
- Provides information on how to use age-appropriate strategies for cognitive, cognitive-behavioral, and physical approaches to reduce pain
- Includes useful resources, such as websites, and other tools, such as pain diaries and patient education information, to support multidisciplinary teams and parents who care for children with acute and chronic pain.
Compact Clinical Guide to
CHRONIC PAIN MANAGEMENT:
An Evidence-Based Approach for Nurses
Yvonne D’Arcy, MS, CRNP, CNS

Compact Clinical Guide to
ACUTE PAIN MANAGEMENT:
An Evidence-Based Approach for Nurses
Yvonne D’Arcy, MS, CRNP, CNS

Compact Clinical Guide to
CRITICAL CARE, TRAUMA AND EMERGENCY PAIN MANAGEMENT:
An Evidence-Based Approach for Nurses
Liza Marmo, MSN, RN, CCRN

Compact Clinical Guide to
GERIATRIC PAIN MANAGEMENT:
An Evidence-Based Approach for Nurses
Ann Quinlan-Colwell, PhD, RNC, AHNBC, FAAPM

Compact Clinical Guide to
INFANT AND CHILD PAIN MANAGEMENT:
An Evidence-Based Approach for Nurses
Linda L. Oakes, MSN, RN-BC, CCNS
Linda L. Oakes, MSN, RN-BC, CCNS, is currently a Pain Clinical Nurse Specialist at St. Jude Children’s Research Hospital in Memphis, Tennessee. She obtained her undergraduate degree in nursing at the University of South Carolina and her master’s in pediatric nursing at the University of Tennessee. During her 37 years as a nurse, her career has also included roles as a critical care nurse and as a nursing educator in the states of South Carolina, North Carolina, Florida, and Ohio. In 1987, she joined St. Jude Children’s Research Hospital as the first intensive care unit (ICU) Clinical Nurse Specialist and gradually became aware of the need to improve the pain management for children with cancer. In 2003, she stepped out of her ICU role by developing the role of the institution’s first advanced practice nurse in pain management. Her passion for pain management has been a key factor in developing a Pain Management Service at St. Jude for patients with complex pain conditions. However, her mission has always been to provide resources for all health care providers so they may use evidence-based assessment tools and interventions.

Linda is currently certified as an acute care clinical nurse specialist as well as a Pain Management Nurse. Her professional memberships include active involvement in the American Association of Critical Care Nurses with local and national level appointments, Sigma Theta Tau, International Association of Pain, American Pain Society, and American Society of Pain Management Nurses, for which she has served on national clinical expert consensus panels regarding the need to provide safe and effective pain management. At St. Jude, she has served as a coinvestigator of several research protocols involving pediatric pain assessment and management, outcomes of nursing procedures, and end-of-life decision making. Linda has had the opportunity to share these research efforts and her expertise in pain and critical care nursing through many publications and presentations nationally, as well as through St. Jude’s international outreach efforts in South America and China.
Compact Clinical Guide to

INFANT AND CHILD PAIN MANAGEMENT

An Evidence-Based Approach for Nurses

Linda L. Oakes, MSN, RN-BC, CCNS
In memory of
Dr. Donna Wong
(1948–2008)

Developer of the Wong-Baker
FACES Pain Scale
Contents

Foreword  Chris Pasero, MS, RN-BC, FAAN ix
Preface  xiii

SECTION I: OVERVIEW OF PAIN IN INFANTS AND CHILDREN

1. The Problem of Pain 3
2. Pain Assessment 23

SECTION II: COMMON MEDICATIONS FOR MANAGING ACUTE AND CHRONIC PAIN

3. General Principles and Nonopioids 57
4. Opioids 73
5. Coanalgesics 115

SECTION III: REGIONAL ANALGESIA

6. Epidural Infusions 131
7. Continuous Peripheral Nerve Block Infusions 149

SECTION IV: NONPHARMACOLOGIC METHODS

8. General Principles and Cognitive-Behavioral Techniques 163
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.</td>
<td>Cognitive Techniques</td>
<td>179</td>
</tr>
<tr>
<td>10.</td>
<td>Physical Approaches</td>
<td>191</td>
</tr>
<tr>
<td></td>
<td><strong>SECTION V: INTEGRATION OF METHODS OF TREATMENT</strong></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Multidisciplinary Approaches</td>
<td>209</td>
</tr>
<tr>
<td>12.</td>
<td>Role of Parents</td>
<td>217</td>
</tr>
<tr>
<td></td>
<td><strong>SECTION VI: SPECIAL TREATMENT CONSIDERATIONS FOR PAIN INCLUDING IMPACT ON THE FAMILY</strong></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Needle-Related Procedures</td>
<td>231</td>
</tr>
<tr>
<td>14.</td>
<td>Critical Illness</td>
<td>247</td>
</tr>
<tr>
<td>15.</td>
<td>Terminal Illness</td>
<td>267</td>
</tr>
<tr>
<td></td>
<td><strong>SECTION VII: MANAGING COMMON PAIN CONDITIONS</strong></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Postoperative and Trauma-Related Pain</td>
<td>277</td>
</tr>
<tr>
<td>17.</td>
<td>Pain and Sickle-Cell Disease</td>
<td>291</td>
</tr>
<tr>
<td>18.</td>
<td>Cancer and Pain</td>
<td>301</td>
</tr>
<tr>
<td>19.</td>
<td>Chronic Pain</td>
<td>313</td>
</tr>
<tr>
<td></td>
<td><strong>Appendix of Select Websites</strong></td>
<td>335</td>
</tr>
<tr>
<td></td>
<td><strong>Index</strong></td>
<td>339</td>
</tr>
</tbody>
</table>
It is an honor to write the foreword for Linda Oakes’s *Compact Clinical Guide to Infant and Child Pain Management*. It is particularly meaningful to me because my nursing career began out of a love for infants and children. I worked in a tertiary neonatal intensive care unit (NICU) for 13 years in the 1970s and 1980s and have never been able to forget the frustration I felt over the prevailing thinking that infants did not feel pain and, if they did, would not remember it, implying a lack of consequences later in life. Even when the presence of pain was acknowledged, it was assumed that infants could not tolerate analgesics and it would be dangerous to administer them. This thinking was used to justify the widespread failure on the part of health care providers to provide analgesics to infants, even to those who had painful congenital anomalies, underwent major surgery, or suffered terminal illness.

Pain is common in infants and children, particularly pain associated with procedures (American Academy of Pediatrics, 2001; American Academy of Pediatrics & Canadian Paediatric Society, 2006). A prospective study recorded all painful procedures in 151 neonates during the first 14 days of their stay in a tertiary NICU and found that each neonate experienced an average of 14 painful procedures per day (Simons, van Dijk, Anand, Roofthooft, van Lingen, & Tibboel, 2003). A multicenter epidemiologic study reported a similar very high number of painful procedures in the NICU, but only 20.8% were performed with analgesia before the procedures (Carbajal et al., 2008). Little is known about the impact of repeated painful procedures and early pain experiences on later quality of life, physiologic changes, and pain-related behavior and perception (Hermann, Hohmeister,
Demirakça, Zohsel, & Flor, 2006; Howard, 2003; Lidow, 2002; Taddio, Shah, Atenafu, & Katz, 2009). For example, there is heightened interest and ongoing research regarding the relationship between the development of chronic pain in children and their previous pain experiences (Hohmeister et al., 2010; Huguet & Miro, 2008).

Although it becomes immediately clear while reading the pages of this clinical guide that there have been major improvements in pediatric pain management since my early experiences as a NICU nurse, we continue to see examples of undertreated pain and its adverse effects in infants and children in all settings (Colleau & Lipman, 2004; Howard, 2003; Jacob et al., 2003). This is why Linda’s clinical guide is both timely and a welcome addition to the growing body of resources available to clinicians who care for these vulnerable populations. It is exciting to review the content that she has organized into seven sections ranging from a chapter on pain assessment, which contains an excellent overview of tools for assessment in both verbal and preverbal patients, to several chapters devoted to specific therapies, such as epidural analgesia and peripheral nerve blocks, and pain associated with conditions such as sickle-cell disease and trauma. It is difficult to find a clinical guide that presents the evidence supporting the appropriate treatment of multiple aspects of pediatric pain in a way that can be applied so readily in the clinical setting, yet Linda has achieved this.

It was a defining moment for me in my career when I heard the great pediatric pain management pioneer, Dr. Donna Wong, state emphatically in a lecture, “Unless proven otherwise, babies and children can feel pain and deserve the same quality of pain treatment as adults!” Linda Oakes’s clinical guide affirms this statement. It is particularly appropriate that she has dedicated it to Dr. Wong’s memory.

Chris Pasero, MS, RN-BC, FAAN
Pain Management Educator and Clinical Consultant
El Dorado Hills, California
REFERENCES


Preface

The *Compact Clinical Guide to Infant and Child Pain Management* is intended to assist primary care providers caring for infants, children, and adolescents who experience pain. The reduction of pain must become a priority for all health care providers, with recognition that failure to do so amounts to substandard and unethical practice. Pain management for infants, children, and adolescents has made great strides in the past 3 decades. However, many pediatric and family practice health care providers need concisely written and evidence-based resources for guidance in using age-appropriate assessment tools as well as how to combine therapeutic pharmacologic modalities with appropriate nonpharmacologic techniques for common pediatric conditions associated with pain.

This book consists of seven sections: Section I: Overview of Pain in Infants and Children, describing the problems of pain and pain assessment tools; Section II: Common Medications for Managing Acute and Chronic Pain, including nonopioids, opioids, and coanalgesics; Section III: Regional Analgesia, including the increasing use of continuous epidural and peripheral nerve block infusions; Section IV: Nonpharmacologic Methods, describing the use of cognitive-behavioral techniques, cognitive techniques, and physical approaches to relieve pain; Section V: Integration of Methods of Treatment, explaining the multidisciplinary approach and the role of parents in reducing pain; Section VI: Special Treatment Considerations for Pain Including Impact on the Family, including the unique strategies needed to reduce pain associated with needle-related procedures, critical illness, and terminal illness; and Section VII: Managing Common Pain Conditions, describing the specific problem, assessment, and treatment of pain associated with surgery, trauma, sickle-cell disease, and cancer as well as chronic pain.
For the sake of providing a concise resource, the reader is to consider the following descriptions of common terms:

- The words *child* and *children* refer to infants, children, and adolescents unless otherwise specified.
- The singular pronoun *he* refers to a child who is either male or female.
- Babies are referred to as follows:
  - *Neonate*: an infant from birth to 1 month
  - *Infant*: an infant from 1 month to 1 year
- The content of this book does not refer to preterm infants unless otherwise noted.
- The word *parent* refers to all family and nonfamily caregivers who are not health care providers.
- The term *health care providers* refers to physicians, nurses, physical therapists, pharmacists, and other clinicians who have been educated to care for patients.
- The term *prescribing health care providers* refers to physicians and advanced practice nurses authorized to prescribe interventions including medications.
- The term *opioid* is the same as narcotic. In light of the negative connotations of the word “narcotic,” the term opioid is used throughout this book when pertaining to medically prescribed narcotic analgesics.
- Specific medicines are included only if they are available in the United States.

In writing this book, I have made every effort to base my practice on the evidence available at the time, translating the literature about pediatric pain management with care to confirm the accuracy of the information presented and to describe generally accepted practice. Every effort has been taken to ensure that the medication selections offered in this book have been described in accordance with current recommendations and practices at the time of this publication. Application of this information for a specific patient remains the professional responsibility of the health care provider. Any recommendations regarding medication dosages are to be compared with recommendations of pharmaceutical sources. The health care provider is advised to check the package
insert for each drug for any future changes in indications, precautions, contraindications, or dosages.

I am aware of many pain management issues that are not included or well covered in this book. I encourage others to pursue future research necessary to improve pain management in children by:

- Increasing the inclusion of viewpoints of older children and adolescents in studies;
- Examining the pharmacokinetics and pharmacodynamics of all analgesic drugs used in neonates and young children, not only with single doses but also with repeated doses;
- Evaluating the outcomes of various combinations of medications, as well as integrating nonpharmacologic techniques into treatment regimens;
- Evaluating the effects of analgesics on long-term growth and development;
- Incorporating the necessary emphasis on patient safety (e.g., the use of “smart pumps” with parameters appropriate for children) without compromising the efficacy of pain management;
- Understanding how to use opioids and antidepressants more safely for adolescents who may have underlying risk factors;
- Investigating the influence of pharmacogenetics and other biological variations in responses to analgesics; and
- Most importantly, determining factors that affect pain management practices, especially ways to improve the translation of well-conducted research to bedside practice.

Based on my experience as a nurse for 37 years, with the last 23 years as a clinical nurse specialist at St. Jude Children’s Research Hospital, I have been privileged to care for many brave children and their courageous families who have stimulated my passion for relieving suffering, which I view as a central element of nursing’s professional commitment to patient care. My patients continue to teach me that the assessment of their pain is not just a pain intensity rating, even with the most valid pain assessment tools; that their responses to opioid and other analgesic drugs can differ from those described in even the most carefully written textbook; and that children with serious and chronic illnesses experience much more than “only one little stick” as they struggle to cooperate with their
caregivers. Because my patients have shared with me, with the utmost dignity and good humor, how we, as health care providers, have succeeded and failed in our efforts to provide comfort, I enthusiastically agreed to compile what I hope will serve future patients. So on behalf of all the children who need our caring touch, thank you Yvonne D’Arcy, Pain Management & Palliative Care Nurse Practitioner at Suburban Hospital–Johns Hopkins Medicine and series editor, as well as Margaret Zuccarini from Springer Publishing Company for asking me to join their efforts in providing such resources for health care providers. I am grateful for the encouragement of Chris Pasero who generously agreed to write the foreword of this book.

Recognizing that many colleagues have influenced my practice throughout my years as a nurse, it is with heartfelt gratitude that I would like to acknowledge several groups of colleagues:

- The members of the Pain Management Service at St. Jude, who teach me every day while offering their compassion and skills as we continue to make a difference in the lives of the children who are entrusted to our care.
- The many coworkers at St. Jude, as well as other pain experts I have had the opportunity to network with through the years, who have reviewed and edited one or more chapters of this book, assuring me that my goal of providing the very best in information is finally a reality: Kelley Windsor, MSN, RN-BC, PCNS-BC (Chapters 15 and 18); Doralina Anghescu, MD (Chapters 1 and 5); Laura Burgoyne, BM, BS, FANZCA (Chapter 4); Roland Kaddoum, MD (Chapters 6 and 7); Valerie Crabtree, PhD (Chapters 4 and 9); Deb Ward, PharmD, BCOP (Chapter 3); Becky Wright, MD (Chapter 16); Jane Hankins, MD, MS (Chapter 17); Yvonne Avant, MSN, APRN-BC, CCRN, WCC (Chapter 14); Lama Elbahlawan, MD (Chapter 14); Sandy Merkel, MS, RN (Chapter 14); Kristin Wiese, PT, DPT (Chapter 10); Terese Verklan, PhD, CCNS, RNC (Chapter 2); and Leora Kuttner, PhD (Chapter 9).
- A patient and skilled scientific editor at St. Jude, David Galloway, ELS, who spent countless hours diligently editing each chapter to improve readability.
And others at St. Jude who continually support me professionally, including my director, Robin Mobley, RN, MSN, CNA; and Kelley Windsor, MSN, RN-BC, PCNS-BC, my job partner on the Pain Management Service.

However, no health care provider can remain a healthy and sustained professional without the support of others who keep one grounded during the highs and lows of a long professional career. I am fortunate, indeed, to have many friends who understood the need for me to seclude myself at times to write this book. I want to thank my father, daughters, sons-in-law, and especially my husband of 38 years, Lanny Oakes, all of whom have continued to encourage me to do my very best while often acting as my caregivers. As I complete what my two young granddaughters have named “Nanna’s Book,” I humbly offer my perspective, along with the best evidence available at this time, so that other health care providers may have more confidence and greater skills to reduce the pain in the children of our future.

Linda L. Oakes, MSN, RN-BC, CCNS
I

Overview of Pain in Infants and Children
THE PROBLEM OF PAIN

Pain is defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage” (International Association for the Study of Pain [IASP], 1979; Loeser & Treede, 2008). For health care providers, the definition of pain is translated as “whatever the person who is experiencing it says it is” (Pasero, Portenoy, & McCaffery, 1999), which is the basis for effective pain assessment and management. However, health care providers caring for infants and young children have the additional challenge of recognizing how pre-verbal patients report pain in the absence of language skills.

In recent decades, because of basic and clinical research, a heightened awareness of the problem of pain has led to improved measures, at least in the most developed countries, in the prevention, assessment, and treatment of pain in all age groups. Heightened attention from accrediting health care organizations, most notably The Joint Commission (2007) and national professional organizations (American Academy of Pediatrics [AAP], 2001; AAP, Committee on Fetus and Newborn Committee on Drugs, Section on Anesthesiology, Section on Surgery, Canadian Paediatric Society, & Fetus and Newborn Committee, 2000; American Pain Society [APS], 1999, 2005a, 2005b, 2008), has prompted the need for
increased knowledge of the physiology of pain and the related pharmacology of analgesics, especially appropriate dosing, as well as incorporating nonpharmacologic techniques into the care of patients (Edwards, 2002; Twycross, 2009). However, even today, the general consensus is that pain is often underrecognized and undertreated (Howard, 2003; Polkki, Pietila, & Vehvilainen-Julkunen, 2003; Twycross, 2007; Van Hulle Vincent & Denyes, 2004), not because health care providers have inadequate human compassion for their patients, but because of the following:

- Incorrect or outdated beliefs about pain (Twycross, 2007),
- Knowledge deficits and decision-making strategies used in pain management (Van Hulle Vincent & Denyes, 2004; Zernikow, Michel, Craig, & Anderson, 2009), and
- An organizational culture regarding the goal of minimizing pain safely and effectively whenever possible (Alley, 2001; Twycross, 2007).

Historically, infants and children have been undertreated for pain because of the now-refuted theory that they neither respond to nor remember painful experiences to the same degree as adults, leading to the erroneous conclusion that optimal pain management is not necessary in this age group (Breau et al., 2006). The ability of children to cope with distress through playing or watching television has led health care providers to conclude that their patients are pain free without asking them, resulting in withholding of appropriate analgesics.

**BRIEF REVIEW OF ANATOMY AND PHYSIOLOGY OF PAIN**

The transmission and modulation of acute pain is fairly well understood. *Nociception* is the term used to describe normal pain transmission. This process begins in the periphery (i.e., skin, subcutaneous tissue, or visceral or somatic structures), where the sensation of acute pain begins with the activation of nociceptors converting a noxious stimulus (e.g., needle stick) into electrical activity, a process called *transduction*. Sharp pain that is easily localized is typically transmitted
along A-delta fibers, but pain transmitted by C fibers is slow, dull, and difficult to localize. Conduction of the impulse occurs via afferent nerves to the dorsal root ganglia of the spinal cord (Edwards, 2002). From the level of the spinal cord, signals travel via the spinothalamic tract to make connections in the thalamus and cerebral cortex, where the pain is ultimately perceived (see Figure 1.1). The cortex also projects impulses to the limbic system, which mediates emotional responses to the pain. The perceptive component is subjective and can be quantified only by the individual.

In addition to receiving and interpreting information from peripheral input, the central nervous system acts as a sensory modulation system that plays a role in enhancing or inhibiting the progression of the pain impulse to the cerebral cortex, a process called neuromodulation. Neuromodulators such as endogenous opioids (i.e., endorphins) provide effects similar to those of opioid analgesics in their action on opioid receptors and are responsible for the attenuation of pain signals, resulting in different levels of pain for patients who undergo the same injury or surgical procedure. Spinal nociceptor input is also subject to descending modulatory influences from supraspinal sites.

Actual tissue damage results in the release of local neurotransmitters and neuromodulators, which in turn activate additional local nociceptors. Local neurotransmitters include bradykinins, leukotrienes, histamine, serotonin, and prostaglandins. Activation of these local nociceptors may, in part, be responsible for prolonged pain after acute injury. Neurotransmitters in the spinal cord, such as substance P, amplify pain signals from the periphery. These chemicals facilitate the transmission of the pain impulse from the periphery to the spinal cord, where sensory fibers travel to and converge on cells within the dorsal horn of the spinal cord.

Pain Transmission in the Developing Child
Substantial evidence shows that neonates, even the smallest of preterm infants, perceive and remember pain (Fitzgerald, 2005) and demonstrate specific pain behaviors (e.g., crying and withdrawing
1. The Problem of Pain

Figure 1.1  Spinal cord nociceptive pathways
limbs), serving as the basis for behavioral pain assessment tools (see Chapter 2). Research confirms that the anatomic structures for pain processing are in place from mid-to-late gestation (AAP, Committee on Fetus and Newborn, Committee on Drugs, Section on Anesthesiology, Section on Surgery, Canadian Paediatric Society, & Fetus and Newborn Committee, 2000; Duhn & Medves, 2004). Peripheral nociceptors remain unmyelinated or thinly myelinated throughout the life cycle from infancy and early childhood. Although incomplete myelination means the transmission of pain impulses is slower, this is offset by the shorter distance the impulse must travel in an infant’s central nervous system. Additionally, a lack of neurotransmitters in the descending tract suggests neuromodulating mechanisms are lacking in preterm infants, thereby making them even more sensitive to pain than older children and adults (Anand et al., 2006). Young infants are especially at risk for pain because of lower pain thresholds and enhanced pain sensitivity (Stevens, Anand, & McGrath, 2007).

CLASSIFICATIONS OF PAIN

To determine appropriate interventions for pain, several methods of classifying pain are useful for clinicians. Identifying pain as being either nociceptive or neuropathic in origin is useful when deciding which analgesics are most likely to be effective. Health care providers are to be reminded, however, that classifications may be oversimplifications and that patients can have more than one identifiable type of pain. Nociceptive and neuropathic pain can coexist, making diagnosis and treatment recommendations complex.

Pain in Terms of Injury to Tissues or Nerves

Nociceptive pain is associated with acute tissue injury or acute inflammation, as illustrated in the previous section of this chapter. This type of pain is an expected result of injury, associated with normal nerve transmission processes, and usually resolves with healing.
Nociceptive pain is protective in the sense that it prevents the patient from reinjury and provides an incentive to seek medical attention. This pain will usually respond to nonsteroidal anti-inflammatory drugs (NSAIDs) and opioids.

Neuropathic pain is characterized by altered sensory function often described as burning, electric, prickly, or shooting. Children use words such as “bugs biting” or “pins and needles” to describe such pain. Neuropathic pain is less understood than nociceptive pain. Although many mechanisms have been proposed, the general consensus is that the injury leads to repetitive spontaneous depolarizations, causing excitability within the peripheral nervous system. Neuropathic pain persists well after the injury to the nerve has subsided or the time expected for the injury to resolve has elapsed; it is often associated with motor, sensory, and autonomic deficits and is typically poorly or only partially responsive to opioids. Patients at risk include patients:

- Recovering from surgery involving nerves even within the surgical incision. A specific type of neuropathic pain that is particularly disturbing is that after an amputation of a limb, producing “phantom limb pain.”
- Who have disease processes involving or compressing peripheral nerve plexuses, roots, or the spinal cord (e.g., metastatic lesion compressing the spinal cord)
- Who have illnesses associated with nerve damage, such as Guillain-Barré or herpes zoster
- Taking medications associated with nerve damage, such as chemotherapy (e.g., vincristine or cyclosporine)

These sensory abnormalities are further defined as follows:

- *Dysesthesias/paresthesias*—unpleasant abnormal sensations, such as tingling
- *Allodynia*—the sensation of moderate to severe pain from a touch stimulus that is not normally painful (e.g., a bed sheet causing foot pain)
- *Hyperalgesia*—more than the expected pain intensity in response to a stimulus that is normally mildly painful (e.g., severe pain from a pinprick)
The diagnosis is based on clinical examination and the patient’s history. Coanalgesic agents, such as anticonvulsants and tricyclic antidepressants, have become the mainstay of treatment (see Chapter 5).

**Pain in Terms of Duration and Pattern**

*Acute pain* is an important biological protective mechanism, much like an alarm, notifying the body of harm and prompting a person to avoid further injury. Acute pain is associated with, at least initially, sympathetic autonomic system activity, such as tachycardia, hypertension, diaphoresis, mydriasis, and pallor. Uncomplicated acute pain is self-limiting and brief (lasting only hours to a few days) and generally disappears when the injury heals. A reoccurrence of acute pain may signal a serious problem, such as an abscess.

*Chronic pain* persists long after the initial acute injury or disease, lasting for as long as 3 to 6 months after the healing has presumed to have occurred (Finley, Kristjánsdóttir, & Forgeron, 2009; Stinson & Bruce, 2009). In other words, the acute phase has moved from a helpful alarm to a syndrome, much like a damaged home alarm ringing out of control (Siddall & Cousins, 2004). In contrast to acute pain, chronic pain is rarely associated with signs of sympathetic nervous system arousal. The lack of objective signs may lead an inexperienced clinician to wrongly conclude that a patient does not have pain (Eccleston, Jordan, & Crombez, 2006). Patients experiencing chronic pain benefit from approaches emphasizing nonpharmacologic interventions and rehabilitation components integrated and tailored to the needs of the patient (Berde & Solodiuk, 2003). For children, most chronic pain complaints are idiopathic in nature (with no known cause), resulting in a cycle of fear and anxiety for both the child and parent, exacerbating the pain (see Chapter 19).

**Pain as Somatic or Visceral**

*Somatic pain* arises from stimulation of pain receptors in superficial cutaneous and deeper musculoskeletal structures, usually well localized
and described as being sharp, aching, or throbbing. This category includes pain associated with surgical incisions, tissue injury such as mucositis, inflammation, and metastatic lesions.

*Visceral pain* is caused by infiltration, distension, compression, or distortion of organs within the thorax, abdomen, and pelvis. Typically described as vague, dull discomfort, this type of pain may be difficult to localize, because it may be referred to superficial sites removed from the involved organ (e.g., visceral pain related to hepatomegaly with radiation to the right shoulder).

**RESPONSES OF INFANTS AND CHILDREN TO PAIN**

Originally, efforts were focused on managing pain by reducing noxious stimuli, such as surgery, but recent advances in our understanding of responses to pain motivate health care providers to provide effective management beyond the obvious humanitarian reasons.

**Physiological Effects of Pain on Recovery**

Depending on the severity of tissue injury, responses to acute pain may be accompanied by systemic responses that alter hormonal, metabolic, immunologic, and other physiological functions, including the cardiovascular and pulmonary systems (Anand et al., 2006). Cardiovascular effects of pain include elevation in heart rate, blood pressure, afterload, and myocardial oxygen consumption, which can be poorly tolerated in medically fragile children. Negative outcomes of unrelieved pain that affect the recovery of patients from illness and participation in care include the inability to cough or take deep breaths. These conditions increase the risk of atelectasis, pulmonary infection, and nonadherence with treatment regimens such as ambulation and physical therapy (Dowden, 2009). Unrelieved pain can interfere with sleeping and eating and increases the risk of the development of chronic pain (Eccleston et al., 2006).
Multidimensional Nature of the Pain Experience

The expression of pain is multifaceted and is influenced by the child’s developmental level, sex, sensory, emotional, cognitive, cultural, and developmental makeup, as well as the context of pain. Further expression and subsequent pain experience are also based on the reception that the child perceives from those around him or her and the social and cultural environment. Experiences of pain can differ even when exposed to the same pain-inducing stimulus. This variation results from differences in personality, learning, expectation, and previous pain experiences. For younger children, the expression of pain will vary greatly, depending on these factors and their cognitive maturation. Therefore, pain can be considered to be a complex and multidimensional experience, incorporating sensory, affective, cognitive, and interpersonal components (see Figure 1.2).

The Developmental Level

The rapid maturation of biological processes during the first years of life and its effects on cognition, language, and behavioral and social competencies influence the meaning of pain and its subsequent expression. See Chapter 2 for further information on developmental level’s influence on pain assessment.

Infants may cry intensely and may be inconsolable, draw their knees to the chest, exhibit hypersensitivity or irritability to any stimuli, and be unable to eat or sleep.

Toddlers may be verbally aggressive, cry intensely, exhibit regressive or resistant behavior, and withdraw or guard the painful area but have limited language skills to describe pain further.

Preschool children are very egocentric in their thinking and believe that all events and sensations originate from their internal world. They have little understanding of cause-and-effect relationships, often misunderstanding the meaning and cause of pain. Young children need to be repeatedly reassured that procedures and painful experiences are not punishments for bad behavior or thoughts. Disruptions
in skin integrity from cuts, abrasions, or incisions are extremely threatening to children because of their fears of bodily injury and mutilation. They may believe that all their body and blood will leak out. Bandages and dressings may hold a special power for children as they “fix the leak” and hold the body in from the environment.
School-age children often resist movement of painful areas and have muscle rigidity, such as clenched fists, gritted teeth, and a wrinkled forehead. Gradually, they become more logical and reasonable in their thinking, gaining greater command over their world and tending to be achievement oriented. Because these children are often organized by rules, they respond well to rituals to cope with painful events. Health care providers need to be aware of these behaviors to gain cooperation during painful procedures.

Adolescents are capable of abstract thinking and have an understanding of “if-then” relationships. Although capable of adult-level problem solving, during stressful situations, adolescents may vacillate between adult-like responses to pain and regression to immature behaviors. How the socialization processes of adolescence affect pain experiences remains understudied in the pain literature, especially the role of their most influential group, their peers. They may deny pain and analgesics in the presence of family or peers because of peer pressure.

**Sex**

The relationship between the patient’s sex and pain varies with the population studied, and most of the work in this area has been done with adults. Whether differences extend to children is less clear, with conclusions that the sex-related differences in sensitivity, experience, and expression are complex, with many situational variables that are also influential in how a child responds to pain (McGrath & Hillier, 2003). However, research for adolescents indicates that the patient’s sex did influence anticipatory distress, and girls had higher pain intensity scores, but the studies did not show sex differences in use of opioids after surgery (Logan & Rose, 2004). See Chapter 19 for further information on the influences of a patient’s sex on chronic pain.

**Culture, Ethnicity, and Influence of the Family**

Cultural implications on pain remain elusive with no compelling evidence that culture significantly affects pain perception. Despite an increase in studies examining ethnic and racial differences in
pain in adults, with the assumption that children learn pain responses from their adult caretakers, few studies have examined the effect of ethnicity and culture on the experience of pain in children in the United States, suggesting potential cultural differences in how pain is expressed (Bernstein & Pachter, 2003; Jacob, McCarthy, Sambuco, & Hockenberry, 2008).

In the United States, health care providers may interpret their own experiences through the lens of Western medicine and culture, as well as their own cultural background and biases, and when combined, may influence the decision to administer analgesics or withhold them. One study showed that, for children with fractures seen in the emergency department, African American children covered by Medicaid were least likely to receive parenteral analgesia (Hostetler, Auinger, & Szilagyi, 2002), but others found no difference in analgesic administration based on ethnicity for adults (Fuentes, Kohn, & Neighbor, 2002), or adults and children (Yen, Kim, Stremski, & Gorelick, 2003).

Most importantly, children’s learning about pain begins at an early age. The feedback parents give by modeling and verbal reinforcement to their young children in response to “everyday” pain influences and shapes how they cope and respond to pain (McGrath & Hillier, 2003). Parents may respond to their younger children who have mild injuries with vigorous attention to every sensation. With older children, especially sons, parents may expect them to “be brave and tough it out” or “be a man,” in which the denial of pain is reinforced (McGrath & Hillier, 2003). Family influence can be more profound when one or more of the parents suffer from chronic pain themselves (Saunders, Korff, Leresche, & Mancl, 2007; see Chapter 19).

**CONSEQUENCES OF UNTREATED PAIN ON DEVELOPMENT**

Besides the initial physical and emotional negative experience of pain itself, growing evidence from both laboratory and clinical studies supports the premise that unrelieved pain has long-term
effects on the development of all patients, especially infants. Research has proved that neonates clearly perceive pain, as demonstrated by their behavioral and physiological responses to nociceptive stimulation (Brislin & Rose, 2005). Not only are these sensors fully present at birth, but they also are more sensitive (i.e., having lower thresholds) in infants than in adults (Brislin & Rose, 2005; Fitzgerald & Beggs, 2001; Gibbins & Stevens, 2003). Descending pathways originate in the higher centers of the brain and modulate the output of the nociceptive neurons in the periphery. These descending inhibitory controls are immature at birth and continue to mature until adolescence. Consequently, this important endogenous analgesic system is lacking in infants and young children, and the effects of noxious stimuli on the central nervous system may be more profound in children than in adults (Fitzgerald & Howard, 2003). Yet it is difficult to differentiate between motor reflexes and pain behaviors for infants and young children (Ramelet, Abu-Saad, Rees, & McDonald, 2004).

**Long-Term Effects of Unrelieved Pain**

Prolonged, untreated pain experienced early in life may have long-lasting effects on nociceptive processing and appear to sensitize infants and young children to subsequent painful experiences (Brislin & Rose, 2005; Fitzgerald & Howard, 2003; Grunau, 2000, 2002; Peters et al., 2005; Plotsky, Bradley, & Anand, 2000; Taddio & Katz, 2005; Taddio, Soin, Schuh, Koren, & Scolnik, 2005). Early work by Taddio, Katz, Ilersich, and Koren (1997) highlighted how painful experiences in early infancy influenced reaction to subsequent pain-generating events. Infants who were circumcised without topical anesthesia showed more behaviors associated with pain during subsequent routine vaccinations at 4 and 6 months of age than uncircumcised infants. In infants who had a eutectic mixture of local anesthetic (EMLA) cream at the site of circumcision, the provision of local anesthetics attenuated the pain response to subsequent vaccinations.
Longitudinal studies have shown that prolonged or repetitive pain at an early age alters the development of the peripheral, spinal, and supraspinal pain systems (Fitzgerald, 2005; Yamada et al., 2008). Relationships between neonatal pain and emotional temperament in infancy or childhood further suggest the widespread distribution of these neurobiologic changes. For example, damage to the peripheral nervous system in the newborn by repetitive pain from heel sticks, leading to hyperinnervation of the affected tissue for a prolonged period, seemed more profound in infants than in adults (Fitzgerald & Beggs, 2001).

In another study, infants who were exposed to repeated heel lance punctures in the first 24 to 36 hours of life exhibited more intense pain response (i.e., they learned to anticipate impending pain) during venipuncture than infants who had not undergone repeated painful procedures (Taddio, Shah, Gilbert-MacLeod, & Katz, 2002). Although the type and extent of the effects of unrelieved acute and repetitive pain during infancy depend on the type of pain stimulus, research suggests that early pain experiences may account for a portion of the variability in the pain thresholds and pain behaviors (both at the site of injury and overall sensitivity) and may influence physiologic, social, and cognitive outcomes (Grunau, Holsti, & Peters, 2006; Stevens et al., 2007). The consensus is that infants are especially vulnerable to the long-term effects, spurring on pain-control efforts in neonatal intensive care units (NICU; Breau et al., 2006).

Development of Hyperalgesia and Chronic Pain

Intense and repeated stimuli from tissue damage or inflammation result in the activation of the N-methyl-D-aspartate (NMDA) receptors in the spinal cord, causing the spinal cord neurons to become more responsive to many types of input from damaged or sensitized nociceptors and sensitizing of the area to even minor irritations (Fitzgerald & Howard, 2003). Repeated pain episodes contribute to “rewiring” of neural pathways in the spinal cord and brain, leading to increased and
ongoing pain sensitivity. This includes conditioned physiological responses triggered simply by the threat of pain, dissociated from actual nociception, so that chronic pain can become a learned, self-perpetuating behavior. Although the extent to which children recall pain and how early pain experiences significantly affect later development of chronic pain remain yet to be determined, the relationship between temperament and pain reactivity is provocative.

In summary, the need to overcome obstacles in providing effective pain relief is heightened by research that suggests pain experiences during the newborn period may have long-lasting effects on future pain perceptions and behaviors (Fitzgerald, 2005; Goldschneider & Anand, 2003; Grunau, Holsti, & Peters, 2006).

REFERENCES


1. The Problem of Pain


