UNDERSTANDING ENDORPHINS: OUR NATURAL PAIN RELIEF SYSTEM

BY B. ANNE WEST, RN, MSN, ANP • Adult Nurse Practitioner in Internal Medicine with Doctors Green, PC • Bristol, Tennessee

The good, old-fashioned back rub isn’t going out of style. It’s coming into its own as a safe, scientific way to increase the analgesic effects of medications. Continuing the series on managing pain, read how research on endorphins is bringing new respect to old comfort measures.

We’ve all had patients whose pain isn’t completely relieved even after we’ve injected 10 mg of morphine.

We know we should try to relieve the continuing pain by repositioning the patient and giving him back rubs. But these nursing actions are so basic we sometimes overlook them in the usual hustle and bustle of patient care. When we do, though, we’re overlooking a safe, effective way to augment morphine’s analgesic effect—through the body’s own pain relievers, the endorphins.

What are the endorphins?

Discovery of the endorphins followed the perplexing discovery that animal brains contained many specific sites to which opiate analgesics (such as morphine) formed chemical attachments.

These sites weren’t limited to cognitive areas of the brain. They were also abundant in the hypothalamus and amygdala, parts of the limbic system, which regulates emotions. They were present in the raphe nuclei along the midline of the pons and medulla and the periaqueductal gray matter that modify incoming sensory impulses. And they were present in the substantia gelatinosa in the dorsal horns of the spinal cord.

The abundance of opiate receptors in brain areas associated with emotions supported the assumption that opiates relieve pain by altering the perception of pain rather than by actually preventing it.

Researchers also reasoned that the brain wouldn’t have receptors for a plant alkaloid like morphine unless it also had natural (endogenous) brain chemicals that used those receptors. They began searching for such a chemical in hopes of finding a safe, effective natural analgesic.

By 1975, researchers had found a small polypeptide with five amino acids that attached to the opiate receptors. When the polypeptide was extracted and then injected into animals, it produced analgesia. Furthermore, when the polypeptide injection was followed by an injection of naloxone (Narcan), a powerful opiate antagonist, the analgesia was reversed.

Researchers called the polypeptide enkephalin, from the Greek “in the head.” But enkephalins aren’t the only opiate-like peptides. Later research identified a larger polypeptide in the hypothalamus-pituitary axis and in the midline of the diencephalon and anterior pons. This opiate-like peptide was called endorphin, a combined form of the words endogenous and morphine. Often, the word endorphin is used in a generic sense to include all the opiate-like peptides. For simplicity’s sake, I’ll use it that way in the rest of this article.

How the endorphins act

Research on the endorphins continues to yield more maybe than certainties. Here are some tentative conclusions researchers have reached:

• Endorphins are located in the synapses between nerve fibers. They probably transmit, modify, and inhibit noxious stimuli. Their inhibitory role probably derives from their ability to inhibit release of another peptide, substance P, which transmits noxious stimuli.
• Endorphins may relieve pain alone. People who have less pain than expected from an injury have high endorphin levels.
• Endorphin release may accompany other pain relief measures. Endorphin levels are measurably higher after successful pain relief by cutaneous electrical nerve stimulation and acupuncture.
• Endorphin release may be essential to the success of other pain relievers. When the narcotic antagonist Narcan is injected, the analgesic effect of electrical stimulation and acupuncture is reversed.
• Endorphin release may be responsible for the pain relief associated with placebos. Narcan reverses the “placebo effect.”
• Continuing pain may deplete endorphin levels. Patients with chronic pain syndromes have lowered endorphin levels. And effective pain relief by implanted electrodes increases their endorphin levels.
• Endorphins probably affect the psychological components involved in all pain. Endorphins have been called the “happiness peptides” because they sometimes cause euphoria. Endorphin levels are low in depressed patients and low in patients with chronic pain, which often involves depression.
• Endorphins may also reduce anxiety. Narcan injections, which inhibit endorphin activity, normally cause anxiety in healthy people. And anxiety is known to increase the perception of pain. Even in unconscious surgical patients, preoperative anxiety can be correlated with the need for increased anesthesia.
• Endorphins aren’t a panacea. Most scientists believe long-term use of injected endorphins would cause all the adverse
effects associated with plant alkaloid opiates such as morphine.

**Pain perception and relief**

Before we can understand the implications the endorphins may have for nursing practice, we must understand current theories of pain perception.

Pain research in the last 20 years has offered several complex theories of pain perception. One of the best known is the theory of two research psychologists, Ronald Melzack and Patrick Wall, called the Melzack-Wall gate control theory. Although neurophysiologists disagree with much of the theory, it provides a useful model of the complexity of pain perception.

Oversimplified, the gate control theory assumes that sensory nerve impulses such as pain impulses travel from the nerve receptor (at the fingertip, for example) to synapses in the gray matter (the substantia gelatinosa) of the dorsal horns of the spinal cord. The synapses are assumed to act as gates, which may close to keep the impulses from reaching the brain or open to allow the impulses to ascend.

Whether these (assumed) gates opened or closed would depend on what other kinds of sensory impulses were simultaneously bombarding the gates.

According to the theory, a predominance of impulses on thick mechanoreceptor fibers (which detect touch or pressure) would close the synaptic gates to impulses on thin thermoceptor (mild temperature change detectors) or nociceptor (irritation detector) fibers, and keep them from reaching the brain. Consequently, the person wouldn't perceive pain.

Only when impulses on thin fibers predominated would the gates open and allow pain impulses to reach the brain.

Other pain theories support Melzack and Wall's contention that pain impulses are mediated in the spinal cord before they reach the brain, and the presence of opiate receptors and endorphins in the substantia gelatinosa of the cord offers further support.

All pain researchers also agree that the brain itself plays an important role in mediating and even inhibiting pain impulses after they pass the dorsal horn synapse. Supporters of the gate theory believe that the brain, in several simultaneous processes, "recalls" the person's experience with pain and relates it to the present situation, assesses the person's emotional state and relates that to the situation. Finally, the brain "decides" how much pain the person will feel and how he will
How Endorphins Inhibit Pain

An afferent neuron from the dorsal root synapses with a pain-transmitting neuron in the substantia gelatinosa.

An impulse (pain signal) arrives at the synapse, and a pain message is transmitted across the synapse and up to the brain.

But a descending impulse from the brain may arrive at the synapse and release endorphins before the pain signal arrives.

The endorphins are released onto the opiate receptors of the afferent pain neuron, blocking the pain message across the synapse so no pain message is transmitted up to the brain.
Gate Control Theory

Most pain impulses probably travel along thin nerve fibers. If the predominant nerve message is pain, the gates open and allow the pain impulses to reach the brain. But competing messages from thick nerve fibers can close the gates before the pain impulses arrive. Fortunately, the skin has a large number of thick nerve fibers that can be stimulated with heat, cold, touch, and so forth, to close the gates and block the pain message to the brain.

Implications for nursing

Like the research that went before it, research on the endorphins confirms the physiological effects—as well as the psychological effects—of traditional comfort measures.

For example, here are some common nursing procedures and their effects:

Preoperative teaching reduces the patient’s anxiety, allows him to ask questions and thus assert his autonomy, and assures the patient that he can expect relief through medication and nursing measures if he develops pain. Teaching doesn't relieve all anxiety, of course, which is probably to the patient's advantage. Clinical research shows that some anxiety helps a patient mobilize his own defenses against pain. A patient with mild anxiety, though, perceives less pain and requires less analgesia than a patient with great anxiety. This supports the theory that anxiety-relieving interventions are associated with endorphin release.

Specific relaxation techniques, such as the Lamaze breathing techniques, increase the patient’s feeling of control and thus reduce anxiety, prevent muscle tension and fatigue—sources of secondary pain—and distract the patient, thereby modifying his perception of pain. Distraction probably achieves its pain-relieving effect by endorphin release, stimulated by a descending impulse.

Positioning increases blood supply to immobilized areas, reducing fatigue and muscle spasm. Although many patients remain immobile in an attempt to reduce pain, the result is an increase in pain as pain impulses from nociceptors in immobilized tissues join pain impulses from the surgical site (for example) in bombarding neural synapses. Frequent positioning reduces activity in peripheral nociceptors.

Massage activates the thick fiber mechanoreceptors. As discussed earlier, a preponderance of thick fiber impulses helps block thin-fiber pain impulses, probably through the release of endorphins. Thus, traditional nursing measures such as touching and rubbing enhance the body's own defenses against pain perception.

This information should do away with the mistaken notion that the patient whose pain was relieved by a back rub "couldn't have been feeling real pain."

Pressure at acupuncture points (acupressure) and over bony prominences (osteopressure) also stimulates the mechanoreceptors, thus blocking pain impulses.

Distraction techniques such as guided imagery, which help the patient focus on pleasant thoughts, are thought to modify or inhibit the brain's perception of pain, probably through its descending pathways.

Continuing research

The more we've learned about pain perception and response, the more complicated we've realized it is, involving cognitive functions, emotions, cultural traditions, memories of previous pain, and environmental influences.

The more we've learned about pain relief, the more we've realized that the comfort techniques we were taught "to increase the patient's psychological well-being" also increase his physiological well-being.

Further research on the endorphins can be expected to add more to our understanding of pain relief and to our respect for simple nursing procedures—with their complicated and effective results.

SELECTED REFERENCES
