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Transcutaneous and Peripheral Nerve Stimulation for Chronic Pain States

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A series of 120 patients with pain syndromes of varying sources were subjected to peripheral nerve electrical stimulation. Transcutaneous, percutaneous and depth electrode stimulation methods were employed. Thirty-eight patients obtained definite relief and twenty obtained equivocal relief. The remaining 62 patients obtained no relief. Pain sources are correlated with treatment results.

THIS article reviews two years experience with transcutaneous, direct peripheral and spinal cord stimulation in 120 patients experiencing chronic pain states.

Introduction

Cutaneous electrical stimulation has been used for many years for treatment of disease and pain, but it was not until 1965 that Melzack and Wall proposed a new mechanism whereby pain could be controlled.[1] This so called "gate theory of pain" postulates that the substantia gelatinosa of the posterior horn functions as a gate control system that modulates afferent nerve impulses before they influence pain transmitter cells. One of the predictions of this "gate control" theory is that stimulation of large diameter cutaneous afferent nerve fibers could reduce pain.

Transcutaneous stimulation was used as a screening test to determine the suitability of patients for surgical placement of dorsal column stimulator devices.[2,3] As a result of investigative work done in this area, the use of transcutaneous nerve stimulation was expanded to treat localized intractable pain.[2-5]

The preliminary results indicate a significant therapeutic application for transcutaneous nerve stimulation.[2-5] When pain becomes intractable, persisting in the absence of demonstrable organic disease and responding to no conventional method of treatment, it can have a devastating effect on not only the patient, himself, but also his family.[3] The increasing investigation and use of transcutaneous nerve stimulation appears, at this time, to be a promising non-invasive treatment for this type of pain.

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Patient Population and Pain Sources

One hundred and twenty patients ranging in age from 18 to 77 were studied. Patients were referred to the University of Florida Division of Neurosurgery or to the private neurosurgical service at North Florida Regional Hospital, Gainesville, Florida. The principal pain sources were related to the lumbar spine. Included in this group were "failed disc operation" syndrome, arachnoiditis, lumbar strain and osteoarthritis. Other frequently occurring pain sources were radiculopathies caused by cervical or thoracic nerve root injury, compression, infections or neoplasms. Also appearing frequently were peripheral nerve injuries and occipital neuralgia.

In all cases, the patient was experiencing pain of greater than six months duration, refractive to all previous conventional methods of pain control. In most cases, the patient was receiving high doses of medication and his activity was significantly restricted.

Methodology

The patient was examined by a

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neurosurgeon before being referred to the Physical Therapy Department for detailed instruction in the use of the transcutaneous nerve stimulator. No formal psychometric testing was performed, but each patient was asked to fill out a questionnaire before his instruction was initiated. The questionnaire attempted to evaluate the patient's description of his pain and to characterize it in light of other commonly experienced pain. An attempt to define attitudinal and behavioral changes resulting from chronic pain was made in every case. Patients were given a brief explanation of the device and the expected sensation. On no occasion was the patient led to believe that this was the ultimate "cure" that they were seeking. It was stated simply that it had helped some patients, had not helped others, and that it might have some effect in changing the patient's awareness of pain. No particular precautions regarding side effects were given except for a warning not to stimulate the anterolateral neck (over the carotid sinus).

The placing of the electrodes varied according to the site of the pain. The site most frequently chosen was directly over the pain site or its surrounding area. In many instances the electrodes were placed over the related nerve trunk. Initial training sessions of approximately three hours were used, as suggested by Long.[4] The patient was encouraged to become independent and confident in the use of the stimulator, with instructions that actual intensity, rate and length of time of use were dictated completely by his needs. He was further instructed that there was no contraindication to continuous use of the stimulator. If the patient appeared to be getting some relief from pain, he was advised to obtain a stimulator on a rental basis from a surgical supply house for a month, whereupon he was re-evaluated for continued effectiveness of the stimulation. All patients were continually encouraged to attempt to reduce dependence on pain medication and to increase their activity during the clinical trial.

Complications and Side Effects

Very few complications were reported. An occasional problem was skin irritation produced either from the electrolyte paste or gel or adhesive tape. This was alleviated by altering the site of the electrode slightly or changing the paste or tape. One patient reported activation of hives or welts along the affected intercostal nerve. This reaction subsided in six hours after cessation of treatment and did not appear to be herpetic eruption. An interesting side effect in one patient with causalgia associated with Sudeck's atrophy was stimulation of hair growth in the previously hairless distal leg, coincident with stimulator use and recovery.

Results

Transcutaneous techniques: Analysis of this group of 113 patients indicates that the best results are to be expected in those with nonherpetic intercostal neuralgia, peripheral nerve injury, cervical radiculopathy, arachnoiditis and lumbar strain.

Direct or implanted technique: Prolonged, gratifying pain relief in three patients with painful peripheral nerve injuries led to their selection for placement of implanted devices. All three patients were completely satisfied with the results, and all experienced relief for one-half to two hours after cessation of stimulation. No complications were encountered. Two patients had ulnar nerve stimulators and one had a sciatic nerve stimulator. Again, all three were extremely happy with the long-term effects—eight, six and four months, respectively.

Percutaneous depth electrode stimulation: Two patients with paraplegia received spinal cord stimulation above and below the area of traumatic transverse myelopathy. Neither experienced any relief of sacral burning when either site was stimulated. Both subsequently underwent cordectomy, resulting in partial pain relief and increased mobility.

Two patients with intractable lumbar monoradiculopathy following unsuccessful disc surgery received stimulation of the L5-S1 nerve roots at the neural foramen. Both reported satisfactory pain relief and are being considered for implanted nerve root electrode placement if such a technique can be developed.

Review of Results

Group I (62 patients)—No beneficial result occurred in 52% of patients treated.

Group II (20 patients)—Equivocal pain relief occurred in 16% of the group.

Group III (38 patients)—Satisfactory pain relief, leading to a decision for permanent or semi-permanent use of the device occurred in 32% of the entire group.

Table 1 shows the correlation of pain sources with treatment results in all groups.

Table 2 shows the relationship between patients experiencing pain relief in the sub-categories of pain sources.

Summary and Conclusions

One hundred and twenty patients with heterogeneous pain sources varying markedly in severity and duration received transcutaneous, percutaneous or direct spinal cord stimulation. Patients suffering from pain due to arachnoiditis or epidural fibrosis, nerve injury, intercostal neuralgia, cervical radiculopathy and lumbar strain appeared to receive significant benefit. Seventy-five per cent or more of the patients with peripheral nerve injuries and lumbar strain improved in a range from satisfactory to excellent. Over 50% of patients with arachnoiditis, nonherpetic intercostal neuralgia and peripheral nerve injury also demonstrated significant improvement. Patients responding the least satisfactorily were those with meralgia

paresthetica, occipital neuralgia and post-traumatic pain. Two patients failed to achieve relief when segments above and below an area of traumatic transverse myelopathy were stimulated, and two patients reported good relief when nerve roots were stimulated using percutaneous electrodes.

The conclusion from this work and from that of Shealy,[2] Burton,[3] Long,[4] Sweet and Wepsic[5] is that transcutaneous nerve stimulation is a valuable, safe and effective means of modifying the subjective sensation of pain. Nearly one-half of the patients in this group were benefitted. Improved surface and depth electrodes are needed to fully exploit this promising new therapy.

In consideration that nearly 50% of the total number of patients with intractable pain treated with transcutaneous nerve stimulation responded positively, the authors believe that further use and investigation is warranted.

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References

1. Melzack, R., Wall, P. D.: Pain mechanisms; a new theory. *Science* 1965, 150:971-978.
2. Shealy, C. N.: Transcutaneous electroanalgesia. *Surgical Forum* 1972, 23: 419-421.
3. Burton, C.: Neurosurgical treatment of intractable pain. *Penna. Med.*, 1972, 75:53-55.
4. Long, D. M.: External electrical stimulation as a treatment of chronic pain. *Minnesota Medicine*, 1974, 57:195-198.
5. Sweet, W. H., Wepsic, J. G.: Treatment of chronic pain by stimulation of fibers of primary afferent neurone. *Trans. Am. Neurol. Ass.*, 1968, 93: 103-107.

TABLE 1
CORRELATION OF PAIN SOURCES WITH TREATMENT RESULTS

Pain source	Total	Group I No relief	Group II Equivocal relief	Group III Satisfactory relief
neuroma	1	1	0	0
post-operative pain (abdominal)	2	2	0	0
arachnoiditis or epidural fibrosis (including "failed disc operation" syndrome)	43	20	11	12
non-herpetic intercostal neuralgia	17	8	2	7
meralgia paresthetica	3	2	1	0
peripheral nerve injury	13	4	1	8
paraplegia or partial cord transection	2	2	0	0
atypical facial pain	3	3	0	0
occipital neuralgia	7	6	1	0
coccyodynia	2	2	0	0
lumbar strain	5	1	2	2
herpetic intercostal neuralgia	1	1	0	0
cervical radiculopathy (including spondylosis, osteoarthritis)	7	1	2	4
post-traumatic extremity pain	9	6	0	3
causalgia	2	1	0	1
brachialgia from cervical rib	1	1	0	0
lumbar osteoarthritis	2	1	0	1
Total	120	62	20	38

TABLE 2
RELATIONSHIP BETWEEN PAIN SOURCES AND PAIN RELIEF

Pain source	Total	% Patients with pain relief	*% Patients with pain relief
neuroma	1	100	0
post-operative pain (abdominal)	2	100	0
arachnoiditis or epidural fibrosis (including "failed disc operation" syndrome)	43	46	54
non-herpetic intercostal neuralgia	17	48	52
meralgia paresthetica	3	67	33
peripheral nerve injury	13	31	69
paraplegia or partial cord transection	2	100	0
atypical facial pain	3	100	0
occipital neuralgia	7	86	14
coccyodynia	2	100	0
lumbar strain	5	20	80
herpetic intercostal neuralgia	1	100	0
cervical radiculopathy (including spondylosis, osteoarthritis)	7	14	86
post-traumatic extremity pain	9	67	33
causalgia	2	50	50
brachialgia from cervical rib	1	100	0
lumbar osteoarthritis	2	50	50
Total	120	52	48

* Ranges from moderate relief to total relief