Behavioral techniques in pain modification

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■ Psychological variables and behavioral techniques influence pain behavior in chronic benign pain syndromes and in cancer pain. Such techniques affect patterns of thought, feeling, and action related to the experience and expression of pain. They demonstrably contribute to the therapy of patients with chronic benign pain and hold promise for increasing the quality of life for cancer patients.

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BEHAVIORAL techniques have been used to modify three types of chronic pain: chronic, recurrent pain (as in headache); chronic, intractable, benign pain (eg, one kind of low back pain); and chronic, progressive pain (eg, some kinds of cancer pain). Most available research focuses on the first two kinds of pain.[1–5]

BACKGROUND

General

A recent NIH Consensus Development Conference reports "a dramatic increase in laboratory and clinical research on nonpharmacological approaches to pain management" in the past 10 years,[5] but a recent article on behavioral factors in cancer pain states "...studies of cancer pain have addressed psychological and environmental factors infrequently, despite the observation that the cancer pain experienced cannot be totally explained by the degree of pathology."[6]

Behavioral techniques for modifying pain can be grouped into two categories, those in which the goal is to control pain behavior independent of reported pain experience, and those in which the goal is to control reported pain experience or the subjective experience of pain.[7–12] A recent review suggests that psychophysiological, psychosocial, and medical/physical factors may have to be evaluated in order to understand a patient in pain and to plan appropriate interventions.[12]

Clinicians have probably shied away from applying behavior modification techniques to patients with cancer pain out of concern that the techniques might keep patients quieter but not in fact improve the quality of their life or their experience of pain. One survey indicated that fewer than 20% of physicians treating cancer referred patients for cognitive relaxation therapy.[13] Ethical appropriateness seems more clear in cases of chronic benign pain. However, data indicating that excessive pain behaviors detract from quality of life in cancer suggest that a more systematic use of behavioral techniques in this population should be considered.[14,15] Also, the cognitive factors that seem inextricably present in behavioral techniques are classically therapeutic. They require establishing joint belief in the effectiveness of a program, forming an alliance with the therapist, and undergoing a defined therapeutic ritual.[16]

Behavioral techniques applied to chronic benign pain

Treatment to control chronic benign pain is typically multimodal, including operant procedures intended to

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influence pain behavior and a variety of other psychological approaches intended to modify reported experience of pain as well as pain behaviors. These other procedures include: relaxation exercises, biofeedback, hypnosis, assertiveness training, desensitization, group psychotherapy, vocational and educational assessment and counseling, family therapy, sexual counseling, individual psychotherapy, videotape role playing, creative therapy, reduction in pain medication, physical therapy, and education about pain mechanisms and effects.[17]

Behavioral techniques applied to cancer pain

Because cancer pain clearly has pathologic cause, the psychological techniques most often used are relaxation, distraction, belief in self-control, suggestion, and reduction of anxiety and depression.

Probably in part because cancer pain is so clearly different from chronic benign pain in its causes and in its possible course and consequences, behavioral methods of altering pain behavior have been underutilized with cancer patients. Although most research on operant methods of treating pain behavior has been on patients with chronic benign pain, the methods are clearly applicable to persistent cancer pain as well. Internal emotional responses such as anxiety and hopelessness, along with behavioral responses such as reduction in exercise and eating, can increase the severity of the pain experience and reduce motivation and acceptance of medical treatment programs.[14]

CONCEPTUAL MODEL

Behavioral methods of treating pain behavior can be summarized using the S→O→R→R model, which represents one way of conceptualizing an active individual in his or her environment. S represents stimuli, O represents the organism, the first R represents response (the behavior of the organism), and the second R represents reinforcement (the consequences of and reactions to the behavior). Stimuli impinge upon a person who responds and whose response is in turn reinforced.

The stimuli include those from the external environment as well as from physiological and psychological processes. The organism includes two sets of variables: psychological (eg, attitudes, assumptions, expectations, feelings) and biological (eg, anatomical, biochemical, physiological). Responses include overt behavioral actions as well as internal psychological and physiological reactions. Responses can in turn be stimuli for new responses. Reinforcement (either negative or positive) can be administered from without, as in sympathy for expressed pain, or from within, as when one congratulates oneself for stoic suppression of feeling.

Both the etiology and the treatment of chronic pain can be understood by examining various elements in the S-O-R-R chain.

The S-O link reflects the classic neurophysiologic explanation (and its complex modifications based on recent research) of nociceptor stimulation leading to subjective experience of pain. Almost the reverse of the process is seen in some phantom limb pain and in conversion reaction pain where central nervous system variables (as in activation of stored memory of pain) seem to lead to "hallucination" of an external stimulus as an explanation for inner experience of pain.

The S-R[18] (response) link refers to pain behavior that may be directly and classically conditioned to a given stimulus (eg, tension experienced with authority figures secondary to stimulus generalization from tension experienced with one's father; nausea and pain on anticipating the next chemotherapy session).

The O-R (response) link includes individual mythologies that alter response to perceived pain, as in a belief in stoic suffering. This link also includes responses that occur as a result of illness or injury to the organism.

The R-R[18] link is often used by behavior theorists to explain maintenance of pain behavior. When, for example, pain behavior is rewarded with relief from responsibilities, it may continue at a higher rate than if it were not so reinforced.

OPERANT CONDITIONING

Behavior modification in its narrower sense refers to operant conditioning,[8] the R-R link. An operant is a response that operates on the environment. In pain, operants are the outer, observable phenomena of pain. They consist of a variety of messages and signals that communicate that one is in pain. These include requesting medication, requesting attention, changing posture, changing expression, going to bed, leaving activities, and so forth. These behaviors are ones that can be affected by environmental consequences. What is done in response to the patient's pain behavior, and the effect of that response on the behavior, can be discussed in terms of operant conditioning. A person's pain behavior (including subjective report) can be shaped by the outcome of such behavior.[8] This is not to say that pain is originally produced by operant conditioning, but rather that the experience of pain and one's behaviors related to that experience can be profoundly influenced by environmental consequences, particularly where the prob-

lem has existed for an extended period.

The operant conditioning model ignores other learning processes—classical conditioning, cognitive conceptual learning, modeling, and identification—that are also relevant to treatment of chronic pain. These learning processes all contribute to the differences in the behavior of patients with pain, from the person who responds to given tissue damage by becoming an invalid with unbearable pain to the one who responds by treating it as a minor annoyance or as a welcome test of will.[19]

Operant conditioning essentially refers to control of behavior. Instrumental responses, operant responses, those that act and operate on the environment, are extensively controlled by their immediate consequences. Responses that result in punishing effects are usually suppressed (not eliminated), and those that produce positive outcomes are retained and strengthened. A response that is followed by a positively reinforcing consequence has an increased likelihood of being repeated on subsequent occasions. Furthermore, the frequency and patterning of outcomes, the kind of schedule of reinforcement, produce different kinds and strengths of responses.[8,18]

In a continuous schedule of reinforcement, there is reinforcement each time for specific behavior. If the reinforcement is later withdrawn, there is typically a brief increase in the behavior, then a rapid decrease, often with emotional reactions.

In a fixed interval schedule of reinforcement, there is reinforcement only after a specified period of time. As time for reinforcement nears, behavior rewarded often increases, but the reinforcement itself often has little immediate impact on the behavior, which may drop off after the reinforcement.

In a fixed ratio schedule of reinforcement, a given amount of behavior is necessary for reinforcement. This usually results in a high, stable rate of response.

In a variable interval schedule of reinforcement, the frequency of reinforcement varies randomly around a temporal value. Reward comes on the average of once an hour, once a day, once a week, etc.

In a variable ratio schedule of reinforcement, the number of responses per reinforcement varies around a selected average ratio. This schedule appears to be the most powerful in sustaining behavior.

Schedules of reinforcement, common behaviors (operants) of people in pain, and reinforcements interact. What rewards pain behavior? It depends on the individual and his or her needs. Some common reinforcers are: rest, relief from pain, change in mood after medication, avoidance of trying responsibilities, money (in the form of compensation), avoiding sexual demands from spouse, attention and concern from others, and avoiding situations that expose inadequacies. Pain behaviors are likely to be reinforced on the powerful variable ratio schedule. For example, attention may be given on the average of every fifth request when one finally feels the complaints can't be ignored. If healthy behaviors (work, normal expression and posture, discussion of subjects other than pain, etc.) are not as systematically reinforced, or reinforced only after pain has intervened, the temporal relationship of reinforcement and behavior will strengthen the pain behavior. For example, a husband may visit and talk with his wife much more when she is in the hospital than when she is functioning at home. A patient may receive narcotics only when complaining of pain. A worker may get rest breaks only when grimacing with pain.

Fordyce[8] has called particular attention to iatrogenic factors in producing chronic pain, foremost among these being PRN pain medication and exercise to tolerance programs. If relief from pain is positively reinforcing, and/or if the medication also produces a pleasurable change in mood, medication that is contingent upon displaying pain behavior may serve to strengthen the behavior. If a patient gets relief from pain, a better mood, or attention from a respected professional, family, or hospital roommate after a number of complaints and other displays of pain behavior (inability to work, etc.), this is a potent program for strengthening pain behavior.

In exercise to tolerance programs, the advice is to perform a given activity until one hurts or is unable to continue because of pain. The reward sequence is Activity→Pain→Rest, a sequence that can reinforce pain behavior. Similarly, if one is told to work until pain intervenes, and then to go home, but to keep trying each day, the sequence will be Work→Pain→Home. If home is a positive reinforcer, the program will be unwittingly strengthening the pain behavior. In such instances, a change in reinforcement schedule may be indicated.

Shifting from a response-contingent to a time-contingent basis may result in a marked drop in the pain behavior. If medication is given at precise times each day, rather than on a PRN basis, pain behavior may decrease. If an individual is told to do so many minutes of activity, or so many hours of work, and then is rewarded, pain behavior may decrease. Many studies indicate that when rewards are made conditional upon occurrence of a given behavior, that behavior is maintained at a consistently high level. But when the same rewards are given only after a certain time has elapsed, independent of the behavior, there is a marked drop in the behavior.

However, eliminating a reinforcement schedule that strengthens and maintains pain behavior may not be enough. With many chronic pain patients, it is also necessary to reward healthy behavior. Chronic pain patients often have a limited repertoire of responses to pain,[20] and a relative paucity of positive coping behaviors. The first step is to identify healthy behavior—vocational, social, physical, sexual, intellectual—that is desired. The second step is to identify positive reinforcers for the particular patient, such as attention from spouse, money, or approval from the physician. Studying what maintains the pain behavior may be helpful in identifying positive reinforcers for a given patient. The third step is to work out appropriate schedules of reinforcement for healthy behavior, and to stop positive reinforcement of pain behavior.

In order to take these steps, the environment must be controlled. This can be difficult enough in a hospital, where nursing personnel and other patients may inadvertently provide much positive reinforcement for pain behavior, but it can be much harder at home, where family and friends dispense reinforcements in a way that often converts a continuous schedule of reinforcement into a more powerful variable ratio schedule. They hold out until they can't stand any more of the behavior they're trying to eliminate, then give in.

The reinforcement schedules for secondary gain may be so complex that hospitalizing the patient in a situation where the staff are trained in operant theory and procedures may be necessary. Hospital treatment is often especially needed when addiction or severe habituation is suspected. In such instances, the patient may be a poor reporter of drug intake, either out of confusion, fear of rebuke, or desire for increased intake. Fordyce[8] has developed an operant conditioning program that is helpful in managing such patients.

Progress can be difficult. A patient who is used to being reinforced for pain behavior can become so emotionally upset at not being given medication on demand that he or she will rip up the contract signed at the beginning of treatment. If the patient's withdrawal into pain serves needs of the family, modifying their reinforcement pattern can be extremely challenging.

But challenging or routine, modification of reinforcement schedules is a potential part of any treatment program for chronic pain. Even if the suffering cannot be alleviated, the attendant behavior often can be dramatically changed. And sometimes both can be changed; for example, a program that uses a multimodal pain management model to help children with cancer manage their reactions to invasive procedures has yielded preliminary data suggesting that both distress and pain behaviors can be reduced by behavioral techniques.[15]

Behavior modification (operant conditioning) requires explicit definition of the responses to be changed, specified steps toward the final response, and positive reinforcement for achieving each step, all within the context of an active learning program. Behavioral assessment is essential to enable explicit definition of the behavior to be modified. A hierarchical cluster analysis of pain behaviors has grouped 78 pain behaviors into nine clusters.[21] A study[14] of head and neck cancer pain identified four specific behaviors—guarded movements, grimacing, rubbing, and sighing—as target behaviors and then examined both activities that might increase pain and those that would relieve pain, as well as modifying activity level, pain medication intake, weight loss, and pain level. In this group of patients behavioral problems related to pain were frequent. These problems seemed independent of treatment of the lesion itself; they persisted and even increased when patients did not have evidence of disease following treatment.

CLASSICAL CONDITIONING

The classical conditioning model,[18] the S-R link of the model, also applies to treating cancer pain. If, for example, one experiences pain and nausea in undergoing chemotherapy, the pain and nausea eventually could be elicited by the people, instruments, and places associated with the chemotherapy, including their symbolic representation in one's mind. Thus, merely thinking about approaching chemotherapy, anticipating it, can evoke pain and nausea as a conditioned response.

Systematic desensitization is a common procedure for treating conditioned pain. It involves having the patient relax deeply while working in imagination through a series of situations graduated in the amount of reaction they produce. The patient starts by constructing a hierarchy of these situations. For example, the top of the hierarchy might be actually receiving the chemotherapy, while in the middle might be anticipating it a week ahead of time, and at the bottom of the list seeing someone in a white coat like those worn by the hospital personnel. The reason for having the stepwise gradation is that as the patient extinguishes the pain response to the stimuli and substitutes a relaxation response, the task should always be one small step, so that the patient is not confronted with a massive sense of anxiety and anticipatory pain together with the demand that relaxation be substituted for this response. Biofeedback train-

ing can assist in the desensitization process by insuring that deep relaxation takes place. Transfer of the imaginal response to real-life situations is often accomplished through homework involving steps approximating those used in the imaginal training.[9]

COGNITIVE BEHAVIOR THERAPY

Operant conditioning and classical conditioning have been very useful models in developing effective programs for modifying chronic pain behaviors,[22] but the techniques may not be effective if they are used independently from cognitive factors, as is often the case.[23–25] An increasing body of evidence indicates that both classical conditioning and operant conditioning are strongly affected by, and in turn affect, thinking patterns. In the cognitive behavioral model, the therapist functions like a coach, helping the patient interpret life experience in a constructive way in order to formulate appropriate attitudes and expectations. The therapist provides the patient a good deal of information, because data suggest that uncertainty creates anxiety and that patients generally wish to be well informed. Findings of a study of persons with osteoarthritic knee pain, for example, support the theory that thinking patterns influence pain and distress.[26] The subjects who scored high on a measure of pain control and rational thinking had less pain and psychological distress and better health status than the patients with lower scores.

RELAXATION AND BIOFEEDBACK THERAPY

Relaxation and biofeedback have given mixed results in patients with chronic low back pain,[2] but relaxation generally appears helpful, particularly in reducing ratings of subjective pain when relaxation is a coping strategy. A recent review[2] of five operant studies concluded "there is no longer any question as to whether the operant program is potent.... The question is no longer does it work, but how well does it work, for whom and why.... The operant program is most effective with those behaviors which it primarily addresses." This review also examined 10 studies in which relaxation training was the primary treatment. It suggested that biofeedback and relaxation might rival operant programs in effectiveness, might be cheaper, and that such programs were particularly effective when combined with cognitive training, helping patients rethink their lives, so that the relaxation was used as a way of coping with pain. The conclusion was "it is now quite certain that relaxation results in significant reductions in pain reports and these are accompanied by moderate improvements in other areas, eg, medication intake, activity, and mood."[29,30]

Relaxation approaches can be either active or passive. The passive approaches usually involve passive focus on imagery or a word or a phrase, done in a place where one won't be disturbed. Progressive muscle relaxation, the most commonly used active approach, involves tensing and then relaxing various muscle groups in the body. With either approach, it is common to make audio tapes for a patient to work with at home. Relaxation is most effective when one develops the capacity to relax briefly throughout the day, using relaxation as a strategy for coping with pain as well as for coping with anxiety, tension, and fear.

Relaxation as a coping tool often employs the quieting reflex,[31] a short relaxation strategy that relies upon multimodal psychological principles, including an improved awareness and discrimination of cues to arousal, relaxed abdominal breathing, cognitive therapy, and imagery. This brief (few seconds) process involves attending to signals of increased stress or pain, gaining a little psychological distance by dissociating oneself from the extreme impact, reinterpreting the experience as expected and manageable, taking a deep, relaxed abdominal breath, and allowing a wave of calm to move down the body and bring heaviness and warmth to the hands and feet.

Biofeedback[32,33] can facilitate relaxation and enhance self-control. Biofeedback partly consists of operant conditioning in which one learns to effect control over physiology by working in small, specified steps, with positive reinforcement at each step. Biofeedback[34] also consists of feedback learning; the biofeedback equipment represents imposition of an external psychophysiologic feedback loop upon already existing internal feedback loops. It can help in learning relaxation through impact on feedback loops of homeostatic control systems.

Biofeedback can also help in learning specific physiologic control, as with direct feedback. In effective biofeedback training, the relaxation response is learned with the assistance of imagery and cognitive exercises; cognitive behavioral techniques are used to help modify assumptions, attitudes, and expectations that contribute to psychophysiologic stress reactions and to increased sensitivity to pain.

The most common biofeedback equipment[35] used in clinics across the country includes EMG, skin temperature, and electrodermal feedback devices. The instruments amplify recorded physiologic activity and trans-

late it into visual and auditory displays. This feedback provides information about results when one is trying to relax. Information about results is an essential condition for effective learning, along with capacity to make the response, desire to make it, and reward for the desired goal. There is controversy as to whether learning to reduce EMG activity is essential for reducing even muscle contraction pain, but it is not controversial that biofeedback equipment assists in learning significant physiologic control. Such learning often has indirect therapeutic effect in one who feels increasingly out of control, at the mercy of pain and dysfunction.

HYPNOSIS

For some patients, hypnosis will constitute an intensifier for relaxation, self-control, and imagery techniques. A firm body of scientific research on hypnosis suggests that hypnotic susceptibility can be reliably and validly measured, and that those who are highly susceptible on the average can experience, in response to suggestion, an average reduction in pain significantly greater than that experienced with relaxation. Patients in a deep hypnotic state typically experience an altered state of consciousness in which Aristotelian logic is replaced by trance logic, which tends to interpret metaphor literally and concretely and to ignore contradictions. Hypnotized persons also feel compulsion to respond to constructive suggestion. Suggestions are given to effect changes in sensation, perception, and memory greater than are possible in the waking state.[37]

Most studies of the effectiveness of hypnosis[36,38] in reducing cancer pain rely on anecdotal case reports; there has been little controlled research. What studies there are suggest that depth of hypnosis is related to degree of relief from pain, and that it is important to assess capacity for hypnosis as a first step in treatment. Assessment of hypnotic capacity typically involves a sampling procedure in which the subject experiences hypnotic induction and deepening and then is given suggestions that represent varying degrees of difficulty of hypnotic responsivity. This approach is used because there are few reliable indicators of hypnotic susceptibility; perhaps the best is a history of intense involvement in imaginal activity.[40] The techniques that are utilized under hypnosis include converting, substituting, or displacing the pain, as in suggesting pressure rather than pain, as well as developing compelling imagery, even "out-of-body" experiences, to dissociate oneself from the pain. Deep hypnosis seems to represent a cognitive behavioral act of mental dissociation, frequently facilitated by imagery.

SUMMARY

Pain behavior[41] in chronic benign pain syndromes and in cancer pain[42] depends on personality,[43] coping styles,[44] cognition,[45] and conditioning, as well as pathophysiology.

Increasingly, behavioral therapies intended to change maladaptive thought patterns and those intended to change maladaptive action patterns are combined in the treatment of pain.[1–4,7,8] It is recognized, in the field of psychological treatment of pain, that thinking, feeling, and acting are inextricably intertwined. In a systematic approach, the patient is taught how to change thought patterns by modifying attitudes and expectations, how to change feelings by learning relaxation and a sense of self-control, and how to change actions by shifting reinforcement contingencies. These programs can help reduce maladaptive pain behaviors and severity of pain in both outpatients and inpatients.[2]

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