# An Introduction to Acute Pain Assessment and Management

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This review is intended to introduce the pharmacy student to the area of acute pain management. Acute pain is a subjective experience that is usually associated with tissue damage. Acute pain is associated with a number of complex pathophysiologic changes that may cause detrimental events apart from the actual site of injury. An initial assessment of the painful state should be performed, followed by consistent assessments once therapies are introduced. Nonpharmacological approaches to pain include the use of heat and cold therapies, transcutaneous electrical nerve stimulation, and psychological techniques. The pharmacological therapies used for pain control include the nonsteroidal anti-inflammatory drugs (NSAIDs), the opioids, and local anesthetic agents. Other products such as the counterirritants are often used topically in the community setting for localized pain control. Regardless of the setting, the interaction between the pharmacist and the patient is an important aspect of pain management.

## INTRODUCTION

Acute pain is commonly encountered in inpatient and outpatient settings, and is managed to some extent by virtually all health care professionals. Therefore, it is not surprising that there is an extensive amount of literature concerning the assessment and management of pain, particularly related to the use of analgesic medications. The opioids have been used for approximately 2000 years to treat pain, although the pharmacist Serturner did not isolate morphine from the poppy until the early 1800s(1). Additionally, there seems to be an unending number of nonsteroidal anti-inflammatory drugs (NSAIDs) being developed and marketed as prescription and over-the-counter products that may be given by a variety of routes. The sheer volume of published information concerning pain management can be overwhelming to the pharmacy student.

During introductory discussions of pain management, it is important that pharmacy students not be overwhelmed with details to the point that important concepts are not retained. This review is intended to provide the pharmacy student with a basic understanding of the pathophysiology and assessment of acute, self-limited pain. Some of the more common nonpharmacological therapies for acute pain will also be discussed, since they may be used as adjuncts or alternatives to medications. The information presented in this article should provide the student with the necessary framework for a discussion of the pharmacological management of pain, which is briefly mentioned in this introduction to acute pain management.

## DEFINITIONS

It is appropriate to begin a discussion of pain control with a definition of pain. This is not as straightforward as it might first appear. Each of us knows when we are in pain *(i.e.,* pain is subjective), but the painful experience may not be reproducible even in the same individual(2). One definition that

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is widely quoted refers to pain as "an unpleasant sensory or emotional experience associated with actual or potential tissue damage, or described in terms of such damage."(3) Acute pain generally follows tissue damage. This damage activates pain receptors called nociceptors that are free nerve endings. Nociceptors have been classified by different systems, which frequently take into account the type and site of stimulus, and the conduction velocity of the involved nerve fibers(4). The pain is eliminated when the damage is sufficiently healed. The pain may also be diminished or eliminated before the healing process has taken place by internal or external interventions.

In contrast, while chronic pain is usually associated with a chronic pathological process, it may not be the result of obvious tissue damage and typically continues for months or years despite therapeutic measures to control the pain(5). The distinction between acute and chronic pain in the clinical setting is often less clear. For example, pain related to various types of malignancies may have components common to both of these general categories of pain. Therefore, many clinicians classify pain related to cancer as a distinct entity, rather than attempting to confine it simply as acute or chronic. Regardless of whether it is classified as a separate entity or as a subcategory of chronic pain, pain related to malignancies (as well as chronic pain) is beyond the scope of this discussion.

## PATHOPHYSIOLOGY

Four general types of pathophysiologic changes occur as a result of surgical-induced trauma: local and regional neurohumoral responses, central nervous system changes particularly in the dorsal horn of the spinal cord, neuroendocrine responses, and activation of the sympathetic nervous system(6). Neurohumoral responses result from the release of mediators such as histamine, bradykinin, serotonin, substance P, and prostaglandins. The role of cytokines in local and systemic changes continues to be investigated. The dorsal horn of the spinal cord serves as the terminal for the peripheral information that is being transmitted to the central nervous system. The dorsal horn neuron does not merely serve as a conduit for sending information up the spinal cord to the brain, but also undergoes changes that modulate subsequent input and output from the neuron(7).

Aspects of these changes are applicable to other forms of acute injury as well. It is important to realize that such changes are not isolated or independent events. These complex and inter-related responses to injury result in a number of beneficial and detrimental effects in the patient. For example, activation of the neuroendocrine and sympathetic nervous systems may help to maintain blood pressure and cardiac output, but the hyperstimulation may also cause agitation, hypertension, and myocardial ischemia. Similarly, while the production of carbohydrates from amino acid substrates may help to supply short-term energy needs, continued protein catabolism may be detrimental to vital organ function. In some patients the detrimental effects of pain clearly outweigh any advantages. The postoperative patient who has had chest or abdominal surgery may develop pulmonary complications (*e.g.*, atelectasis), as a result of shallow breathing and lack of coughing from pain, so steps need to be taken to ensure adequate control of pain(8).

An understanding of the pathophysiology of pain provides insight regarding therapeutic intervention for acute pain control, although the mechanism of analgesia is not always well-defined *(e.g.,* acetaminophen). According to conventional theory, NSAIDs act peripherally at the site of tissue injury by interfering with prostaglandin production, whereas the opioids act on various parts of the central nervous system depending on whether they are injected centrally or systemically. Recent evidence suggests the actions of NSAIDs and opioids are more complicated than this, since agents from both classes have demonstrated effects at peripheral and central sites. Similarly, while topical capsaicin is thought to act by depleting substance P from peripheral nerve endings resulting in loss of pain sensation, central actions of capsaicin have also been established(9). Local anesthetic agents produce analgesia by interrupting the transmission of impulses necessary for eliciting the perception of pain. A variety of counterirritants are available over-the-counter (OTC) such as camphor, menthol, and methyl salicylate. These products produce local irritation that is intended to relieve another irritating factor. Therapies that act on the neuroendocrine or sympathetic nervous systems may be useful for attenuating the pathophysiologic consequences of pain, even if they don't control the subjective component of pain(5).

## ASSESSMENT OF PAIN

"Pain cannot be said to have been relieved unless pain or pain relief has been directly measured."(10) Since pain is subjective, the patient should be involved in the measurement process. The initial assessment should include questions related to the patient's quantity and quality (*e.g.*, burning) of pain. Information should also be obtained regarding: location of the pain; the onset and evolution of the pain; what causes, increases, and relieves the pain; how the pain has affected the patient's functional status(11).

Systems used to quantify pain or pain relief rely on either verbal or nonverbal scales. Verbal scales have the advantage that they are relatively easy to use in most clinical settings, but they may lack sensitivity. With verbal scales, patients are asked to describe their pain, typically using words chosen by the clinician or investigator. The words must be chosen carefully to avoid ambiguity. It is also important that the gradation between successive words on a scale be similar, particularly when quantifying pain in studies(12). For example, assume that a researcher is testing three analgesics for effectiveness. One group of patients will receive DRUG X, another DRUG Y, and a third DRUG Z. After receiving their assigned drug, the patients are queried regarding pain control. The researcher has patients use the terms none, little, some, and severe to describe their pain. The words are assigned numerical scores so that formal statistical testing can be performed (none=0, little=l, some=2, severe=3). The mean scores are determined for each drug with the following results: DRUG X=1.9, DRUG Y=2.7, DRUG Z=2.3. All scores are found to be significantly different. The gradations between none and little, little and some, and some and severe should be equal to ensure that any conclusions drawn from the statistical evaluation are valid. If the patients thought that the terms "little" and "some" meant the same thing, conclusions about analgesic superiority would be limited. One verbal scale that is commonly used rates pain as none, mild, moderate, and severe. These words have been shown to be adequate descriptors of pain and may be useful in the clinical setting(11)

Nonverbal or graphic rating scales are also used to measure pain and pain relief. These scales would not be

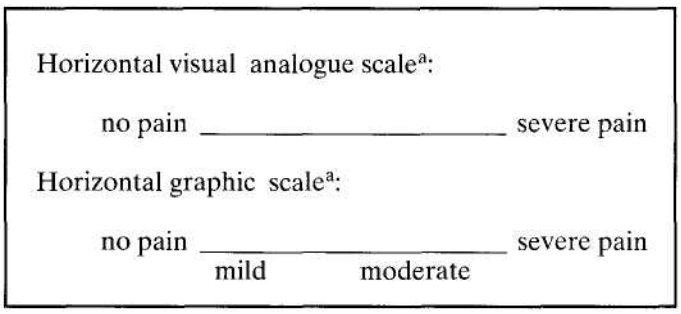


*Fig. 1. Visual analogue and graphic rating scales.*

[a]The patient is asked to draw a mark on the line that best describes his/her pain.

appropriate in patients with visual or physical impediments who would be unable to draw marks on a printed scale (see Figure 1)(13). The patient must be educated about the use of this instrument so that the same degree of pain will be marked on the same place of the line each time. A number of factors may affect the scoring and interpretation of results of nonverbal scales including: horizontal versus vertical line, length of the line, words used with line, and the number and placement of calibration marks on line(14). Although nonverbal scales have the potential advantage of greater discrimination between pain states, studies have not consistently demonstrated advantages beyond those obtained with verbal systems(15-17). It is likely that each of the rating systems has advantages for certain populations, and in some instances the systems may be complimentary when used together(18).

A number of questionnaires are available for evaluating painful experiences. These questionnaires often provide information about the quality, as well as quantity of pain. Many of the questionnaires also provide information concerning the psychological and functional status of the patient. However, they are often lengthy documents that may limit patient acceptance, especially if administered during the painful experience. The McGill Pain Questionnaire is one of most tested instruments for measuring and assessing pain; it is a reliable and valid tool(19).

The assessment of pain in children has its own unique problems. The neonate and infant do not have the verbal skills necessary to communicate their pain. This places more burden on the clinician to identify behavioral and physiological changes associated with pain. Older children may be capable of communicating, but words commonly used in adult pain scales may not be understood. A variety of techniques have been developed to assess pain in children, including numerical, spatial, and face scales(20).

Consistency is an important aspect of pain measurement, regardless of the type of assessment instrument that is used. Pain should be assessed at regular intervals, the frequency of which will vary. A patient in the immediate postoperative period may require minute-by-minute measurements in contrast to a patient with chronic pain that has been well-controlled for weeks or months. Ideally, one clinician should be responsible for administering and interpreting the pain instrument, although this may be impractical in some situations. Various clinicians may interpret the same results differently, leading to inconsistent recommendations for the patient. Similarly, lack of adequate documentation of the assessment results may hinder consistent prescribing patterns.

## NONPHARMACOLOGICAL THERAPY

The application of heat or cold to painful areas is an old and commonly used remedy. Similarly to some of the other therapies that will be mentioned, the mechanism responsible for the pain relieving activities of heat and cold has not been clearly defined. Assuming that neither is given in excess producing tissue damage, it is known that heat produces vasodilation and cold produces vasoconstriction(21).

Various devices have been used to deliver heat therapy including ultrasound and diathermy (electrical current). Cold therapy is probably most useful for the acute treatment of musculoskeletal injuries since it would tend to decrease the already high metabolic rate. Heat and cold therapies should not be used in people with vascular insufficiency or altered sensation. The vascular problems could be aggravated, while sensory deficits might diminish the recognition of excessive heat or cold causing further tissue damage.

More recently, transcutaneous electrical nerve stimulation or TENS has been used for relieving acute pain. The nerve is stimulated by electrical energy from a device that is applied on the surface of the skin. In a controlled study of traumatic pain, TENS has demonstrated efficacy similar to that of acetaminophen with codeine with both being superior to placebo(22). Transcutaneous electrical nerve stimulation has also been used for dental and labor pain, as well as perioperative administration(23). An advantage to TENS that is also found with heat and cold therapy, is it's relative safety.

Several psychological techniques may be used alone, or in conjunction with pharmacological therapy for pain control. These techniques can be categorized under four general headings: relaxation, biofeedback, hypnosis, and cognitive/behavioral. A description of the advantages and disadvantages of these therapies is beyond the scope of this review since they are primarily used for the management of chronic pain states. Articles discussing such therapies are available for the interested reader(24-26).

## PHARMACOLOGICAL THERAPY

In addition to acetaminophen, the salicylates, and topical counterirritant preparations that can be purchased over-the-counter and are commonly used for their mild analgesic activity, there are three major classes of medications used for the pharmacologic management of pain: NSAIDs (other than salicylates), opioids and local anesthetic agents. The NSAIDs are primarily used for mild to moderate pain, or pain that has an inflammatory component. There are many-prescription NSAIDs, as well as two over-the-counter products, ibuprofen and naproxen sodium. With the exception of ketorolac, which can be administered parenterally, the NSAIDs are administered orally. The adverse effect profiles for the various NSAIDs are similar. For example, all medications in this class have the potential for causing gastrointestinal problems ranging from irritation or "upset stomach" to massive gastrointestinal bleeding.

The opioids are used for moderate to severe pain. They can be administered by a variety of routes (oral, intramuscular, intravenous, subcutaneous, epidural, intrathecal), depending on individual patient considerations. Morphine is the prototype opioid to which other members of this class have been compared. Its adverse effects are well-documented and can usually be avoided with appropriate dosing and monitoring. The adverse effect profile is similar for the

**Table I. Common causes and treatments of acute self-limited pain[a]**

| Origin of pain | Pharmacological treatment |
|---|---|
| Dental (extraction) | acetaminophen, NSAIDs[b], opioids |
| Labor pain | opioids, local anesthetics, inhalational anesthetics |
| Musculoskeletal (overuse) | aspirin, NSAIDs, topical analgesics, local injections of anesthetics or corticosteroids |
| Perioperative | acetaminophen, NSAIDs, opioids, local anesthetics |
| Tension/muscle contraction headache | aspirin, acetaminophen, NSAIDs |
| Trauma | acetaminophen, NSAIDs, opioids, local anesthetics |

[a]This table describes medications commonly used for painful states; the particular agent chosen will vary depending on patient-specific factors.
[b]NSAIDs= nonsteroidal anti-inflammatory drugs.

**Table II. Nonsteroidal anti-inflammatory drugs used in adults with acute pain**

| Analgesic | Maximum daily dose (mg/day) |
|---|---|
| Aspirin | 6000 |
| Choline magnesium trisalicylate | 4000 |
| Diflunisal | 1500 |
| Etodolac | 1200 |
| Fenoprofen calcium | 3200 |
| Ibuprofen | 3200[a] |
| Ketoprofen | 300 |
| Ketorolac tromethamine (oral) | 40 |
| Ketorolac tromethamine (IV/IM) | 60-120[b] |
| Meclofenamate sodium | 400 |
| Mefenamic acid | 1000 |
| Naproxen | 1250 |
| Naproxen sodium | 1375[C] |

[a]For over-the-counter use, no more than 1200 mg/day is recommended.
[b]The lower daily dose should be used for patients 65 years of age, patients who weigh less than 50 kg, or patients with renal impairment
[c]For over-the-counter use, no more than 660mg/day of naproxen sodium is recommended (600mg/day as naproxen) if 65 years of age; no more than 440 mg/day of naproxen sodium is recommended if > 65 years of age (400 mg/day of naproxen).

different medications in this class, and includes respiratory and central nervous system depression. One of the most common complaints by patients taking opioids is constipation. There are a few important adverse reactions associated with particular agents. An example would be meperidine, which has an active metabolite normeperidine that accumulates in patients with renal dysfunction and may cause seizures.

Another class of medications used for pain management is the local anesthetics. Topical anesthetics may be used for localized pain relief, particularly when mucous membranes are involved. The topical anesthetics are generally less effective when they must be absorbed through intact epidermis, although new formulations are being studied that penetrate intact skin without the need for high concentrations of local anesthetics that may cause systemic toxicity. Local anesthetics are primarily administered in conjunction with opioids for epidural or intrathecal administration in the institutional setting. When given by the latter routes, local anesthetics may cause respiratory depression, urinary retention, and nerve block. Blockade of the sympathetic nervous system may result in hypotension, while motor and sensory fiber blockade may cause muscle weakness and decreased sensation, respectively. Epidural and intrathecal medication administration also require the involvement of specialized personnel. These disadvantages may be offset by improved analgesic efficacy compared to conventional parenteral opioid administration in selected patients(27).

Several basic principles of medication administration for acute pain control have been delineated by experts in pain management, including a panel of experts who published guidelines under the auspices of the Agency for Health Care Policy and Research. Agency for Health Care Policy and Research(28), These principles include the administration of regularly scheduled doses whenever possible with "as needed" doses for breakthrough episodes of pain. The routine scheduling of doses allows for pain prevention, which may not only yield better pain control than "as needed" doses, but may also decrease overall amount of medication required. However, the health care provider must realize that the amount of pain medication needed for specific patients can vary substantially. There is no maximum daily dose for medications in the opioid class of analgesics, instead doses are titrated to achieve adequate relief of pain or until the risk of clinically significant adverse effects becomes a factor. Maximum daily doses have been established for medications in the NSAID class, since the potential benefits are less likely to exceed the risks of toxicity when higher doses are administered (*e.g.*, gastrointestinal upset or bleeding).

Table I describes common causes and therapeutic options for acute self-limited pain, while Table II lists NS AIDs and maximum doses indicated for treating acute pain in adults. The medications listed in the tables may be administered by a variety of routes and methods. The oral and topical routes of administration are commonly used for self-medication in the community setting. These routes are safe, convenient and economical modes of administration compared to most other routes. Those patients with severe pain, or those unable to take medications by mouth are often treated with injectable preparations. The site of injection depends on the desired effect and potential toxicities of the medication, in addition to the training of the health professional. Intravenous, intramuscular, and subcutaneous injections are commonly given by nursing personnel, whereas physicians are more likely to administer local anesthetics, and epidural or intraspinal opioids. The introduction of transdermal delivery systems, such as the fentanyl patch, provides patients with another option for pain medication administration. However, the prolonged absorption of the available transdermal fentanyl product limits it's usefulness for acute pain management.

Whatever the setting, a health professional should be

available to provide consultation to the patient. The health professional may have to encourage patients to participate in this important conversation, since some patients either in too much of a hurry, or are reluctant to "bother" a busy clinician. The pharmacist may be the first and only reliable source of information for patients who are treating their own afflictions. Over-the-counter products are often perceived by lay persons as having few or no substantial adverse effects. There are numerous examples demonstrating the inaccuracy of this perception such as gastrointestinal bleeding, renal dysfunction, or aseptic meningitis that may be caused by the ingestion of NSAIDs.

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