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Management of Chronic Pain In Children
Zeev N. Kain, MD* and Stephen Rimar, MD†

Development of the fetal neocortex begins during the eighth week of gestation; by 20 weeks, each cortex has a full complement of neurons. Sensory pathways required for pain transmission can be traced from receptors in the skin to sensory areas in the cerebral cortex of infants. Functional development of the cerebral cortex is suggested by specific features of both the fetal and the neonatal electroencephalogram.

Pain relief has received considerable attention in recent years, but pain in neonates and children has been underreported, undertreated, and misunderstood. Several reviews have dealt with the recognition and treatment of acute pain, but much less has been written about chronic pain in children. Here we will address general considerations of pain management in children and specific chronic and recurrent pain syndromes of childhood.

Developmental Considerations
The perception of pain includes both a sensory component, involving neural pathway activation in response to noxious stimuli, and an affective/cognitive response, involving several behavioral aspects.

Cutaneous sensory perception has been reported in the perioral area of human fetuses as early as the seventh week of gestation and spreads to include cutaneous and mucosal surfaces by the twentieth week. Incomplete myelination of nerve fibers and immature synaptic connections have been thought to indicate a lack of maturity in the neonatal nervous system, but this phenomenon merely implies a slower conduction velocity, with much shorter traveling distance in newborns.

FOCUS QUESTIONS
1. How does the developmental status of infants, children, or adolescents modify their reactions to pain?
2. What are the common chronic pain syndromes in childhood?
3. What are the etiologies of chronic pain syndromes in childhood?
4. How are the chronic pain syndromes of childhood best managed?

The Response To Pain
A generalized motor and vocal response occurs to pain; among neonates, with maturation, this response becomes more focal and directed. For example, newborn infants undergoing circumcision and heel lance exhibit a distinct set of facial changes and body movements that accompany the crying response. Because infants lack the communications skills of adults or even older children, the question “Do neonates feel pain?” is difficult to answer. Older children develop anticipatory fear from past pain, and as they grow older, the number and variety of these experiences increase. The child’s perception and response to pain becomes more like that of an adult as cognitive and verbal abilities develop (Table 1).

Pain Threshold in Children
Some authors have proposed that infants and children have an elevated pain threshold compared with older children or adults. This view initially was supported by the observation that some neonates sleep comfortably following major surgery, even without analgesic medications. Recent observations of facial expression, motor movement, crying, and physiologic stress response, however, suggest a significant adverse response to a painful episode in infants. Other studies involving children’s response to abdominal pain and dental procedures suggest a decrease in pain tolerance with age. These studies, however, were conducted with children who suffered from recurrent episodes of pain; thus, the observations may represent age-related changes in anticipatory fear rather than pain threshold.

Furthermore, using tibial pressure as a painful stimulus, Haslam reported that younger children actually may have a lower threshold for pain than do older children. To date, however, there is no evidence that young children tolerate pain better than do older children or adults, and prospective studies still are needed to determine the effect of age on pain threshold.

Familial and Cultural Factors
Children and adolescents learn from parents and older family members about socially acceptable behavior in response to pain. Frequent episodes of pain and illness in the family correlate with episodes of pain in children and adolescents. Family size, place in the sibling order, socioeconomic status of the family, and the relationship between the child and the parents also are important.

Assessment Of Pain In Children
PHYSIOLOGIC PAIN MEASURES
Several physiologic parameters have been used to assess pain in infants and children, including changes in heart rate, blood pressure, serum cortisol concentrations, transcutaneous oxygen tension, and palmar sweating. Newborn infants demonstrate markedly increased heart rate and blood pressure during and after painful procedures; pain relief via opioids or local anesthetics can decrease or eliminate these cardiovascular changes. In older children, both heart rate and blood pressure are sensitive measures of distress during dental procedures and bone marrow aspiration. Palmar sweating also has been used in infants and children for measuring the degree of anxiety and distress related to surgical or dental procedures. Although used extensively by researchers, physiologic measures are not yet available for routine clinical practice.
OBJECTIVE MEASURES

Objective scales rely on behavior assessments coupled with physical signs of sympathetic activity. The most valuable observational measures are crying, facial expression, response to touch, leg position, and general body movements. It is difficult, however, to separate behavior associated with pain from that caused by fear, hunger, and separation from parents. In addition, these methods do not always agree with self-reporting measures: They may overestimate distress due to fear and underestimate acute postoperative pain.

SELF-REPORTED MEASURES

Because of the subjective nature of pain, simple self-reported methods are considered the best measure for children older than 6 years. These methods are less reliable in younger children because they rely on visual analogues, sensory association, and verbal response. Furthermore, young children may be frightened by strangers, and their response may depend on the manner in which questions are asked. The application of self-reported rating scales, therefore, is limited to children who can understand the objectives and descriptors of these techniques.

In an attempt to overcome the limited expressive abilities of young children, a number of projective measures have been suggested, including the use of cartoons, colors, poker chips, and children’s drawings. These projective measures provide a simple and attractive means of reporting pain—indeed, independent of verbal ability and communication skills. However, adult assumptions about appropriate ranking may not correspond to those of the young child; as a result, these scales are not always accurate. For example, school children using a numeric pain scale may associate high scores with good grades in school and use a score of 10 (no pain) rather than 1 (the worst pain).

TREATMENT OF PAIN

NONPHARMACOLOGIC TREATMENT

Relaxation techniques are especially useful in children who are anxious or who have hypertension or psychosomatic disorders. Relaxation training with biofeedback and a behavioral program is the preferred prophylactic treatment for recurrent headaches over any form of drug therapy. Techniques frequently used in children include guided imagery, alternating muscle tension, and biofeedback of temperature.

Hypnotherapy has been described for children and adolescents who have acute and chronic pain syndromes. It involves a combination of altered state of consciousness, time distortion, and alternation in sensory experiences. Hypnotic susceptibility increases throughout the school-age years, and many children can be hypnotized easily. With training, children can practice self-hypnosis and induce relaxation, focused attention, and diminished response to pain.

Physical methods, including exercise, can improve the body image of a child who has chronic pain and provide aerobic conditioning and improved muscle strength. Depending on the location of the pain, patients should be encouraged to swim, bicycle, lift weights, and perform other physical activities. Application of ice and massage are effective in treating pain associated with fractured limbs, chronic musculoskeletal injury, cancer, and headaches. In addition, tactile stimulation and alternating cold and heat frequently have been employed for stump pain and other deafferentation pain syndromes.

Transcutaneous electrical nerve stimulation (TENS) involves the application of a small electrical current to the skin via conductive pads attached by wires to a battery-operated generator. The analgesic action probably is due to inhibition of afferent nociceptive transmission by large fiber input to the spinal cord. TENS has been shown to be effective for acute somatic pain as well as for chronic neuropathic pain. This technique usually is well tolerated and accepted by older children and adolescents.

Acupuncture is an ancient Chinese technique used in a number of pain management centers in the United States. This technique involves placement of several fine needles at specific points (acupuncture points) in the skin. Acupuncture can be of ben-
Effin in adults for conditions such as peripheral neuropathic pain, recurrent headaches, and chronic chest pain. This modality, however, has not been well studied in children.

**PHARMACOLOGIC TREATMENT**
The pharmacologic management of pain in children has been detailed in several comprehensive reviews (see Shannon and Schechter in Suggested Readings) and will be discussed under specific chronic pain syndromes.

**Chronic Pain Syndromes**
Several features are common to chronic or recurrent pain syndromes in children. The painful episode may lack an organic etiology and may be triggered by a variety of external and internal factors, particularly stress. In most children, chronic pain syndromes are described more accurately as recurrent rather than continuous; pain occurs periodically, with symptom-free intervals. Recurrent pain may influence self-esteem, socialization, and academic achievement, and these issues must be addressed as well.

**ABDOMINAL PAIN**
Recurrent or persistent abdominal pain is common among children; as many as 25% of school-age children present to the clinician with symptoms. Although it is important for the pediatrician to exclude organic illness, the literature suggests that most children who have recurrent abdominal pain have no underlying organic pathology. Some investigators suggest that recurrent abdominal pain is the result of abnormal autonomic response to stress; others have observed that affected children have an exaggerated behavioral response to pain and frequently a family history of abdominal pain, as well.

Several characteristics are common in nonorganic chronic abdominal pain in children (Table 2). Children who have recurrent abdominal pain typically are of school age, with a slight female predominance. The pain is recurrent rather than constant and may be associated with nausea, vomiting, pallor, and headaches. The abdominal episodes appear to be precipitated by stress secondary to the child’s anxiety about performance at school, sports, social events, or parental pressure to achieve. These children are eager to please their parents and often are described as "superachievers" or even obsessional. Absences from school are frequent, and secondary gain may exist. Family issues cannot be ignored, and the pediatrician must determine how family dynamics reinforce pain behaviors. Family history of recurrent abdominal pain is important, and the physician should address this issue in his or her discussion with the family.

Treatment of abdominal pain resulting from an organic disease should be undertaken as indicated, and attention to the psychological aspects of the illness must be individualized. If no organic etiology is identified, the psychological background of the child and family should be assessed. Once an external trigger has been determined, the child and family should be given strategies for coping with stress. Secondary gain must be eliminated, and the child should participate in normal activities, such as attending school and social events. Absence from school is the equivalent of lost work time in the adult and should not be encouraged. Relaxation training with biofeedback and a comprehensive behavioral program is suitable for nonorganic recurrent abdominal pain. Reassuring the family about the absence of a correctable organic cause is an important part of therapy.

**HEADACHE**
Headache is the most studied pain problem in children and adolescents. The prevalence of childhood headache varies with age, ranging from 75% in adolescents to 2% in young children. The most common types of headaches in children are recurrent functional headaches, tension headaches, and migraine attacks.

Among children ages 10 to 17 years, stress is the most frequently reported precipitating factor of functional headaches, with 30% of elementary students and 40% of high-school students reporting it as the primary cause of their headache. Recurrent school absence may be due to chronic headaches and should be investigated by the pediatrician. In one study, class registers were inspected for two 12-week periods, and the parents of each absent child were mailed a questionnaire inquiring about the reason for each noted absence. Nearly 4% of the students missed school because of headache, although most of the absences (85%) lasted no longer than one school day. In another study, headache accounted for 10% of all children who were sent home from school because of illness.

Migraine is less common in children, reported in 3% of 7-year-old children and 11% of 14-year-olds. Stress is an important factor for both migraine and tension headaches. A recent study suggested that children who have migraines frequently may show symptoms of depression and anxiety and have somatic complaints.

In younger children, headache is less common and often indicates underlying organic disease. Dental conditions and sinusitis are treatable causes of facial headache and must be considered.

A thorough history, including description of the headache and associated findings, is essential for evaluation. Because stress is a frequently reported precipitating factor, the pediatrician should investigate underlying child and parental anxiety, as well as parental pressure for a child to achieve. Children who have mild benign headaches should be treated symptomatically with conservative measures, such as rest, quiet environment, analgesics, and physical and...
psychological measures. Patients who have severe recurrent headache without an organic etiology should be treated with a program involving behavior measures and prophylactic drugs. Hypnosis, stress management, relaxation, and biofeedback techniques have been shown to produce significant reductions in headache frequency and medication requirements. Treatment with ergot derivatives is recommended when headaches are severe but too infrequent to justify prophylactic treatment. Other drugs useful for migraine prophylaxis include propranolol, amitriptyline, phenytoin, phenobarbital, and calcium channel blockers.

**LIMB PAIN**

Recurrent limb pain is a common syndrome in children and accounts for nearly 10% of all pediatric office visits. Most limb pain is of benign origin, but it can represent a serious organic disease. One study of pediatric emergency room visits by patients who had limb pain found that presence of a limp, inability to walk, and positive findings on physical examination were predictors of organic causes (Table 3).

Recurrent episodes of lower limb pain in a clinically normal child often are called "growing pains." The etiology of this condition is unknown, and the pain may coexist with recurrent abdominal pain and headaches. This association may reflect a common psychological etiology related to stress and anxiety. Other investigators suggest that growing pains are similar to fibrositis in adults and represent an organic pain syndrome as yet undefined. Despite its name, the syndrome is not associated with rapid growth and is benign. Symptoms include pain late in the day that also can awaken the child at night. The pain is not related to the joints. Results of the physical examination, radiographs, and laboratory studies are normal. This syndrome can be treated effectively with reassurance, nonsteroidal anti-inflammatory drugs (NSAIDs), and massage of sore muscle sites. To date, there are no known long-term sequelae, and growing pains are not associated with any other organic illness of the extremities.

Neuropathic pain syndromes, including reflex sympathetic dystrophy (RSD) and causalgia, are being recognized increasingly in children. RSD manifests clinically as recurrent limb pain associated with vasomotor and sudomotor instability (abnormal sweating), hyperesthesia, edema, cyanosis, and eventually trophic changes of the affected extremity. Causalgia refers to a known injury to a major nerve trunk, but RSD may occur without a known precipitating event. Physical and psychological therapy may help in treating neuropathic pain, along with low doses of tricyclic antidepressants. When these measures fail, sympathetic nerve blocks can provide pain relief, often with long-lasting results.

**CHEST PAIN**

Chest pain is a common complaint in children and adolescents, but only a few of the cases are due to organic illness. The pediatrician should elicit a thorough history, including description of the pain, its location, and associated symptoms and findings, to evaluate and rule out an organic illness. A significant number of children who have benign recurrent chest pain may have a close family member who has ischemic heart disease. The most common cause of chest pain is musculoskeletal disease, especially costochondritis. Reassurance and treatment with NSAIDs and TENS may help. Chest pain can be a common complaint in children who have asthma and cystic fibrosis, in which rib fractures or intercostal muscle fatigue may be the underlying cause.

**SICKLE CELL DISEASE**

Children who have sickle cell disease have recurrent episodes of vasoocclusive crises, with severe pain in multiple sites, including abdomen, chest, and extremities. A painful episode in a patient who has sickle cell disease should be evaluated carefully to rule out other etiologies. Bone pain among these patients may be secondary to bacterial osteomyelitis, right upper quadrant pain due to cholecystitis, and left upper quadrant pain due to splenic infarction. Precipitating conditions such as hypoxia, acidosis, hypovolemia, and hypothermia should be treated first. For mild and moderate pain, rest, oral hydration, and mild analgesics such as acetaminophen, aspirin, ketorolac, and other NSAIDs may be indicated. For more severe pain, oral opioids such as codeine, morphine, and methadone are indicated. Severe pain crises should be treated with systemic narcotics in addition to aggressive intravenous hydration.

**CANCER PAIN**

Pain is common in children and adolescents who have cancer. A survey by the National Cancer Institute found that about 50% of hospitalized children experienced pain at the time of assessment. Pain can result from the tumor itself or from diagnostic and therapeutic procedures, such as bone marrow aspiration and lumbar puncture. The fear and anxiety associated with cancer can be treated successfully with hypnosis and other play or relaxation techniques. Small doses of tricyclic drugs such as ami-

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**TABLE 3. Diagnosis of Organic Versus Nonorganic Limb Pain**

<table>
<thead>
<tr>
<th>ORGANIC</th>
<th>NONORGANIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Occurs during day, night, school days, vacations</td>
<td>- Pain only on school days</td>
</tr>
<tr>
<td>- Impairs gait; inability to walk</td>
<td>- Does not impair gait</td>
</tr>
<tr>
<td>- Referred to joints</td>
<td>- Referred between joints</td>
</tr>
<tr>
<td>- Signs of systemic illness and localized pathology on physical examination</td>
<td>- No signs of systemic illness or localized pathology on physical examination</td>
</tr>
</tbody>
</table>
Chronic Pain Management

Acetaminophen

Mild pain in these patients can be treated with nonopioid drugs such as acetaminophen and NSAIDs. A combination of acetaminophen and NSAIDs. Patients who experience pain may be prescribed the addition of short- and long-acting oral narcotics. A combination of a short-acting agent (codeine, oxycodone, hydromorphone, or morphine) has been effective among these patients. Adjunctive medications such as antiemetics, antidepressants, and stimulants may be effective in treating nausea and disease-associated depression. Severe pain can be treated with continuous intravenous opioids. 

Chronic Pain Management

Analgesics necessary to bring relief. The consequences of the child’s pain and its relief must be evaluated and viewed in the context of rewards, secondary gain, and parental anxiety. Chronic pain may influence self-esteem, socialization, and academic achievement, and these issues must be addressed.

SUGGESTED READING


Schechter NL, Berde CB, Yaster M. Pain in Infants, Children and Adolescents. Baltimore, Md: Williams & Wilkins; 1993


BACK PAIN

Unlike the pain syndromes mentioned previously, back pain in children is uncommon and frequently results from organic illness. A clinician faced with back pain in a child should exclude infections and tumors as the underlying etiology. The history should be directed to neurologic changes, alteration in gait, or bowel and bladder dysfunction. Physical examination should include a complete orthopedic and neurologic evaluation. Overuse syndromes in athletes may result in facet syndromes, spondyloysis, fractures of the pars interarticularis, and herniated nucleus pulposus. Treatment depends on the underlying disease and manifestation.

Summary

Much has been written about the recognition and treatment of acute pain, but the syndrome of chronic pain in the pediatric population has received little attention. A pediatrician faced with a child suffering from recurrent or chronic pain first should exclude an underlying organic illness. However, the clinician also should understand that recurrent painful episodes may lack an organic cause; they may be triggered by a variety of external and internal factors, particularly perceived stress. The consequences of the child’s pain and its relief must be addressed.
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