Electrical Stimulation of the Nervous System For Control of Pain: University of Texas Southwestern Medical School Experience

Kemp Clark, M.D.

Division of Neurosurgery, University of Texas Southwestern Medical School, Dallas, Texas

A number of electical stimulation procedures on patients with chronic pain were carried out at the University of Texas Southwestern Medical School. The procedures included dorsal column stimulation, peripheral nerve stimulation by means of implants and transcutaneous nerve stimulation. Some of the results are discussed and tabulated.

A CONSERVATIVE approach has attended the use of electrical stimulation for pain control since our introduction to implantable stimulators in Dallas in 1970. Thirteen patients have received dorsal column stimulation (DCS) device implants, six have received peripheral nerve implants and a larger number have received transcutaneous nerve stimulation (TNS). Use of DCS has progressively declined as the other two methods have proved effective and safe.

Selection of patients includes psychologic testing, a surgeon's evaluation and response to TNS. Data from psychologic testing have not proved useful in preoperative selection nor in evaluation of postoperative results and hence are not included in this report. Presently, the conclusion is that TNS is the best screening device for the more permanent implant. It is of considerable interest that 15 patients with chronic intractable pain have required no other form of therapy than TNS.

Reprint requests: Dr. Kemp Clark, Division of Neurosurgery, University of Texas Southwestern Medical School, 5328 Harry Hines Boulevard, Dallas, TX 75235

KEY WORDS: chronic pain · dorsal column stimulation · peripheral nerve stimulation · transcutaneous nerve stimulation

Results

Four of the five patients with sciatic nerve implants have had excellent results, while the fifth patient is rated as having a failure. One patient has a stimulator on her median and ulnar nerves which affords effective pain relief. However, she does not feel the stimulus in the palm of her hand nor in the three fingers on the ulnar side of the hand; these areas remain painful to her. The longest follow-up observation period in these patients has been two years.

Six of the 13 DCS implants were done in 1970, three in 1971, three in 1972 and one in 1973. This reflects a growing concern with complications of DCS and also success with alternate methods of pain control.

Table 1 presents brief case summaries of the 13 patients. Seven patients had significant pain relief. One of these had relief only in her legs, while her back pain remained (3). Another patient (1) with successful results had 50% to 75% pain relief, and a third (2) had good pain relief but only intermittent DCS device function. The other four (4, 5, 12, 13) had 80% to 100% pain relief and reversal of pain-oriented life-styles. Less than satisfactory results occurred in patient 7 who achieved only 30% to 40% pain control and uses the DCS only intermittently. He did not return to work. The remaining five patients (6, 8, 9, 10, 11) were rated as having complete failures; most of them no longer use the DCS or the implanted unit has been removed.

Table 1 also lists complications. The DCS device ceased functioning in two patients (1, 2), thus requiring revision; two patients (6, 8) had increased leg weakness which persisted in one despite halting DCS (6); and two (3, 13) had dorsal column dysfunction. Patient 3 had mild lower extremity dorsal

Surg Neurol 4:164-166, 1975

TABLE 1
CASE SUMMARIES

Patient Information	Pain Etiology	Previous Surgery*	TNS Results	DCS Results	No. of Revisions	Complications	Date, Site of Implant
1 48-year-old female	low-back syndrome	—	good	50–75% pain relief	1	DCS ceased function	6/73 thoracic
2 44-year-old male	arachnoiditis	—	equivocal	good relief but only intermittent DCS function; needs second revision	1	DCS ceased function	6/72 thoracic
3 middle-aged female	low-back syndrome	unilateral cordotomy	good	good relief in legs; no relief in back	0	band of thoracic hyperesthesia at electrode implant level. mild but persistent dorsal column dysfunction 4 months after ceasing DCS	6/72 thoracic
4 74-year-old male	metastic bladder cancer (Patient died of tumor 4/72)	—	not done	85% pain relief	0	none	1972 thoracic
5 middle-aged male	low-back syndrome	—	good	80% pain relief, marked reduction in narcotics, first employment in 20 years	0	none	8/71 thoracic
6 middle-aged male	giant-cell tumor of sacrum	bilateral thoracic cordotomy; moderate paraparesis resulted	not done	failure, ceased using DCS	0	increased neurologic deficit, more difficulty walking	2/71
7 41-year-old male	low-back syndrome	—	not done	30–40% relief. did not return to work. Uses DCS only intermittently.	0	none	6/71 thoracic
8 42-year-old female	pain in paraplegia (high-grade paraparesis from trauma	unilateral cordotomy	not done	failure, ceased using DCS	0	increased leg weakness with DCS, cerebrospinal fluid leak	10/70 cervical
9 70-year-old male	postherapetic neuralgia (thoracic)	thoracic posterior rhizotomy	not done	failure, ceased using DCS	0	chronic subdural hematoma secondary to sitting position at surgery	11/70 cervical
10 58-year-old female	flank pain, cause unknown before DCS. cord AVM found at DCS removal	—	not done	failure after transient relief	0 (DCS removed)	severe paraspinous fibrosis and wound pain	10/70 thoracic
11 48-year-old male	low-back syndrome	—	not done	failure; patient not working, remains on narcotics	1	electrode disconnected from receiver; revision afforded no pain relief	9/70 throacic
12 73-year-old male	cancer of the bladder expired from tumor 2/71)	—	not done	80% relief	0	none	10/70 thoracic
13 middle-aged female	right arm pain secondary to multiple operations	—	not done	100% relief, no medications, complete reversal of life-style	0	withdrawal seizures from meprobamate when DCS supplanted drug; right arm dorsal column dysfunction with DCS on	6/70 cervical

* Previous surgery includes only special pain relieving procedures, not those done for the original disease, e.g., laminectomy.
TNS = transcutaneous nerve stimulator, DCS = dorsal column stimulator.

column deficit four months after halting use of the DCS device. Chronic subdural hematoma related to the sitting position at surgery (9) and severe paraspinous fibrosis (10) were two unusual complications of surgery.

Discussion and Conclusions

Electrical stimulation of the nervous system for the control of pain is a sound principle which deserves further investigation and clinical consideration. Impressive relief of pain has been achieved with TNS, peripheral nerve stimulation and DCS. The latter method has resulted in significant complications as well.

Patients now selected for trial with electrical stimulation first receive careful evaluation with TNS by the surgeon. If this benign method fails, peripheral nerve implantation is the next consideration. If most of the patient's pain is located within an area served by a peripheral nerve, this site is selected for stimulator implantation in preference to the dorsal columns. If it is considered that the method is highly likely to be successful and location of pain requires it, a DCS device is implanted. Progressively fewer DCS devices are being implanted than were originally used, however, reasons for the decline in use of DCS include concern over nervous system complications. Two deficits of dorsal column function are recorded in this series of 13 patients. The truly long-term effects of electrical stimulation of the human spinal cord are unknown and are of concern. It will not be possible to rule out nervous tissue oncologic or cicatricial effects until long-term follow-up studies are done. I do not know whether the two dorsal column deficits I recorded are related to intrinsic cord damage or to external arachnoiditis and scarring. Further, it is unknown whether the effect is mechanical compression or, although less likely, whether the effect related to tissue injury from the electrical stimulus itself. Long-term follow-up studies have revealed a need for increased voltages and sometimes late failure to perceive DCS in the painful area despite maximal voltage increases.

I am impressed with the equipment and mechanical-electronic problems of DCS. Replacement of DCS electrode is a major undertaking and has been all too common a need with some present and past equipment.* Electrode improvements will be of considerable assistance in increasing DCS success rates for relieving pain. These problems are probably best avoided by careful selection of patients prior to the first implantation and use of alternate pain-relieving methods where possible and prudent.

TNS alone has produced relief in 10% to 20% of the patients with chronic pain whom I have seen. TNS is certainly safer for patients and easier for the surgeon to employ, or if implantation is necessary, to place the stimulator on a peripheral nerve and make necessary revisions at that site, than is a more difficult, less safe thoracic or cervical laminectomy.

The highest rate of failure in the present series occurred before the availability of TNS for careful use as a screening aid. This method appears to be the most useful objective means of preselection of patients for implantation. Years of experience with chronic pain patients enables the surgeon to be a better, more careful selector. Certainly some failures early in the present series were related to poor selection on psychologic, social or physiologic bases. The selection process and consequently the successful implantation rate have been improved by longer, more thorough preoperative evaluations, hospitalizations, office visits and observation of the patient, as alternate, sometimes temporizing methods are employed to combat his chronic pain. The clinical judgment of a concerned, experienced surgeon has a value which other adjunctive testing and selection methods are unlikely to supplant.

Addendum January 1975

Since this was compiled, one patient with a sciatic nerve stimulator has had recurrence of pain and has returned to narcotic use. The patient with the median and ulnar implant has failed to achieve any relief of pain. She must be considered as a failure despite early good results.