DIAGNOSIS AND TREATMENT OF PHANTOM LIMB PAIN: MECHANISMS AND OP--ETC(U)

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DDEAMC-81-19-1
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DIAGNOSIS AND TREATMENT OF PHANTOM LIMB PAIN:
MECHANISMS AND OPTION FLOW SHEET.
DDEAMC # 81-19-1 August 1982
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Diagnosis and treatment of phantom limb pain: Mechanisms and option flow sheet

The basic mechanisms underlying phantom pain as well as the diagnostic and treatment procedures are difficult to keep track of and coordinate during both teaching and clinical application. A figure summarizing the major mechanisms is provided along with the rational upon which each treatment is based. A flow sheet outlining when to do each diagnostic and treatment procedure and providing options based on results of each is provided to simplify teaching and keeping track of progress through a complex process. Only treatments with at least a fair success record on follow-up are included.
DIAGNOSIS AND TREATMENT OF PHANTOM LIMB PAIN: MECHANISMS AND OPTION FLOW SHEET.

Richard A. Sherman*

TREATMENT OVERVIEW AND RATIONALE:

Phantom limb pain should be recognized as a special case of referred pain in which the pain can be referred from a wide variety of locations for many reasons utilizing several interdependent psychophysiologic mechanisms. Successful treatment of phantom pain depends on the ability of the health care team to be alert diagnosticians, able to trace the source of referral when only minimal and confusing clues are available.

Many theories have been developed to account for phantom limb pain. Most of those having a modicum of neurophysiological and clinical evidence to support them are summarized in Figure 1. Several are based on pain mechanisms previously related to causalgia and have not been discussed in relation to phantom pain in previous articles.

The treatments suggested here are based on: (1) the theoretical mechanisms discussed here and elsewhere, 1, 3, 5, 6, 9, 10, 12, 15 (2) clinical experience by us and by the hundreds of health care providers responding to our phantom pain treatment survey, 11 (3) an updated version of our analysis of the literature, 8 and (4) especially, on responses to our phantom feelings surveys by over 3,000 amputees who identified which treatments actually did work and for how long.10

The major types of treatments recommended and their theoretical bases are as follows:

1. Appropriate standard treatments are given to areas referring pain into the phantom such as back and bowel problems, impinged nerves, etc.

2. EMG muscle tension feedback from the stump is given to dampen and to disrupt the shooting pain associated with the stump spasm cycle. The cycle hypothesis involves a self sustaining positive feedback system which includes remaining portions of these nociceptors originally innervating the amputated portion of the limb, the spinal cord, the muscles in the stump which once controlled movement of the amputated area, and the stump nociceptors. Impulses from the nociceptors originally ending in the amputated area would cycle through the spinal cord to the stump muscles. Muscular responses would stimulate the

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stump nocioceptors as well as the remaining portions of the nocioceptor nerves arising from the amputated area, thus continuing the cycle.

3. Modalities such as sympathetic blocks, temperature feedback from the stump, and chemical sympathetic depressants are used to reduce peripheral sympathetic arousal. This, in turn, reduces the stimulation and sensitization effects that efferent sympathetic fibers have on afferent nocioceptors from the amputated limb which are located in the same nerve bundle. Shortcircuiting of efferent sympathetic fibers and afferent nocioceptors may occur in the neuroma and is frequently related to causalgia like burning pain. Beta blockers may be of some use to treat this portion of the problem. A recent report shows success upon follow-up with propranolol, and theoretically they should have a positive effect on these kinds of problems but prior reports were not promising.

4. Prosthetic refitting and gait correction are used to eliminate nocioceptor sensitization and hyper-reactivity caused by release of algesics from sores, from damaged blood vessels, and from the body's normal physiological responses to chronic destructive physical stress in the stump. Treatments reducing physical stress to the more normal appearing proximal portions of the stump are especially important. These areas are far more sensitive than corresponding areas on the intact limb.

5. Chemical, behavioral, and relaxation techniques are used to treat exaggerated stress responses, anxiety, and depression to minimize their effects of pain magnification and reinterpretation of benign signals into painful ones. These treatments can also reduce sympathetic arousal and disrupt the pain-tension-anxiety cycle.

6. TENS and ultrasound at the stump are broad, low intensity stimuli used with the rationale that closing the pain gate will temporarily disrupt any self sustaining pain cycles in progress. These treatments are used concomitantly with treatments aimed at permanent control of the pain gate to avoid their effects from quickly wearing off. Disrupting the cycle, even temporarily, is still very important because it prevents permanent establishment of and disrupts chronic pain systems - both physical and behavioral. It gives the patient a hiatus during which longer lasting skills can be learned.

The mechanisms discussed above would lead to the prediction that acupuncture and hypnosis would be of some highly transient benefit by temporarily closing the pain gate from the peripheral and central axes of the nervous system respectively. However, as is found with TENS and ultrasound, a longer lasting treatment should be used concomitantly with them to take advantage of the temporary disruption of the pain cycles. By extension of these models, modalities such as resection of the stump and excision of a neuroma should tend to exacerbate the pain. The predictions are supported by the literature.

PREAMPUTATION PREPARATION:

The patient should be told about expected, normal phantom sensations and about the possibility of phantom pain. The concept of nerves from the limb to be amputated remaining intact and responsive between the stump and brain can be introduced at this time to reassure the patient that these feelings and pains are neither unusual nor a sign of madness. This discussion is vital to the patient's ability to
incorporate seemingly impossible sensations into his new perceptions of himself. It should decrease the number of hysterical reactions and help prevent magnification of benign phantom sensations into painful ones through excessive attention, anxiety, and depression cycles.

WITHIN ONE WEEK POST AMPUTATION:

Watch for magnification of pain due to acute stress, psychotic, and grief reactions to loss of the limb. These intense acute pains can usually be resolved with simple reassurance and explanation. When necessary, several short psychiatric interventions are helpful.

Many recent amputees experience severe acute phantom pains closely associated with even more severe acute stump end pain. This is probably partially because nociceptors are directly stimulated and their firing thresholds are reduced by algesics released by damaged tissues and blood vessels. Nociceptors cut and damaged during the amputation are probably especially sensitive. Another contributing factor is probably sympathetic hyperarousal due to physical stress in the stump and due to mental stress from the amputation circumstances. Patients can be honestly reassured that these pains will decrease substantially as the acute stump pain from the amputation process resolves. The immediate post amputation period is well suited to review the normality of phantom sensations and the expected occurrence of at least occasional discomfort in the phantom. Reassurance and teaching by physicians and other medical staff can go a long way toward preventing patients from developing habitual reinterpretation of normal phantom sensations into painful ones which can be magnified with anxiety-pain cycles on a chronic basis. The idea that it is not "insane" to experience phantom pain should be emphasized to staff and patients alike to permit generation of an accepting, knowledgeable, understanding atmosphere. The patient's overall attitude toward prosthetic adjustment and re-entry into normal life can have a profound influence on the extent to which normal psychological and physical difficulties are interpreted as painful sensations. Figure 1 illustrates some of the painful phantom feelings which can be expected. It appears vital to explain the mechanism through which referred feelings and pain originate and to give examples of these phenomena if patients are to accept their feelings as not being fancied. We usually use examples of intense referred sensations from common life situations such as the headache resulting from quickly eating very cold ice cream and the tingling sensations in the fingers following a sharp blow to the elbow. The relevant pain mechanisms described in Figure 1 are frequently discussed at this time. The exacerbating effects of stump conditions, weather, fatigue, and stress on both phantom and stump pain are described.

SUBCHRONIC AND CHRONIC PHANTOM LIMB PAIN:

The subchronic period is the interval between the acute post amputation phase and the chronic pain phase. It is the optimal time to begin treatment in order to minimize the establishment of resistant chronic pain patterns which are exceedingly difficult to disrupt. The factors discussed with acute amputees should be reviewed with the patient. The diagnosis-treatment guide presented in Figure 2 can be used to avoid missing crucial information and to select the optimal treatments currently available for each particular case. The flow sheet includes the basic steps to follow in diagnosis and treatment of phantom limb pain including frequently missed diagnostic problems identified in surveys by amputees and physicians. All treatments having reasonable success rates on follow-up are included.
Referred pain from back injuries, intestinal problems and stump problems must be dealt with prior to any treatments aimed solely at phantom pain. Poorly fitting prostheses and other stump problems should also be rectified before initiation of phantom pain treatments. Trigger points, stump spasms (both micro and macro), and local circulatory problems frequently play a major role in initiation and intensification of phantom pain so they must be properly evaluated. Bear in mind that phantom pain is a therapeutic problem. If all modalities from Figure 2 fail, the prognosis for invasive intervention is exceedingly dim. The only resource currently available to patients not successfully treated with the above methods is referral to pain control centers specializing in helping patients learn to live with their pain.
REFERENCES


FIGURE 1
PHANTOM PAIN AND POSSIBLE MECHANISMS

- Sensory homunculus
- Central nervous system
- Pain gate
- Peripheral or central (fight/flight) stimulation of efferent sympathetic fibers causes increase in firing rate of associated nociceptive fibers
- Nerve endings greatly sensitized by tissue & blood vessel damage (due to rubs, sores, etc.)
- Pain gate altered by: 1) Peripheral changes in signals along all nerves from and going through stump due to use fatigue, circulation, prosthetic use, etc.; 2) Changes in same nerves in the spine due to CNS related back problems, etc.

- Interpretation (decision)
  - Attention beliefs attitudes
  - Benign (feelings not painful)

- Magnification
  - Stress anxiety depression
  - Intensified pain

- Nociceptive fibers from hand
- Nociceptive fibers from arm/stump
- Efferent sympathetic nerve fibers mixed in with nociceptive fibers
- Intensifying feedback loop
FLOW CHART OF DIAGNOSIS AND TREATMENT OF PHANTOM PAIN

During initial interview take time to establish a warm relationship with the patient. Listen to symptoms and environmental correlates of the pain. Openly discuss (1) the role of central nervous system mechanisms (not called psychological) in which slightly elevated depression, anxiety, and stress act as major magnifiers of pain, (2) physical and mental stress resulting in musculoskeletal and cardiovascular responses which in turn cause pain, and (3) mechanisms of referred pain. Patient should be reassured that problem is common and not a psychiatric one.

Very careful evaluation to uncover subtle stump problems. Crucial tests frequently not performed include (1) surface EMG of major stump muscles for unusual tension levels and micro/macro spasms/tremors and (2) stump circulation and temperature checks. Crucial questions frequently not asked include those identifying and differentiating between cardiovascular, musculoskeletal, and intestinal stress responders.

STUMP PROBLEMS? yes Correct problems using standard techniques. Correction of existing stump problems is likely to decrease phantom pain.

no

Chemical or physical alteration of a normal stump is not likely to reduce phantom pain.

Give MMPI - Best researched psychological test used to uncover masked depression, anxiety, and extent of functional component of pain. (NOTE: It is crucial to tell patients that this is a standard part of all chronic pain evaluations which is looking at mind/body styles of interacting - not mental illness!)

PAIN CONTROLLED? yes

no Follow for 2 years.

WAS AMPUTATION PERFORMED WITHIN 3 MONTHS? yes

Acute pain problem. Just post amputation phantom pain can be associated with trauma and stump healing. It is likely to decrease as stump problems clear and use of prosthesis becomes regular.

no Subchronic or chronic pain problem.

continued

continued
There is a diagram showing a decision tree for patient management, likely related to pain or mental health. The tree includes branches for conditions such as pain control, psychological reasons, and medical reasons, leading to decisions on whether to follow up or continue monitoring.

The text on the page appears to be associated with the diagram, possibly explaining the criteria or conditions for each branch of the decision tree. However, due to the nature of the diagram, a full transcription of all relevant text is not possible within the constraints provided.
Figure 2 - second page

Carefully evaluate for masked depression, situational anxiety, and hysterical reactions to loss of limb. Team's psychiatrist should treat as appropriate. (NOTE: patients are alienated by referral of their case to a psychiatry department and success is not optimized.)

PAIN CONTROL BY END OF 3 MONTHS?
  yes
  Follow for 2 years

Check fit and alignment, have patient walk,

FIT GOOD?
  yes
  Correct problem and allow sufficient time for adjustment.
  no
  PAIN CONTROLLED?
    yes
    Follow for 2 years
    no

DOES PATIENT SUCCESSFULLY WEAR PROSTHESIS?
  no
  MEDICAL REASONS?
    yes
    Attempt to correct.
    no
    PSYCHOLOGICAL REASONS?
      yes
      OTHER REASONS?
        yes
        IS FITTING FEASIBLE?
          yes
          Fit and permit sufficient time for adjustment.
          no
          PAIN CONTROLLED?
            yes
            Follow for 2 years
            no

Have patient keep a home log of pain intensity. Attempt to correlate changes with (1) specific items in diet (e.g., onions), (2) excretion, (3) changes in temperature/humidity, (4) use of prosthesis, (5) physical or psychological stress, and etc.
Figure 2 - third page

Were correlates of body function identified?

no

Trials of diet changes, stool softeners, etc. as appropriate.

yes

Look for trigger points.

MAJOR TRIGGER POINTS?

no

yes

Attempt to correct and/or desensitize.

PAIN CONTROLLED?

no

yes

Follow for 2 years.

IS THERE A POSSIBILITY OF REFERRED PAIN FROM BACK INJURY, ETC. (THIS IS ONE OF THE MOST FREQUENTLY MISSED CAUSES.)?

no

yes

Treat problem area as appropriate.

PAIN CONTROLLED?

no

yes

Follow for 2 years.

IS PATIENT DEPRESSED OR SHOWING MAJOR PERSONALITY DISORDERS?

yes

Regardless of whether depression is transitory, situational (reactive), or endogenous, the treatment team’s psychiatrist should begin appropriate chemical and/or behavioral treatment ASAP and follow for a minimum of two months. Personality disorders must be treated as appropriate. It appears to be crucial not to refer patients to a separate psychiatry clinic for primary care at this time.

PAIN CONTROLLED?

no

yes

Follow for 2 years.

IS PATIENT ABNORMALLY ANXIOUS?

no

The team’s mental health professional should give relaxation training or begin chemical and/or behavioral treatment for anxiety. Follow for a minimum of two months. Same caution about referral as for depression.

continued

continued
Figure 2 - fourth page

DOES PATIENT HAVE AN OVERRIDING NEED FOR PAIN? (PAIN GAMES, MAJOR SOMATIZATION OF PROBLEMS, PENDING COMPENSATION CASE, ETC.)

PAIN CONTROLLED?

yes

Treat with behavior modification, local pain clinic and/or as appropriate.

no

Follow for 2 years.

DOES THE PATIENT SHOW ANY OF THE FOLLOWING?

1) ABNORMAL MUSCULOSKELETAL STRESS RESPONSES (E.G. FREQENT TENSION HEADACHES, STRESS INDUCED MUSCLE CRAMPS?)
2) STUMP TENSER THAN NORMAL?
3) UNCONTROLLED MICRO OR MACRO STUMP SPASMS?

yes

Give EMG feedback from the stump for muscle tension control and home relaxation training oriented toward muscular relaxation.

no

continued

no

PAIN CONTROLLED?

yes

Follow for 2 years.

PAIN CONTROLLED?

no

DOES THE PATIENT SHOW ANY OF THE FOLLOWING?

1) INCREASE IN PAIN WITH DROP IN ENVIRONMENTAL TEMPERATURE?
2) BURNING TYPE OF PHANTOM PAIN?
3) CIRCULATION ABNORMALITIES IN STUMP?
4) TEMPERATURE CHANGE IN STUMP PRIOR TO ONSET OF PHANTOM PAIN?
5) ABNORMAL CARDIOVASCULAR STRESS RESPONSES (E.G. VERY COLD HANDS WHEN STRESSED, VASCULAR HEADACHES?)

yes

Give trial of temperature biofeedback from the stump with home relaxation training oriented toward warming.

no

PAIN CONTROLLED?

yes

Trial of diagnostic sympathetic blocks.

Follow for 2 years.

no

PAIN CONTROLLED?

yes

Trials of chemical methods of circulation control.

Follow for 2 years.

no

PAIN CONTROLLED?

yes

Follow for 2 years.

no

PAIN CONTROLLED?

yes

Follow for 2 years.

no

PAIN CONTROLLED?

yes

Follow for 2 years.
continued

Figure 2 - fifth page

Trial of transcutaneous electrical stimulation at stump.

Follow stimulation with active range of motion exercises and home program of electrical stimulation.

PAIN DECREASED?

yes

no

PAIN CONTROLLED?

yes

Follow for 2 years.

no

Trial of ultrasound at stump.

PAIN DECREASED?

yes

no

Use standard program including steroids.

PAIN CONTROLLED?

yes

Follow for 2 years.

no

Trial of sedative hypnotics.

PAIN SIGNIFICANTLY DECREASED?

yes

no

Trial of relaxation training if not attempted previously.

PAIN CONTROLLED?

yes

Follow for 2 years.

no

Continued medication and follow for 2 years.

Honestly tell patient that current treatments are not likely to succeed. The best alternative is referral to a pain clinic for distraction training, optimal adjustment to living with pain, etc.
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