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CHAPTER 14

Cognitive Behavioral Therapies and Beyond

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If you are distressed by anything external,
the pain is not due to the thing itself,
but to your estimate of it.
This you have the power to revoke at any time.
Marcus Aurelius, circa AD 180

Patients suffering chronic pain are often overwhelmed psychologically and emotionally. The toll taken upon these individuals includes changes in lifestyle, mood, interpersonal and family interactions, and generally a sense of being out of control of one's own life and destiny.

Psychological treatments for chronic pain, both in the past and present, have centered on offering patients validation for their pain problem and attempting to reestablish a sense of control over one's own life. Dynamically oriented psychotherapy had shown equivocal results in its applications to chronic pain management. Specifically, one study found that although the level of function of the person was increased, the pain awareness was also increased. Over the past 20 years, cognitive behavioral therapies have come to the forefront as one of the most effective psychological treatments for chronic pain management.

The 1990s was officially the Decade of the Brain, and fortunately for pain management, much information has been learned in terms of acute versus chronic pain, memory, learning, and perception. This research has generated newer understanding and hypotheses of nociception and the psychological ramifications of chronic pain, and this newer understanding is now being applied to psychological methods in pain management.

This chapter will discuss some of the newer research in terms of central sensitization, how memory is made and stored, concepts of learning, and perception in general. We will then attempt to place these newer concepts in perspective for their application to pain management, reviewing both cognitive behavioral treatments and more recently developed approaches, including eye movement desensitization and reprocessing (EMDR).

PAIN

Price has introduced a new definition of pain. He proposes that pain is "a somatic perception containing: 1) a bodily sensation with qualities like those reported during tissue-damaging stimulation, 2) an experienced threat associated with this sensation, and 3) a feeling of unpleasantness or other negative emotion based on this experienced threat" (1). This suggested definition of pain distinguishes somatosensory sensations from unpleasantness and requires nociceptive sensation and unpleasantness in order to produce pain. It links integrally the affective dimension of pain to the cognitive-evaluative dimension of pain. By linking the three components in his new definition of pain, Price aligns this definition with the experience of pain or the resultant holistic perception. According to Price, this new definition "helps justify using the term 'pain' for persons whose pain is *not* objectively or subjectively associated with tissue injury. Nevertheless, the definition retains the idea that painful sensations have at least a putative relationship to tissue injury because the sensations are *like* those that result from tissue injury" (1).

Pain has been categorized, with difficulty, over the years. Earlier efforts attempted to differentiate pain as acute or chronic and also as Category I or Category II types of pain. Category I (acute pain) pain represents a symptom of underlying illness or injury. Category I pain is considered a warning, and its purpose is to alert the person that something is wrong and needs to be investigated and treated at the site of primary pathology. Category II pain, on the other hand, has no value to the person in terms of its message and reflects pain resulting from a neurobiological change within the nervous system. These changes in

TABLE 14-1. *The experience of pain*

	Immediate pain (Eudynia, acute pain, Category I)	Long-term pain (Maldynia, Category II)
Primary Quality	"Ouch"; primary stage of pain affect	Suffering ("yuck"); secondary stage of pain affect
Meaning of Pain	Physically based; sudden intrusion; possible harm	Interference; difficulty in enduring; ultimate consequences
Felt Sense	Fear; shortly followed by anxiety, anger	Despair; frustration; hopelessness; depression
Dimensions of the Experience	Desire to avoid harm; expectation of avoiding harm; threat to self	Desire to avoid or terminate the interference; burden of enduring pain; expectations whether desires can be fulfilled
Psychophysical Attributes	Highly reliable pain thresholds; minimal adaptation of pain intensity in the presence of maintained nociceptive stimulation; slow temporal summation; spatial summation; and radiation of perceived areas of pain sensation at suprathreshold levels of nociceptive stimulation	Exaggerations or abnormal triggering of same mechanisms

the central nervous system result in a central sensitization that tends to affect the sensory system in general, which includes the nociceptive and limbic systems as well as special senses perception. The American Academy of Pain Medicine has officially adopted the term *eudynia* (good pain; i.e., normal pain, warning pain) for Category I. Category II represents *maldynia* (bad, destructive pain). Some ongoing painful disorders can actually represent a combination of eudynia and maldynia concurrently.

Most definitions of pain, including Price's new definition, include both a sensory nociceptive component and an emotional component. However, it is important to understand that the emotional component adds the affective dimension to pain and unpleasantness and is not a separate issue from the painful experience. The emotional experience is based on desire and expectation, which incorporate both cognitive appraisal (2) and physiological activation or arousal. The extent of physiological arousal generally increases with the significance of the desire factor and early stimulation (3,4), and the patterns of that arousal are often codetermined by the nature of attitudes, expectations, and intentions (1). How expectation and desire factor into the experience of pain differs for immediate pain (Category I) and long-term pain (Category II). These are summarized in Table 14-1, based upon the work of Price (1).

The affective dimensions of pain also differ between immediate pain and long-term pain. Table 14-2, again based on Price's work (1), summarizes these differences.

PAIN AND GENDER

Although there has been a great deal of interest regarding sex differences and pain perception, the issue remains largely unanswered. Fillingim (5) points out the discrepant research findings, with some indicating that sex differ-

TABLE 14-2. *Affective dimensions of pain*

	Immediate affective dimension	Secondary affective dimension
Unpleasantness	Moment to moment	More reflective cognitions
Orientation	Present or short-term future	Past and long-term future
Affect	Closely linked with the intensity of painful sensation and associated arousal	A component of the pain itself
Meaning of the pain	Attentional shift to bodily area of concern and motor orientation to this area; autonomic responses	Interruption of function; burden; permanency of damage or harm
Neuroticism (high emotionality and arousability)	Contributes mild influence	Can contribute significant influence
Age	No effect	Decreased negative emotional feelings with increasing age

ences in pain are robust, and others indicating only mild to moderate differences. Mogil (6) reports that genetic pain-related differences may relate to species as well as biological sex and that they may be interrelated. For example, in some species of rats males demonstrated a greater pain threshold than females, whereas other species of rats showed the reverse condition. Robinson et al. (7) indicate that as the psychosocial factors affecting pain reporting and pain response are stripped away, there seems to be less and less sex difference (biological) in humans than gender difference. The increased reporting of pain by women is felt to be strongly psychosocial in humans.

Much of the discrepancy regarding pain, sex, and gender remains because of the complexity of research strategies and identified criteria in this area. Most of the work has focused on the sensory discriminative portion of acute pain, with less research being done on the affective dimension of chronic pain. Thus, there are no clear-cut answers for this issue.

CENTRAL SENSORY DYSFUNCTION

Central sensitization seems to occur at different levels within the central nervous system. Studies have shown sensitization of the spinal cord, brainstem, and possibly at the cortical level as well (1,8–14). This sensitization of the central nervous system seems to result either from repetitive timed stimulations or an overwhelming single stimulation resulting in long-term potentiation. It has been known for many years from animal studies that sensitization can result in seizures through kindling (11,15). There are three stages to kindling. In the early stage, repetitive subthreshold stimulation results in an occasional seizure in the animal. In the complete stage, each subthreshold stimulation will result in a seizure, and in the automatic phase, seizure occurs without further stimulation. In addition to seizure itself, behavioral and nociceptive sensitization has been demonstrated in animals and is strongly postulated in humans (16). Repetitive timed stimulation has been shown to promote kindling, whereas continuous stimulation has been shown to inhibit it. In addition, animal studies have shown that recruitment and convergence are important in the development of sensitization. Through recruitment and convergence, nonrelated (nonnociceptive) neurons are drawn into action, so that seemingly innocuous stimulation can now result in the sensitized behavior. For example, in rats that have reached the complete stage of sensitization, a seizure can be produced from the resultant stimulation of the hand touching the rat hair by simply picking the animal up (17,18).

Central sensitization has been implicated in multiple painful syndromes, including complex regional pain syndrome (CRPS) (19), phantom pain (19), myofascial syndrome and fibromyalgia (20), chronic headache (11) and rebound headache (21), chronic visceral painful syndromes (especially irritable bowel syndrome) (22), and chronic dysphoria (depression) (23). Central sensitization is also considered to be heavily involved with posttraumatic stress disorder (PTSD) (24–28). This takes on special importance because it is known that the incidence of psychological traumatization, with or without a full-blown posttraumatic stress disorder clinically evident, is much higher in chronic pain patients than it is in the general population (29–31).

Because of the strong correlation between posttraumatic stress disorder, psychological trauma, and chronic pain, let us take a more in-depth look at posttraumatic stress disorder. Kardiner has described the five cardinal features of human response to trauma as (32,33):

1. The persistence to the startle response and irritability
2. A proclivity to explosive outbursts of aggression
3. A fixation on the traumatic event
4. A constriction of the general level of personality function
5. An atypical dream life

The clinical symptoms that we see as described by Sonenberg (33) include intrusiveness (having thoughts, having dreams, and feeling the event again), diminished interests, detachment, constriction of affective responses, hyperalertness, cognitive dysfunction (including memory/concentration problems), avoidance of activities that arouse recollections, intensification of symptoms by exposure to similar events, autonomic lability, headaches, and vertigo.

Van der Kolk (34) has described the difficulty with modulating the intensity of affect as secondary to the hyperarousal seen in these patients. He quotes a patient as saying, "You can never feel just a little bit: it is all or nothing." According to van der Kolk (35), it is common for the dichotomy of mature intellectual growth and emotional immaturity to coexist in adults who were traumatized as children. As one patient expressed it, "The head keeps growing, but the body keeps count." Van der Kolk (25,34, 36) has examined the concept of intrinsic vulnerability to PTSD and has found that individuals with a high internal locus of control (those who have previously successfully overcome adversities) appear to be more stress resistant. Spiegel (37) has pointed out that part of the locus of control is inborn, and part is also affected by early trauma. Inescapable shock studies in animals show that those animals that previously had exposure to escapable shock are more stress resistant (26,34). Rauch (38) points out that MRI studies of PTSD patients show an increase in the cavum septum pellucidum (a small midline cerebrospinal fluid-filled variant of normal anatomy) and that this increase may represent the notion of preexisting vulnerability. Hence, there may be both constitutional and learned determinants to vulnerability.

Rauch also postulates that PTSD patients exhibit hypersensitivity within the amygdala and a failure of the medial frontal cortex to exert governance over the amygdala. He asserts that hippocampal damage results in

amnesia, learning problems, and memory decrease. Hence, there is clear evidence for involvement of the limbic system in PTSD.

Shalev (39) demonstrated with auditory stimulation that there is a neuronal sensitization involved with PTSD. In this study, loud noise was shown to produce a more severe and exaggerated effect in persons with PTSD compared to normal controls, supporting the findings for lowered thresholds to actually cause a reaction, in addition to augmentation of the reaction itself. (A separate but similar study looking at hypervigilance in fibromyalgia also supports the same kind of response. In fact, in that study, it was suggested that fibromyalgia patients have a perceptual style of amplification and prefer lower levels of external stimulation than do controls [40].)

MEMORY

We will look further at how sensitization is involved in painful syndromes and their concomitant emotional states later. Now we will explore newer concepts in memory.

Memory is made for all events in our lives. It is in our "hard drive." This memory is permanent on a cellular level but does not necessarily remain in our conscious awareness. For example, van der Kolk found that the victims of early (before age 6 to 7 years) sexual abuse are generally amnestic to it, unless the memory has been revived by a more recent event (28,34,35,41,42).

Recent research on memory has concluded that memory is made and stored according to events and patterns. The magnitude of the activation in the left prefrontal, temporal, and parahippocampal cortices predicted whether events would be remembered or forgotten (43,44). The hippocampus and amygdala (45) are heavily involved with emotional memory and the evaluation of emotional stimuli through a complex chemically modulated system, including NMDA (N-methyl-D-aspartate) receptors and dopamine (12,46–48). Long-term potentiation in the hippocampus may underlie learning and memory (12).

Memory can be declarative or procedural. Working memory is short-term and operates over a period of seconds but is integrally related in behavior, language, and thinking. This memory can be declarative or procedural. The prefrontal cortex seems to be quite significant for object identity, spatial locations, memory and coding, and analysis of the meaning of items (2,49,50). Different parts of the prefrontal cortex are involved in different types of memory. The middorsolateral and midventrolateral frontal cortical areas make distinct functional contributions to spatial working memory. Imaging studies show increased prefrontal cortex activity as the complexity of semantic processing rises (43,44,46,50).

Contrary to earlier precepts, it is now understood that memory is made in mnemonics and not pictures. This mnemonic-type memory involves both the memory traces of the actual event as well as the memory traces of the affective and emotional components of that event. Memory is stored according to like associations, whether they be actual events or their affective components (43,44, 46,50). It is now postulated that memory to sensory discriminative nociceptions (lateral pain pathways) is made separately, but in parallel, with memories for the affective dimensions (medial pain pathways) of those nociceptive events (10,51).

Based on this understanding of dual and parallel memories, we can then begin to understand how memory made to two seemingly disparate actual events, which may have a similar emotional or psychological meaning to the patient, will then create memory storage of like mnemonics (associations) for the affective or emotional component but separate remembrances for the actual events. Recall of events then consists of drawing upon the storage compartment for the actual events as well as the storage compartment for the affective component. But if the mnemonic storage compartment of the affective component is heavily loaded because of other affectively similar (linked) events in that person's life, the recall of the actual event may then be burdened with an affective response disproportionate to what one might expect (52).

PAIN AND MEMORY

This affective augmentation in relationship to pain perception is best explained by the hypothesis of Rome and Rome (10). They have titled this hypothesis "Limbically Augmented Pain Syndrome (LAPS)." This syndrome is characterized by chronic pain often disproportionate to physical findings, with associated disturbances of mood, sleep, energy, concentration/memory, libido, behavior, and stress tolerance.

According to the LAPS hypothesis, a central sensitization takes place through kindling of both nociceptive and nonnociceptive systems. Rome and Rome postulate that through the lateral and medial pain systems, a sensitization occurs in vulnerable individuals, which results in an augmented pain response to future stimuli, which may not even be nociceptive in nature.

The lateral pain system has projections from the spinothalamic tract to the ventral posterolateral and posteromedial thalamic nuclei. The cortical projections go from there to the primary and secondary ipsilateral somatosensory cortices and result in contralateral, highly discriminative nociception. This lateral system provides the "ouch" portion of our pain consciousness, or the sensory discriminative component.

On the other hand, the medial pain system has projections from the spinal reticular and spinothalamic tracts to brainstem nuclei (including periaqueductal gray, locus coeruleus, and raphe nuclei) and medial thalamic nuclei (including parafascicular and central lateral nuclei). These thalamic and extrathalamic pathways go to the limbic and paralimbic regions and continue rostrally to the prefrontal

and motor cortices. There are direct and indirect nociceptor projections to the hypothalamus, central nucleus of the amygdala, nucleus accumbens, infralimbic cortex, ventral pallidum, and globus pallidus. The medial pain system can represent one or both sides of the body, can be both ipsilateral and contralateral, is nondiscriminative, and provides the affective coloration or the "yuck" component to our pain consciousness.

Especially important to the Romes' LAPS hypothesis are the concepts of behavior sensitization, long-term potentiation, and time-dependent sensitization. These are all considered related mechanisms of neuroplasticity and share a premise that a neurobiologic mechanism or sets of mechanisms that occur preferentially within the limbic system serve as an amplifier for biologic reactivity to repetitive/low intensity stimuli.

Rome and Rome draw upon the work of Price (1), Harkins (53), as well as Gracely (54) to develop a tiered system of pain perception, involving a primary pain affect (which is related to the current nociceptive signal) and a secondary affect (which can include both pain-related and nonpain-related affects). This tiered system allows for secondary affects (pain related and nonpain related) to serve as a gain mechanism to amplify the affective (and possibly the nociceptive) component of our conscious perception of pain, which is consistent with the understanding of memory storage for like associations being linked together (52). This emotional memory is processed through the amygdala (45).

There is support for the LAPS concept in both animal and human research. In their work with animals, Weiss and Post (55) have identified six common features in response to repeated stimuli:

1. There are shorter latency and increased magnitude of response (sensitization).
2. Effects are dose related and persist for weeks or months.
3. Intermittent stimulation facilitates sensitization.
4. Genetic factors may influence sensitization.
5. Sensitization is highly context-dependent and conditionable.
6. Cross-sensitization occurs between various stimuli.

Human studies have shown that pain-evoked potentials in control subjects show a graded increase in wave amplitude depending on whether the stimulus was above or below pain threshold. However, in chronic pain patients (sensitized individuals) the wave amplitude was high in both stimulus conditions. Studies with deep brain stimulation of the somatosensory thalamus reproduced pain with a strong affective loading in patients who previously had such affectively charged pain, but in those subjects without such a history the induced pain was free of such coloration.

It is this repetitive affective stimulation, according to the LAPS hypothesis, that can lead to sensitization, especially of the medial (limbically connected) pain system. The gain control amplification of the primary pain signal ("ouch") may come about by the extra load then placed on the actual event (the primary signal) by the overloaded affective component ("yuck") as the message passes through the cortex and is finalized in conscious perception.

Thus, we can begin to understand how earlier traumatization(s) may be drawn into the person's conscious perception of current pain. This concept correlates with what we see clinically in the syndromes associated with central sensory dysfunction. There can be augmentation of the affective component of a pain signal in a person with previous like-mnemonic memory traces, even if there is no full-blown posttraumatic stress syndrome present in that person.

LEARNING

Learning theory also has benefited from the Decade of the Brain research. New understandings of how we learn show that learning seems to be integrated in the brain through multiple neurochemical channels and is more closely linked with brain circuits and interconnections rather than with any one particular area of the brain or any one neurochemical transmitter. NMDA is highly involved in learning, restorative function for neuronal cell life and growth, as well as cell death, and is also thought to be intricately woven with sensitization-related neurobiological changes (12,13,56–58). As with other areas of cortical functioning, the amount of NMDA involvement is more predictive of better memory (55). The same intensity of synaptic strength underlies long-term potentiation development (12). As cited earlier, dopamine and serotonergic systems are also involved with long-term memory and learning (46,59).

Thus, we are beginning to understand the involvement of the prefrontal cortex in short- and long-term memory development with subsequent involvement of the amygdala and limbic system. In fact, brain-imaging studies have shown that the prefrontal cortex shows sustained activity during the delay period of visual working memory tasks, even in the absence of sensory input (60). This working memory is considered one of the components of conscious perception or awareness of pain.

Perhaps one of the best applications of these new learning concepts in terms of pain management is the placebo response. Studies of the placebo response (1) have shown clearly that the amount and intensity of placebo response are most closely correlated with expectancy than any other phenomenon. Conceptually, we may then begin to understand why many of our patients can be maintained on long-term opioid use without significant increases in dosage, yet with good maintenance of pain relief.

PERCEPTION

Conscious perception is still somewhat of an enigma, in spite of all the recent learning that has taken place about brain function. There does not seem to be any one

"perception center" within the brain, but rather conscious perception seems to be a manifest intricate networking of multiple systems coming together through related patterned tracts within the brain to produce our awareness. The eventual consciousness that arises from this construction of perceptions is defined as qualia and represents psychologically projected constructs into the external world. Some of these perceptions may be up to 90% memory (61). Thus, pain perception, per se, is influenced by the lateral pain system with its highly discriminative nociceptive identification, mixed with the medial pain system, including its affective colorations and stored memories, previous memory trace expectancies, and nonnociceptively related (but linked in memory by the brain) inputs.

Although the brain is continually "multitasking," conscious perception is limited to "single tasking" (37). That is, we can have only one image on our screen at a time. This can serve to our advantage in terms of pain management because as we develop ways to keep conscious perception on any issue other than pain, we then defeat the awareness of pain for that amount of time. Indeed, this limitation has been usefully adapted in many techniques, including cognitive behavioral techniques, self-hypnotic techniques, meditative techniques, etc. We are all familiar with the cliche that if your foot hurts, bang your thumb with a hammer, and your foot will no longer hurt. This concept is based upon that single-tasking screen we have for conscious perception. However, that screen can also replace nociception with anything pleasant.

APPLICATIONS OF BRAIN RESEARCH TO PAIN MANAGEMENT

The LAPS hypothesis, as mentioned, can help us understand an augmented affective component, or increased emotional intensity, to painful syndromes. This concept can apply to any painful syndrome where sensitization has occurred. In addition to emotional augmentation, we can see the effects of central sensitization resulting in a central sensory dysfunction for the nonemotional (sensory discriminative) component of painful syndromes. Let's review some common painful conditions representing this central sensory dysfunction, including fibromyalgia, chronic fatigue syndrome (CFIDS), visceral pain, headache, complex regional pain syndrome (CRPS), phantom pain, and dysphoria.

Fibromyalgia

In studying fibromyalgia, Vecchiet (20) found hyperalgesia of the skin, subcutis, and muscles in both tender points and nontender points, and Graven-Nielsen (62) found lower pain thresholds in patients with fibromyalgia. Both of these findings seem to be indicative of a spinal level of sensitization. Graven-Nielsen also found larger areas of referred pain, which are attributed to a supraspinal central sensitization.

Bradley et al. (63) found decreased regional cerebral blood flow (rCBF) to the caudate nucleus and thalamus in patients with fibromyalgia syndrome, who concurrently also demonstrated a decreased pain threshold and increased CSF substance P. They postulate that "central sensitivity is the final common pathway for the development of abnormal pain in fibromyalgia syndrome."

Chronic Fatigue Syndrome (CFIDS)

In chronic fatigue syndrome (CFIDS), a related problem apparently also reflecting central sensitization, Goodnick and Klimas describe myalgias, arthralgias, cognitive difficulties, depression, and concentration/memory problems among the associated symptoms in addition to fatigue (64). Goodnick indicates that in their patient series, 80% had complaints of depression, and 74% had a diagnosis of fibromyalgia (65). Hence, CFIDS may represent another variant of central sensory dysfunction.

Visceral Pain

Giamberardino (9) has described early visceral pain as a poorly defined sensation that is always in the same location (usually midline abdomen or thorax) and accompanied by marked autonomic signs and emotional reactions. Subsequently, pain is referred to somatic structures (skin, subcutis, and muscle) and may or may not be accompanied by hyperalgesia to that referred area. At that stage the pain becomes sharper and better localized and no longer has the autonomic signs. She describes three forms of visceral hyperalgesia: primary, that is, hyperalgesia of the involved organ; secondary, which involves the referred site; and viscero-visceral, which is hyperalgesia of a noninvolved visceral organ that shares afferent innervation with the involved organ. That same author found that patients with irritable bowel syndrome developed pain to smaller bowel distention and had larger areas of referred pain than normal controls. There was also evidence of hypervigilance, inducible visceral hyperalgesia, and lower rectal sensory threshold in these patients. In healthy persons, acute rectal pain was associated with activation of the anterior cingulate cortex (ACC), but there was no ACC response in patients with irritable bowel syndrome. Instead, there was activation of the left prefrontal cortex during both painful rectal distention and during the anticipation of it. The lack of ACC response in patients with irritable bowel syndrome is felt to possibly represent a failure of descending pain inhibition. Studies in rats show a supraspinal descending influence for visceral hyperalgesia in the brainstem rostral ventrum medial medulla, and this includes a facilitatory component

(which is NMDA-mediated) and an inhibitory component (which is non-NMDA-mediated). Selective block of either component unmasks the other. Trophic changes in the referred areas reveal an increase in subcutis thickness and a decrease in muscle thickness.

Giamberardino showed that it is the perceived visceral pain and not the visceral pathology that determines the occurrence of referred hyperalgesia, its degree, and its duration. The extent of muscle hyperalgesia was also a function of the pain experienced. In studies of renal calculosis, for example, patients passing stones had higher levels and longer-lasting episodes of visceral hyperalgesia than those who underwent lithotripsy because of the repetitive pain experience (with resultant sensitization) of the former as the stone passed through the ureter. Pain thresholds in renal calculosis were also normal for naive patients, but lowered in those with a previous history of this pain. Based on her research, Giamberardino has proposed that visceral hyperalgesia is the result of a peripheral sensitization that first occurs, causing a lowered pain threshold. Through recruitment, this process then leads to a central (supraspinal) sensitization, which results in increased spontaneous activity of central neurons, enlarged receptor field areas, and an increased response of large and small primary afferent fibers. This central sensitivity is also mediated through NMDA.

Headache

The headache literature reveals substantial evidence to support peripheral and central sensitization concepts. Silberstein et al. (11) have stated that "sensitization of the nucleus caudalis neurons can cause normal, nonpainful stimuli to become painful, producing trigger spots, and overlap of the symptoms of migraine and tension headache, and activation of the trigeminal vascular system." Rapoport and Sheftell (66) have stated that the blood vessels of migraineurs show a greater sensitivity to serotonin and have more extreme reactions to tyramine and adrenaline than do controls. Burstein and Strassman (67) found that following chemical irritation of the dura, 66% of the neurons became hypersensitive and reacted to subthreshold stimulation. Hence, they feel that this peripheral sensitization of the mechanosensitive meningeal nociceptors might explain how small increases in intracranial pressure during routine activities, such as bending over, coughing, etc., can aggravate headache pain. These same authors also describe central sensitization and in their research showed that sensitization of the trigeminal mechanosensitive meningeal primary afferent neurons can lead to activation and sensitization of second order trigeminal brainstem neurons. In fact, following chemical irritation of the dura, 95% of the animals showed increased sensitivity to mechanical indentation, decreased pain thresholds, and a two- to fourfold increase in intensity and magnitude of response. Because the second order nociceptive neurons receive convergent input from cerebral blood vessels, meninges, and facial skin, the clinical implication of central sensitization is the development of intra- and extracranial hypersensitivity through convergence and recruitment. There was also evidence for autonomic augmentation.

Srikiatkhachorn et al. (21) studied analgesic rebound headache. They found a role of central 5-hydroxytryptamine (5HT)-dependent neurons in response to paracetamol. Chronic administration of paracetamol produced a down-regulation of 5HT2A receptors by causing an increase in 5HT release, followed by depletion. More specifically, 15 days of paracetamol administration resulted in a down-regulation of 5HT2A receptors and an up-regulation of 5HT transporters in the frontal cortex. However, 30 days of paracetamol administration resulted in normalization of 5HT levels, and this occurs simultaneously with a decreased efficacy of the drug. The up-regulation of 5HT2A receptors may result in a hyperalgesic state and facilitate the headache because there appears to be an inverse relationship of 5HT levels and headache. They postulate that because there is already 5HT suppression in migraine, this further suppression via these neuroplastic changes may result in an increase in headache frequency. What is interesting is that the neuroplastic changes they describe are mainly in the cortex, not the brainstem, and seem to be reversible after the paracetamol is withdrawn.

Complex Regional Pain Syndrome (CRPS)

Complex regional pain syndrome (CRPS) has been postulated to represent a central sensitization with significant autonomic involvement as well (19). Certainly the allodynia seen with CRPS represents not only sensitization, but also recruitment and convergence. Here, clearly nonnociceptive neuronal transmission is perceived as painful.

Phantom Pain

Likewise, phantom pain is most likely another example of central sensitization (19), felt to result from a one-time overwhelming nociceptive input as peripheral nerves are severed in the process of the amputation or alternatively from the release of previously inhibited afferents. The concept of so-called preemptive anesthesia, as utilized in elective amputations, is designed to prevent this barrage of nociceptive input and thereby prevent the chance of phantom pain.

Dysphoria

The dysphoria seen so frequently in patients with maldynia is often labeled as depression. However, many of these mood problems do not run the same clinical course when left untreated and do not show the same treatment

response to antidepressants that more classical major depressions do. In fact, this type of dysphoria seems to clinically fit better with the limbically augmented emotions described by Rome and Rome.

Mayberg et al. have argued that "the associated impairment of cognitive, motor, and somatic functions in patients with dysphoria suggests that depression is a composite disorder affecting discrete but functionally interconnected limbic, paralimbic, and neocortical circuits" (23) Metabolic and rCBF flow studies consistently show decreases in the prefrontal cortex of patients with depression. Less consistently seen are changes in the limbic (amygdala) and paralimbic (cingulate gyrus) systems and may represent different subgroups of depression. Positron emission tomography (PET) studies show changes of two pathways of regional localization: (a) orbital frontal → striatal → thalamic circuits and (b) basotemporal limbic circuits. Mayberg suggests that these changes may be explained by "disease specific disruption of converging pathways to the paralimbic frontal and temporal cortices" and could account for "the presence of indistinguishable depressive symptoms in patients with distinctly different pathologies." Recent neuroimaging studies have placed particular emphasis on the prefrontal cortex, anterior cingulate gyrus, parietal cortex, and amygdala as critical components of dysfunctional circuitry involved in both depression and anxiety (59).

This cluster of apparently divergent syndromes (fibromyalgia, headache, CRPS, phantom pain, visceral painful syndromes including irritable bowel, and dysphoria), which we feel represents central sensory dysfunction, has similar overlapping associated symptoms (decreased energy, decreased concentration with its consequent memory dysfunction, decreased motivation, decreased libido, decreased tolerance to stress, disrupted sleep patterns, and magnified behavioral responses to stimuli, including nociception) with different "target organs." There is also similarity in the brain areas involved, as demonstrated anatomically and by functional studies (imaging, rCBF, etc.), by the neurochemistry involved, by the neuroplastic changes that occur resulting in sensitization at both the spinal cord and supraspinal levels, and by effective treatments.

Rauch (38) has pointed out that limbic system dysfunction results in hyperresponses affectively, with poor ability of the frontal cortex to exert governance, and a resultant decrease in memory and learning. The paralimbic system serves as a conduit from the motor, sensory, and associative cortex to the limbic system and plays a role in prioritizing the flow of information within the brain and in coding the information based on its importance within the brain. The anterior cingulate gyrus (AC) integrates cognitive, affective, and sensory motor functions. The dorsal AC connects with motor centers; the rostral AC connects with the affective centers, including limbic and paralimbic; and the ventral AC connects with deep brain regions that monitor and mediate visceral motor functions. The rostral AC regulates the prioritization between cognitive and affective processing. Thus, the rostral AC and the paralimbic system form a feedback loop for affective intrusions on cognition and for cognitive modulation of emotional information processing.

Thus, we may be seeing in central sensory dysfunction syndromes one "genotype" (central sensitization) with various "phenotypic" (target organ) presentations. Further support for this genotype-phenotype analogy comes from the positive results of treatments that seem to alter the conscious perceptions that are the result of the "genotype" rather than the "phenotype." In fact, the portions of the phenotypes that are apparently due to peripheral sensitization seem to respond differently. For example, the work by Srikiatkhachorn on analgesic rebound headaches showed that the decrease in the headaches when the offending agent is removed is due to the peripheral sensitization of the dura. But the affective component and intense reactions to future headaches, which are represented by the central sensitization, continue. Similarly, Giamberardino has demonstrated that the subcutis and muscle changes of referred pain areas, due to central sensitization and not the peripheral sensitization portion of visceral hyperalgesia, continue indefinitely beyond the instigating event of visceral pathology.

Marcus Aurelius also said,

> As for pain, a pain that is intolerable carries us off;
> But that which lasts a long time is bearable;
> The mind maintains its own tranquility
> By retiring into itself,
> And the ruling faculty is not injured.
> As for the parts which are hurt by the pain,
> Let them, if they can, give their opinion of it.

Marcus Aurelius clearly seems to be relating how a nontraumatized or noncentrally sensitized individual could handle chronic pain. Is there a way to help sensitized individuals do the same?

COGNITIVE BEHAVIORAL THERAPIES (CBT) AND PAIN

Cognitive behavioral therapies have evolved over the past 35 years as a result of early animal research on patterns of behavior. Early studies of extinction gave rise to behavioral and cognitive approaches to humans with painful conditions. Since about 1985, cognitive behavioral therapies have come to the forefront of the treatment armamentarium for chronic painful conditions.

Multidimensional Aspects of Pain

The multidimensional aspects of pain have been described in the literature over the last 25 to 30 years. Fordyce (68,69) was among the earliest writers to elucidate the importance of cognition and behavior in chronic pain. Since then, much has been written about the cognitive dimension of

chronic pain. The cognitive aspects of pain and the relationship to pain behaviors as a learned mechanism have been reviewed extensively (70–72). Ciccone and Grzesiak found specific patterns of dysfunctional thinking, including "awfulizing," low frustration tolerance, self-downing, and overgeneralizing, as important in accounting for major symptoms of chronic pain. Turk and Rudy (73) have even suggested a multiaxial assessment of pain (MAP), classifying patients into three subgroups, and this system was applicable across multiple pain syndromes, including low back pain, headache, and temporomandibular disorders. This work was based on the assessment scale of the Multidimensional Pain Inventory developed by Turk, which was derived initially from the West Haven-Yale Multidimensional Pain Inventory (WHYMPI) (74).

Brands (75) described the importance of learning processes in the persistence behavior of chronic pain patients in the face of acute pain stimulation. Chronic pain patients were found to demonstrate poorer acute pain tolerance and to report higher levels of acute pain than controls. Richard (76) studied the relationship of pain behaviors in chronic pain patients in relationship to their children and families. Their study demonstrated a higher frequency of behaviors in the children of pain patients—behaviors that are thought to be learned through observation of and interaction with the parent in pain—than was found in children of control groups or children of patients with diabetes mellitus.

This multidimensional approach to chronic pain has certainly led to the development of multidisciplinary treatment of chronic pain, with an emphasis on addressing cognitive, affective, behavioral, and social factors in addition to physical pathology (77). The success of the multidisciplinary approach has been reviewed elsewhere and is nicely demonstrated by Flor et al. (78). That metaanalysis demonstrated that multidisciplinary treatment is superior to single-discipline treatments, such as standard medical or surgical approaches, with resultant improvement in pain, mood, and interference in life activities, including return to work and decreased use of the health-care system. Moreover, these effects were stable over time.

COGNITIVE BEHAVIORAL APPROACHES

Because of the complex multidimensional nature of chronic pain, the cognitive behavioral therapies have evolved over the past 35 years as a result of early animal research on patterns of behavior. Early studies of extinction gave rise to behavioral and cognitive approaches to humans with painful conditions as well. Cognitive behavioral therapy focuses on bringing about changes in attitudes, judgments, and values; correction of distorted thinking; reexamination of core assumptions; correction of behaviors; and involves validation, remotivation, and resocialization; increasing coping skills; increasing problem-solving abilities; increasing self-esteem; and increasing a sense of personal control (79). This form of psychological treatment has been applied to multiple disorders, including addictive behaviors, especially problem drinking (80), depression (81), chronic psychotic disorders, including hallucinations and delusions (82), insomnia secondary to chronic pain (83), compulsive hoarding (84), infertility (85), pathological gambling (86), noncardiac chest pain (87), and terminal illness (88). Interestingly, the use of cognitive behavioral treatment in terminal illness by Fishman (88) emphasized two ideas: Pain and suffering are not the same, and patients can exercise substantial control over their thoughts, feelings, and behavior. In this study, patients were taught to separate suffering (as a feeling of pervasive personal destruction) from pain, the sensory stimulus (the affective dimension of pain vs. the sensory discriminative dimension). These patients were able, even in advanced stages of their terminal illness, to experience themselves as active agents who could reduce their own suffering and enhance their sense of well-being.

CBT and Age

Cognitive behavioral therapy also seems to be efficacious across age groups (89). Children have been especially successful using cognitive behavioral interventions during painful procedures (90–93), including such procedures as bone marrow aspirations and burn wound debridements. Treatments included breathing exercises, relaxation and distraction techniques, imagery, cognitive coping skills, videotaped modeling, behavioral rehearsal, and active coaching. Humphreys and Gevirtz (94) describe the use of cognitive behavioral biofeedback-assisted treatments combined with fiber for treating recurrent abdominal pain in children. Cognitive behavioral interventions for pain have been used as an effective adjunct to pharmacologic interventions with juvenile rheumatoid arthritis (95).

The elderly also are able to utilize cognitive behavioral techniques effectively. Manetto and McPherson (96) showed that noncognitively impaired elderly pain patients can benefit as well as younger populations from the use of behavioral cognitive techniques with emphasis on concreteness, high organization in terms of format, and brief sessions. Luskin et al. (97) reviewed geriatric literature regarding musculoskeletal disorders in the elderly and found that multiple mind-body practices, including cognitive behavioral therapy, were effective as complementary treatments for these musculoskeletal disorders. They do point out the need, however, for good randomized controlled studies. Cook (98) found that elderly residents of a nursing home who received cognitive behavioral training reported less pain and less pain-related disabilities and that these treatment effects were maintained at 4-month followup, despite an overall increase in reported pain.

Thus, the cognitive behavioral therapies are useful in multiple disorders, both pain related (see the following)

and nonpain related, and they are useful across all age groups, from pediatric through geriatric.

Characteristics of CBT

Cognitive behavioral therapies are problem oriented and practical, emphasize real-life and living skills, and offer concrete viewpoints and techniques (99). These characteristics enable the wide application as mentioned and allow for usefulness both by professionals and by nonprofessionals. For example, many cognitive behavioral programs for pain also educate families in appropriate cognitive behavioral interventions toward their loved ones in pain. Keijsers (100) and others point out that cognitive behavioral therapy is also characterized by a more active and directive stance on the part of the therapist and higher levels of emotional support than are found in insight-oriented psychotherapies. These relationship factors between therapist and patient have a moderate, yet consistent, impact on outcome of cognitive behavioral techniques. Dobson and Khatri (101) also discuss the art of psychotherapy and the impact of "nonspecifics" of therapy in addition to the specific techniques used on the outcome. Other differences between psychodynamic psychotherapy and cognitive behavioral therapy reveal that the latter tend to promote control of negative affect through the use of intellect and rationality combined with vigorous encouragement, support, and reassurance from the therapists. Dynamic psychotherapy, on the other hand, emphasizes the evocation of affect by bringing troublesome feelings into awareness and integrating these with previous life experience.

Caudill (102) has pointed out that cognitive behavioral therapies in the treatment of pain tend to improve functioning while decreasing pain perception. These findings are consistent with the earlier understanding of the affective dimension of pain as described by Price (1) and Rome and Rome (10), where the goal of therapeutic intervention would be to use the cognitive abilities of the patient to decrease limbic arousal as much as possible.

CBT and Learning

As cognitive behavioral therapies have gained importance in the treatment of chronic pain, the role of learning in chronic pain has been emphasized in the literature (72, 103–108). Tan (109) recently reviewed cognitive behavioral therapy as 1 of 25 empirically validated or supported psychological treatments for chronic pain and other disorders.

Brands and Schmidt have shown that chronic low back pain patients demonstrate poorer acute pain tolerance and report higher acute pain (75,110). Jensen et al. (111) have demonstrated that patients' beliefs predict their level of functioning. In the Jensen study, patient beliefs were compared with patient-reported functioning and family-reported functioning and association of pain behaviors. Significant associations between patient beliefs and pain behavior were found. A significant hindsight-effect (112) has been demonstrated in a chronic pain population and was found to be significantly higher in this group than in a control group. Hindsight bias is considered a universal cognitive mechanism, and relates to the concept that information processing is in part uncontrolled, automatic, and pre-attentive; and that information available at any given time will change the memory of prior judgments, predictions of future events, and resultant behavior. Indeed, anticipation of pain and fear-avoidance beliefs predicted variation in a spinal isometric strength test (113). Wegner et al. (114,115) have demonstrated the effects of thought suppression and disruption of memory sequence on current cognition and perception.

The power of learned pain beliefs and behaviors is such that it affects not only patients, but also their families. Children of chronic low back pain patients exhibit higher frequency of behaviors felt to be learned through observation or interaction with the parent in pain (76), as we have pointed out.

Goals of CBT

Cognitive approaches to chronic pain focus on the way the person perceives, interprets, and relates to pain rather than on elimination of pain per se (70). The goals of cognitive behavioral therapy are to help patients restructure their view of their pain and what it means to their life. Additionally, in view of the concepts of kindling of pain (1,10), it is also important to prevent chronicity from developing. As soon as possible an attempt should be made to prevent eudynia from becoming maldynia. Chronic low back pain patients have shown an inability to habituate the pain, and this inability is now considered a significant risk factor for the development of chronic pain (75,110). Hasenbring et al. (116) have shown the usefulness of cognitive behavioral interventions in acute sciatic pain. They demonstrated in a group of patients with "acute sciatica" and "psychosocial high risk factors for chronicity" that both electromyographic (EMG) biofeedback and cognitive behavioral approaches were effective in reducing pain and preventing chronicity. The cognitive behavioral interventions were superior to the EMG biofeedback, and 90% of their patients showed a clinically significant reduction in pain comparable to the psychosocially low-risk patients, 83% of whom experienced pain reduction. Patients who refused such intervention had poorer outcomes in pain reduction, disability, and work performance.

Cognitive behavioral techniques incorporate multiple strategies and can be administered individually to the person in pain and to groups and can be taught to families as well. Puder (89) found cognitive behavioral group therapy to be successful in decreasing the degree of pain interference with activities, increasing ability to cope with pain, and decreasing use of medications and other physical treatments. There was, however, little effect on perceived pain intensity. These gains were maintained at a 6-month

followup as well. The ultimate goal of cognitive behavioral therapy is to teach patients coping strategies that can be used over time by the patients, supporting their ability to regain control over their lives (107,108,117).

The actual techniques of cognitive behavioral therapy are at the discretion and creativity of the therapist. Davison et al. (118) demonstrate the usefulness of having patients articulate their thoughts while engaging in a task or situation. They point out the immediacy of the effect of this technique, as opposed to being retrospective. Rosenstiel and Keefe (119) have described techniques for diverting attention, reinterpreting pain sensations, offering coping self-statements, eliminating catastrophizing, and increasing activity levels as ways of intervening. Likewise, Blinchik and Grzesiak (120) emphasize having patients conceptualize their pain by becoming aware of their thoughts prior to and during their experience of pain and then training the patients in replacing those thoughts and relabeling their pain experience.

CBT and Painful Disorders

Cognitive behavioral therapies have been shown to be useful in multiple painful syndromes (71,107,121–126). Johansson et al. (127) employed cognitive behavioral therapies, including educational sessions, goal setting, graded activity training, pacing, relaxation techniques, cognitive restructuring, social skills training, medication reduction techniques, contingency-based pain behavior management, and planning of work return, in a multidisciplinary pain program. This program was effective at up to 1-year followup in improving occupational training and nonvocational activity level, decreasing catastrophizing, and decreasing pain behaviors. Measures of sick leave, pain interference, control over one's life, pain intensity, suffering and affective distress, physical fitness, medication reduction, and increased avocational activities all improved.

There is rather extensive literature on the usefulness of cognitive behavioral therapies for treatment of soft tissue pain, pain of arthritis, and chronic low back pain. Bradley (128) has discussed cognitive behavioral therapy for treating the pain of fibromyalgia. Similarly, Haldorsen et al. (129) used a cognitive behavioral 4-week program to treat "musculoskeletal pain" in patients who were sick-listed in Norway. Although the group receiving cognitive behavioral therapy had no higher return-to-work rate than the control group at 1-year followup, their work potential, quality of life, suffering, and ergonomic behaviors showed significant improvement.

Treatment of rheumatoid arthritis-related pain has shown mixed results. Bradley et al. (63) demonstrated clinically and statistically significant improvement in pain behavior and anxiety, for up to 6 months, and a short-term beneficial effect on pain and disease activity in patients with rheumatoid arthritis who were treated with a cognitive behavioral program. Likewise, Leibing et al. (130) found an effect of cognitive behavioral treatment in slowing the progression of rheumatoid arthritis in their patients. The more significant effects, however, were in stabilizing emotion, improving coping, and reducing impairment more than pain level. They found reduction in emotion-focused coping, helplessness, depression, anxiety, and pain unpleasantness. Keefe and Van Horn (105) reviewed the role of cognitive behavioral therapy in managing pain in patients with rheumatoid arthritis and found variable results in pain and disability reduction and found, as did Bradley et al. (63), a significant dropoff of maintenance of pain coping skills with time.

The literature is more supportive of effectiveness for cognitive behavioral techniques in the treatment of chronic low back pain, even though that term can be representative of multiple pain-producing factors. Patients with chronic low back pain in which the pain and symptomatology are incongruent with physical pathology have shown a poorer outcome in response to treatment and excessive use of health-care resources in the past (131). These patients have been found to have more maladaptive and dysfunctional cognitions. They have been viewed as overwhelmed and ineffective in their attempts to cope and as more physically disabled as a result of their pain. Burns et al. (124) explained low back pain according to the manner in which noxious stimuli are attended to and interpreted, the degree to which certain behaviors become conditioned stimuli for fear responses, and how environmental contingencies increase and decrease the frequency of maladaptive and adaptive behaviors. They have found cognitive behavioral therapies to be effective in reducing pain, decreasing disability, and improving mood. Other authors likewise have found significant improvement in affect, higher activity tolerance, decreased pain behaviors, better coping, and better pain control (122,123,126). Slater et al. (125) found that 47% of patients in their program receiving behavioral treatment evidenced clinically significant improvements in at least one of the dimensions of the pain, disability, and/or depression associated with chronic low back pain. However, it was rare for patients to show improvement on all three measures. Sullivan et al. (81) also found success with cognitive behavioral approaches in conjunction with antidepressants in treating depression-related chronic low back pain. Nicholas et al. (132) found significant improvement in self-efficacy beliefs, decreased medication usage, improved active coping strategies, and other-rated functional impairment. Interestingly, at 6-month followup, the patients receiving the cognitive behavioral treatment program were continuing to do their physical exercise as well as relaxation, maintaining an increased activity level, and cognitive coping strategies on a regular basis of 1 to 3 days per week.

Thus, cognitive behavioral therapies have been shown to be useful in a variety of painful conditions. The positive effects also seem to be ongoing and long lasting. These cognitive behavioral therapies seem to effect change in

patients with chronic pain by improving the ability of the prefrontal cortex to alter cognition and thereby have a downward effect on the brain pathways involved with nociceptive perception, including the limbic system, the descending inhibitory pathways, and motor output.

HYPNOSIS

The role of hypnosis in pain management, even today, remains controversial (133). Turner and Chapman (107) have emphasized that clinical research on the use of hypnosis for pain "has been sparse, and quite poor methodologically." Recently, however, better studies have shed more light on the role of hypnosis in pain management and how it may be working (1). Montgomery et al. (134) examined the effectiveness of hypnosis in pain management, comparing studies of hypnoanalgesia in healthy volunteers versus pain patients, and also comparing hypnoanalgesic effects in participants' hypnotic suggestibility. Metaanalysis of 18 studies revealed a moderate to large hypnoanalgesic effect for both clinical and experimental pain reduction. Likewise, Edelson and Fitzpatrick (135) showed improvement on the McGill Pain Questionnaire in patients treated with cognitive behavioral techniques or hypnosis relative to patients treated with only attention control. They found superiority in the cognitive behavioral treatment on behavioral measures, but equivalence between cognitive behavioral and hypnotic treatment on subjective measures. These results were also sustained on a 1-month followup. Eimer (136) had success with hypnoanalgesia coupled with development of individualized pain-coping strategies through trance, including such constructs as direct suggestion, cognitive reframing, hypnotic metaphors, and pain-relief imagery. In addition, that author used psychodynamic reprocessing of emotional factors during the trance state. Spira and Spiegel (137) emphasized that success with hypnosis for pain control depends upon the hypnotizability of the patient, the patient's particular cognitive style, the patient's specific motivation, and the patient's level of cognitive functioning. They did find success with hypnoanalgesia through individual sessions and group sessions and found hypnoanalgesia useful even for hospice patients confined to bed. Spiegel and Spiegel (37) have correlated the degree of hypnotizability and learning style for usefulness in hypnoanalgesia. Specifically, highly hypnotizable subjects are able to create anesthesia through the use of hypnosis, whereas lowly hypnotizable subjects are better able to utilize distraction as a hypnotic technique.

Liossi and Hatira (138) found both hypnosis and cognitive behavioral coping skills effective in preparing pediatric oncology patients for bone marrow aspiration. They found that both techniques resulted in lowered pain and lowered pain-related anxiety compared to controls and compared to patients at baseline.

Alden and Heap (139) view hypnoanalgesia as part of cognitive and behavioral interventions. They view hypnosis as a set of skills deployed by the individual rather than as a state in and of itself. Factors common to a trance, however, that facilitate management of pain include a sustained focus of attention, an absence of judgment and censorship, a suspension of time, the experiencing of one's own responses as automatic, and a feeling of relaxation (1,37). These factors allow for facilitation of new ideas or cognitions, which may or may not contain accepted inconsistencies, and heighten the suggestibility of the patient. Hypnosis, through these mechanisms, is then available to target both the affective-motivational dimension of pain as well as the sensory-discriminative dimension through such mechanisms as reinterpretation or dissociation. For example, one of our patients, who was suffering from a severe electric-type painful peripheral neuropathy secondary to snake venom toxicity, was taught to place a mental rheostat switch between himself and his electric-type pain and turn the switch down until the pain was lowered to a bearable intensity. He was then taught to alter that minor electrical feeling into a pleasant one from an unpleasant one.

Rainville et al. (140) demonstrated that hypnotic suggestions can selectively modulate the affective dimension of pain but that when it is used to modulate the sensory discriminative dimension, the affective dimension is modulated in parallel with it. This work also supports the work of Spiegel and Spiegel (37) in using hypnotic susceptibility to target different dimensions of pain.

Price (1) suggests that hypnoanalgesia works through three general mechanisms: The first is related to spinal cord descending mechanisms; the second relates to prevention of awareness of pain at higher centers by dissociation; and the third is a selective reduction in the affective dimension of pain by reinterpretation of meanings. He further substantiates these mechanisms by citing brain activity in the anterior cingulate cortex, as related to pain unpleasantness, with no change in neural activity of the somatosensory cortex. However, when hypnotic suggestions were targeted toward pain sensation, there was change in activity within the primary somatosensory cortex. Price concludes that "hypnotic modulation of pain is both psychologically and neurophysiologically multidimensional; that is, different mechanisms target different pain dimensions." He concludes that hypnosis may be more useful than had been formerly thought in pain management. He suggests that utilization of suggestions for "reducing both sensory and affective dimensions of pain experience may more effectively optimize the capacities of individuals to alter the overall experience of pain by changing any one of several aspects of their experience. . . . It is important to consider that the efficacy of attempts to induce hypnotic analgesia may differ somewhat depending on susceptibility, the hypnotic approach used, the relationship between the hypnotist and the patient, the pain

dimensions assessed, and the level of pain. The observed magnitude of hypnotically-induced analgesia, in both clinical and experimental contexts, must be considered in terms of all of these factors."

PSYCHOTHERAPEUTIC DETERMINANTS

Thus far, several psychotherapeutic modalities have been discussed, i.e., cognitive behavioral therapy, etc. Although such approaches are indeed helpful to many patients suffering from chronic pain, there are inherent limitations. Cognitive therapy, by its very nature, relies on dealing with a given patient's cognitive structure relative to his or her intellectualized beliefs about pain and challenging such beliefs in favor of achieving a reorganization of the belief system, leading to different conclusions about the patient's situation. Although virtually anyone can engage in rational thought and enter into a therapeutic dialog about his or her painful situation, not everyone approaches his or her world initially through logic and reason. Many patients view their world initially through their emotions. The notion of how they "feel" may be much more important to them than what they "think." Herein lies a long-held belief by many mental health professionals that they must first psychologically evaluate patients in order to ascertain their inherent personality characteristics and then tailor the manner of psychotherapy so as to be consistent with patients' orientation to their own existence. By contrast, other clinicians, by virtue of their training and adherence to a particular theoretical orientation—i.e., psychoanalysis, psychodynamic psychotherapy, cognitive-behavioral therapy, etc.—apply the same "brand" of therapy to all patients, regardless of a patient's personal style of relating to the world.

The issue of "matching" the style of psychotherapeutic intervention to the personality of the patient has been considered quite important relative to maximizing the level of treatment outcome. Spiegel and Spiegel (37) have looked at the relationship between personality type and hypnotic trance capacity and found a modest statistical correlation. In effect, there is an inverse relationship between personality style and inherent trance capacity. Persons who are more cognitively oriented tend to have a lower potential to enter a deep hypnotic trance, whereas more affectively oriented individuals tend to have a higher trance capacity. Accordingly, applying hypnotherapy to all patients suffering from chronic pain will be only partially helpful, insofar as only certain personality types will have a higher biological potential to benefit from such an intervention. It is arguable that a highly motivated patient can still benefit from hypnotherapy. However, patients with the personality characteristics that correlate with lower biological trance capacity can still achieve a positive result, albeit to a probable lesser degree. Applying hypnotherapy to all pain patients would be both clinically ineffective and inefficient. As with all aspects of the field of medicine, the treatment should fit the needs of the patient.

Although the foregoing implies the inherent limitations of hypnosis, it has been previously noted that Price (1) has concluded that hypnosis may be more clinically useful than previously thought in the area of pain management. He suggests that the procedure focus more on "reducing both sensory and affective dimensions of the pain experience." His justification relates to the relationship of hypnoanalgesia to neurophysiological processes, as previously discussed. However, once again, the personality of the individual must be taken into account relative to his or her inherent trance potential based on the patient's basic personality structure. A similar rationale can be applied to providing such modalities as cognitive behavioral therapy, or perhaps biofeedback to all patients as well.

As previously stated, cognitive behavioral therapy attempts to challenge an individual's belief system and modify the thought processes engaged in by the individual. However, in a chronic pain population, a differentiation must be made between "pain intensity" and "suffering." In comparing two patients with the same diagnosis and the same reports as to pain intensity, one may differentiate one patient to be in more pain by virtue of the degree to which he or she is suffering. This implies that the individual's emotions and attitudes toward pain play a greater role in the production and maintenance of the painful experience. To have any particular treatment modality serve the intellectual needs of the patient at the expense of his or her emotional well-being will ultimately fail to achieve positive results. Treatment will not generalize from the office setting to daily life experiences. An example might be a patient who achieves excellent clinical results utilizing thermal biofeedback in the office, demonstrating a peripheral body temperature of 95 degrees. The patient has learned to "master" the machine; however, after having left the office, the patient will revert to his or her typical manner of relating to pain, that is to say, with negative cognitions and emotional suffering, unless these specific issues are addressed. Generalization of clinical effect will tend to occur only in those patients who take consistent personal responsibility for "practicing" their newly learned strategies outside the office setting. This implies that even in those cases where such modalities as hypnotherapy and/or biofeedback are learned skills by the patient, the clinical effect of the procedure is inherently time limited. This requires the patient to repeatedly incorporate the procedure one or more times during daily activities in order to minimize pain. Such procedures generally do not produce a permanent reduction or elimination of pain and/or suffering.

In addition, some patients have difficulty relating to the technology associated with biofeedback machinery, again lowering their potential to benefit from the procedure. In order to be maximally effective, it is suggested that any treatment modality take into account the patient's cognitive and

affective functioning, with the need to alter both. Within today's managed care environment, the need for effective and highly efficient treatment takes on even added importance.

EYE MOVEMENT DESENSITIZATION AND REPROCESSING (EMDR)

Given the more recently published knowledge regarding memory, perception, learning, and particularly central sensory dysfunction and the role of the limbic system in augmenting pain intensity and suffering, as previously discussed, more advanced psychotherapeutic procedures must be brought into the treatment. One such procedure is eye movement desensitization and reprocessing (EMDR) (52). EMDR is to a large degree a rapid information-processing system in which the patient "internally" processes traumatic or dysfunctional thoughts and/or feelings. Many of the components of EMDR in its current form have been developed over the past 13 years or so, based on extensive research on patients suffering from posttraumatic stress disorder (PTSD), with refinements made and expanded to include an increasingly wide variety of clinical populations. Although EMDR is a very precise procedure, it is clearly compatible with a variety of theoretical orientations, i.e., cognitive behavioral, psychodynamic, etc.

Shapiro (52) draws an analogy of EMDR with the emotional processing effects of rapid eye movement (REM), with the procedural portion of EMDR found to be equally efficacious when also incorporating other sensory modalities, i.e., auditory and tactile stimulation. The key feature in "activating" the brain to engage in rapid informational processing appears to be the initiation of bilateral alternating brain stimulation. In this sense, the old adage of "all roads lead to Rome" clearly applies. However, it is not meant to be suggested that EMDR is a "simple" procedure by which the clinician activates the brain for the purpose of processing information, with an automatic result ensuing. Rather, EMDR is a sophisticated and complex procedure that requires a highly skilled and knowledgeable mental-health professional. The goal of EMDR is to disengage affective memories that are neurophysiologically linked through various perceived similarities, thereby reducing the affective dimension of painful memory to a situation-appropriate level. As in all clinical work, one should not entertain a particular treatment modality until a differential diagnosis has been rendered, which most importantly applies to EMDR.

A standard protocol for EMDR intervention requires eight phases (see Table 14-3), with a differential diagnosis based on a detailed history being the first phase. The second phase of treatment relates to preparing to begin the procedure, which requires the establishment of rapport with the patient, explaining the procedure to the patient, allaying any concerns and developing safety procedures. The third phase relates to assessment. This phase focuses on identifying the particular components or "targets" that will be addressed during treatment, as well as establishing a baseline level of disturbance that is operating at cognitive, affective, as well as somatic levels. The fourth phase is desensitization, in which an attempt is made with specific EMDR interventions to alter the patient's cognitive, affective, and somatic symptoms or distress, regardless of whether the intensity of such symptoms is increasing, decreasing, or remaining stationary. The fifth phase is an installation phase. Whereas the fourth phase serves to decrease, or eliminate, the negative or dysfunctional aspects of the patient's presenting problems, the fifth phase attempts to "install" a positive replacement to the negative or dysfunctional aspects. An example of comparing phases 4 and 5 might relate to desensitizing the patient in phase 4 regarding a negative thought and feeling that his/her level of pain and the associated suffering will never improve. Phase 5's focus would be to insert a "positive cognition" that the patient does have power over his or her pain. Here, it is important to note that one of the differentiating characteristics of EMDR compared to most other forms of clinical intervention is the emphasis on using the patient's own perceptions as to thoughts and feelings to generate exactly what will be targeted in the treatment process in terms of the initial desensitization, as well as on the patient's articulating his or her own internally derived source that would be needed to obtain clinical relief. This procedure is felt to contrast with psychotherapeutic approaches such as hypnosis or biofeedback, in which the clinician is typically required to generate the components of intervention, i.e., creating the correct posthypnotic suggestion to alleviate pain and suffering, or asking the patient to "think of something" that will result in increas-

TABLE 14-3. *Phases of EMDR treatment*

Phase 1	Establish differential diagnosis based on obtaining a detailed history
Phase 2	Preparation: establish rapport; explanation of procedure to patient; allay concerns; develop safety procedures
Phase 3	Assessment: identification of specific targets that will be focus of intervention; establish baseline of disturbance
Phase 4	Desensitization: specific EMDR intervention to alter cognitive, affective, and somatic disturbances
Phase 5	Installation: install a positive replacement to the dysfunctional symptoms
Phase 6	Body scan: identification of any residual somatic symptoms that had been associated with previously identified negative cognitions and emotions
Phase 7	Closure: ensure equilibrium at the close of a treatment session
Phase 8	Reevaluation: reassessment of the patient's clinical status at the outset of the next treatment session

Adapted from Shapiro (52).

ing peripheral body temperature or decreasing EMG activity during a biofeedback session. Phase 6 is identified as the body scan, in which, after a positive cognition has been installed and the patient has been desensitized to the target event, a review of the entire body is conducted in order to identify any somatized residual symptoms that had been associated with the previously identified negative cognitions and emotions. The seventh phase relates to closure. In this phase, the clinician ensures that the patient is left with a state of equilibrium (cognitive and emotional stability) at the termination of a treatment session. The eighth and final phase of the EMDR protocol relates to reevaluation, in which the clinician reassesses the patient's clinical status at the beginning of the next treatment session.

Whereas research on the uses and effects of EMDR continues to proliferate, in the area of chronic pain, a paucity of data is available. However, as the clinical efficacy of this procedure regarding the treatment of chronic pain becomes more recognized, particularly within the field of pain medicine and pain management, increasing application of this procedure is predicted to occur, thereby leading to a corresponding increase in the needed research. To date, there have been a number of case reports that support EMDR's role in facilitating pain relief (141–144).

Despite limited controlled studies of EMDR to date, its importance to the future of effective and efficient pain management relates to its presumed consistency with what we now believe relative to neurophysiological mechanisms of pain, particularly in terms of the involvement of the amygdala, hippocampus, and prefrontal cortex (145). With regard to EMDR's similarity with processes associated with REM sleep in humans, research has demonstrated that "the pattern of activation in the amygdala and the cortical areas provides a biological basis for the processing of some types of memory during REM sleep" (146).

Chronic pain patients are indeed a difficult clinical population to treat for a variety of obvious reasons. For the medical practitioner, this task is made more difficult when a patient presents not only with emotional trauma associated with the illness or injury that defines his or her chronic pain, but also with a traumatic premorbid history that serves to exacerbate his or her perception and complaints of pain and suffering. The physician cannot be expected to separate the emotional from the organic; rather, the physician must treat the patient as a whole. Accordingly, in more traditional terms, it is incumbent on the mental-health professional to identify and deal with the "functional" aspects of the patient's presenting pain, so as to reduce or eliminate the "nonorganic aspects," leaving the patient more available for appropriate treatments of the sensory discriminative portion of his or her pain. In this regard, a procedure such as EMDR can be of invaluable assistance.

One of the most important theoretical constructs associated with EMDR relates to what Shapiro (52) refers to as "memory networks." She hypothesizes about the "brain's innate information-processing system which metaphorically reflects a series of channels where related memories, thoughts, images, emotions, and sensations are stored and linked to one another" (52). Although Shapiro's conceptualization is theoretical, emerging information about the function of the brain, as previously discussed, is providing compelling evidence as to the neurophysiological validity of the model.

When a patient presents with a traumatic injury that results in chronic pain, the original injury can be viewed as a traumatic event. The chronicity of the pain and the associated limitations frequently imposed by the sequela serve to maintain the trauma. When the patient has a traumatic premorbid history, there is a significant probability, according to Shapiro's model, that both the premorbid traumatic event(s) and the trauma associated with the chronic pain situation are stored in the same "channel." Clinically, the patient may not be aware of any relationship between previous and current traumas. Nevertheless, the effects are believed to be both intertwined and cumulative by virtue of the manner in which memories are stored at a neurophysiological level. In the past, traditional training would have caused the mental-health practitioner to look for hysteroid or perhaps hypochondriacal tendencies as a theoretical construct that would potentially account for the patient's intensity of clinical presentation. However, if one takes into account what has recently emerged in the area of brain research, there are now neurochemical explanations, i.e., kindling, neuroplasticity, limbically augmented pain syndrome, etc., that can properly account for much of a patient's degree of suffering. No one would argue that there are a significant number of patients who do present with underlying characterological disorders or other forms of psychopathology that are of long-standing duration that predate their presenting complaints. However, given the role and importance of brain function relative to the emotional expression of the chronic pain experience, it is quite important to restore the integrity, the respect, and most importantly, the credibility of those patients who have emotionally decompensated for reasons of neurological etiology.

Case Illustration

It is believed that EMDR is an important tool that can facilitate the processing of emotional trauma that is linked in memory to present pain complaints. A specific case report illustrates this importance. A 36-year-old female presented to a multidisciplinary pain treatment program a lifting injury suffered one year earlier in an industrial accident. MRI scan revealed evidence of a small central herniated disc at L-5–S-1, with no clinical evidence of lumbar radiculopathy or cauda equina syndrome. There was also a very mild diffuse annular bulge at the level of L-4–5. Further radiological studies revealed straightening of the lumbar lordosis and a diagnosis of lumbosacral strain. Multiple physicians who examined this patient consistently

reported a strong "functional overlay." Vegetative functioning was positive for a sleep continuity disorder, with recurrent nightmares. Appetite was decreased, although she experienced a 20-pound weight gain due to physical inactivity associated with her injury. Sexual performance was decreased secondary to pain. Mood was noted to be significantly depressed, with frequent crying episodes and passive suicidal ideation. Energy level was decreased, with a corresponding decrease in her functional routine activities. Historically, the patient married at the age of 17, had five children (one of whom was autistic and rarely left her presence, largely for reasons of safety), and was divorced. During her marriage she had been the victim of verbal, emotional, and physical abuse. Subsequent relationships with boyfriends were also reported to have been abusive for the patient. Academically, she reported a seventh-grade education, with her premorbid medical history having been negative. Clinically, the patient ambulated very slowly with a markedly antalgic gait. Prior to her industrial accident, the patient was an avid jogger and cognizant of engaging in regular exercise, all of which had been aborted since her injury. Baseline exercise performance on admission to the program and prior to EMDR intervention was: treadmill: 20 minutes @ 1.5 mph; health rider: 5 minutes @ 30 rpm; stationary bicycle: 10 minutes.

During the patient's involvement in a multidisciplinary pain treatment program, the patient entered into psychotherapy. Given that the patient was unable to work, she had been experiencing pronounced financial strain, making it increasingly difficult to support her family, this having been identified as a significant source of her depression, notwithstanding her ongoing pain. Despite the patient's limited educational background, she was able to articulate a metaphor characterizing how she felt about her situation. She felt "as if she were stuck in mud filled with earthworms, with all of her children." Subjectively, she was feeling a very strong need to "save them" but could not as long as she could not work. Following is a transcript of a single EMDR session comprised of 13 "sets," which dealt with the preceding traumatic content:

Set 1 I'm with my kids in the mud . . . they're gonna get sick and die . . . I have to get them out . . . I can't move, I'm stuck.

Set 2 (Patient begins to cry) I'm stuck, I can't move . . . I'm telling them to move. I can't reach any of them. I'm going under, the mud is reaching my chin.

Set 3 (Patient continues to cry) I'm a bad parent . . . I'm not doing enough for my kids. I'm gonna die and who's gonna take care of them?

Set 4 (Patient continues to cry) I just want to die 'cause I can't take care of my kids. My kids would be better off without me (At this point the patient admitted to a recent suicide gesture 1 month prior to this session in which she took a knife into the bathroom and contemplated cutting her wrists).

Set 5 I'm in mud up to my neck. I feel like I'm being pulled under . . . feel like I'm losing my breath. Don't like it!

Set 6 I feel worms crawling on my legs (Patient becomes short of breath and complains of having no more strength).

Set 7 I can't raise my hands to remove the worms from my head or nose. I can't get out of the mud . . . the mud is too thick.

Set 8 The mud is very thick and heavy (The patient is asked to think of something that would soften the mud).

Set 9 It's raining and I hear thunder. The mud now feels like a pool of dirty water. The kids help each other get out of the mud.

Set 10 I see the kids on the porch. They look like their clothes are dry and clean, but I'm still in the mud.

Set 11 I found some stairs under the mud. Climb out of the mud hole. Shaking off the worms, but I'm still dirty standing on the porch (Patient is asked how she could become clean).

Set 12 Patient leaves the protection of the porch and walks out into the rain. Patient smiling, stating that the rain water is cleansing her and spontaneously states "I'm free." Patient states that she sees the sun and a rainbow and sees that her children are laughing.

Set 13 Patient is laughing that she and the children are "all wet." Patient is asked what she could do to become dry. Patient and children begin playing in the sun until completely dry.

The preceding reflects a patient who not only was experiencing chronic pain, but also by virtue of having been unable to work and thereby financially provide adequately for her children was severely depressed with suicidal features. The magnitude of her depression was sufficient to impede her motivation and energy levels regarding her physical involvement in the various somatic therapies. Accordingly, treatment of the depression became the priority regarding her overall treatment plan. It is believed that traditional verbal psychotherapy, regardless of the clinician's theoretical orientation, i.e., psychodynamic, cognitive behavioral, etc., might have been clinically effective over the course of time. Also presumed is that the clinician would have developed a particular thematic focus in treating the previously described depression that would have alleviated the problem. By comparison, within an EMDR framework, the patient was able to arrive at her own metaphor regarding her depression, with EMDR facilitating a rapid and effective amelioration of the depression based on the patient's "internal" perspective, as well as utilize her own cognitive and emotional strategies to effect the needed change. By facilitating the patient's ability to extricate herself from a "mud hole," the patient's level of emotional and physical energy was sufficiently raised so as to result in a dramatically improved response

to the somatic therapies offered by the multidisciplinary pain treatment program. For example, her discharge exercise performances were: treadmill: 30 minutes @ 4.2 mph; health rider: 20 minutes @ 55 rpm; and stationary bicycle: 20 minutes. Concurrently, however, it was also important to deal with her pattern of entering into dysfunctional relationships, which had repeatedly served to cause her to view herself as "victimized" in the context of being in another "muddy hole." Despite the patient's medical diagnoses, she was subsequently able to physically improve to the point of returning to work without the need for invasive surgical intervention. Virtually any "brand" of psychotherapy is potentially useful in treating chronic pain patients, although cognitive behavioral approaches have demonstrated the most significant utility in assisting such patients. However, even the most skilled psychotherapist is seen as not as effective as patients' own internal resources in healing themselves. EMDR appears to afford such patients the opportunity of rapidly and effectively accessing their own "power of the mind."

In addition to being a powerful cognitive tool in the treatment of pain, EMDR, by separating the affective dimension of linked memories, with a resultant "appropriate" response rather than augmented affective response, appears to have a direct effect on the limbic system. Thus, this new tool would appear to allow us to access the patient's abilities on a neurophysiological level, through cognitions both in a downward serial system and in a parallel system through precortical intervention. It has also been our experience and that of others (144,147–150) that the limbically "deaugmented" emotions remain this way unless further traumatization takes place. That is, after the patient establishes a more normalized emotional response to pain and stressors, he or she does not revert to a limbically augmented reaction to further pain, without further traumatization. In our experience, this parallel response to EMDR gives this technique an added dimension beyond that of more traditional cognitive behavioral interventions, including hypnosis, cognitive approaches, and biofeedback. Those techniques allow for significant cognitive interventions to help improve a person's perception of pain and quality of life but do not offer a permanent change in the affective dimension of his or her pain experience, as does EMDR.

CONCLUSION

In this chapter we have attempted to bring together the most current knowledge regarding learning, perception, and the interface of these brain functions with the nociceptive system. We find the concepts of Price (1) and Rome and Rome (10) particularly important to this understanding. Price has elegantly described both the sensory discriminative dimension and the affective dimension of pain perception. Rome and Rome have further utilized these concepts in describing the lateral and the medial pain systems and how limbic augmentation can occur through the neuroplastic changes in the brain in a chronic pain state. Central sensitization is a key feature of many chronic painful disorders, leading to what often becomes a generalized central sensory dysfunction, affecting not only the nociceptive system, but also other sensory systems, as evidenced by the hypervigilance noted in multiple chronic pain disorders.

Peripheral nociceptive stimulation can result in local sensitization in acute pain, and this peripheral stimulation, if repetitive, chronic, or intense enough, can produce spinal level and/or supraspinal level sensitization. This sensitization affects both the sensory discriminative dimension of pain as well as the affective dimension (through the limbic system). Both the affective dimension and the sensory discriminative dimension, one or both of which can be augmented as a result of sensitization, connect to higher cortical areas, thus contributing to the ultimate perception of pain by the person. Depending on which dimension has a greater contribution to that perception of pain, the qualitative experience of the person will vary.

Through cortical feedback in a downward fashion, we are able to utilize cognitions and behavioral modifications to alter both the sensory discriminative and affective dimensions of pain. Changes in cognition result in a change in perceptual awareness; that is, we change the channel on our television screen. In addition, these cognitive changes and the associated motor changes through behavioral interventions have a downward effect on the limbic system and brainstem, modifying the affective experience of the patient and stimulating the thalamospinal nociceptive inhibitory fibers. As Price has pointed out, modifying the sensory discriminative dimension of pain, which works in parallel with the affective dimension, results in a change in the latter as well. However, the opposite is not true, and therefore we have the ability to also utilize cognitive and behavioral changes directed at the affective component without necessarily modifying the sensory discriminative dimension. These cognitive behavioral interventions, including hypnosis, can thus be effective tools directed at modifying the patient's experience of pain.

However, in addition, we have described EMDR as a new and powerful tool in treating chronic pain. Recent research on memory has demonstrated the neurophysiological involvement of the limbic system, with a strong correlation to the areas of the limbic system involved with nociception as well. EMDR is useful in separating linked memories of traumatic and painful associations and allows persons to affectively experience their memories and their consequent motor expressions in behavior to those events more appropriately. It is our belief that EMDR not only works through cognitions, but also seems to have a direct effect on desensitizing the limbically augmented portion of the pain experience. Thus, in effect, it seems to reset the circuit breaker for emotion. It allows a more normal affective response to pain signals and to

stressful events posttreatment, and this response seems to be permanent, unless the individual is retraumatized or resensitized. In this way, EMDR adds a dimension to the treatment of pain that is quite different from other cognitive and/or behavioral interventions, including hypnosis.

Traditionally, psychiatric and psychological interventions in chronic painful disorders have frequently been based upon the theoretical orientation of the particular therapist. In regard to treating chronic pain, the modus operandi was based on "a pain is a pain is a pain." However, our current understanding of neurophysiological central nervous system function, especially the nociceptive system, would seem to mandate that psychiatric and psychological interventions for persons with chronic painful conditions be based on these newer understandings, rather than on the orientation of the therapist. It is incumbent upon us as practitioners to develop the understanding and knowledge necessary for the techniques that have shown themselves to work most effectively in helping patients improve the quality of their existence and to be able to do this through the most effective techniques.

The U.S. Congress declared this decade, beginning January 2001, as the Decade of Pain. We can all anticipate a much richer knowledge base about nociception, pain perception, and appropriate physical and psychological treatments as a result. We who practice pain medicine and management have already gained a significant enrichment from the previous Decade of the Brain research. We look forward to the next 10 years in terms of added benefits that further research may help us bring to more successful treatment of our patients.

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