Dorsal root entry zone lesions for the treatment of post-herpetic neuralgia

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Post-herpetic pain was treated in 12 patients using dorsal root entry zone (DREZ) lesions. All patients had failed to receive adequate pain relief from conservative therapy consisting of transcutaneous nerve stimulation, carbamazepine, and/or amitriptyline. Dorsal root entry zone lesions were made to include the involved dermatomes plus one-half of the dermatomes above and below the painful areas. Eight patients reported good pain relief with follow-up periods ranging from 6 to 21 months. A ninth patient obtained satisfactory pain relief, but the superior 1 cm of the original painful area was not included in the distribution of the DREZ lesions. Patients whose lesions were performed using a thermally controlled lesion probe suffered no significant postoperative neurological deficit. Dorsal root entry zone lesions appeared to be a satisfactory treatment for post-herpetic neuralgia in patients who have failed to respond to more conservative modes of therapy.

KEY WORDS • herpes zoster • pain • evoked potentials • dorsal root entry zone lesion

POST-HERPETIC neuralgia remains an incapacitating pain which is usually recalcitrant to therapy. Patients complain of two types of pain. The first is a persistent, burning, aching, superficial pain accompanied by hyperpathia (an elevated threshold for pain, but the pain elicited has particularly unpleasant characteristics). There is usually concomitant hyperesthesia which may be triggered by light touch and relieved by firm pressure. The second pain is a deep itching or feeling of formication.

None of the proposed treatments for this disorder has had a consistently high rate of success. Antidepressant, psychotropic, and anticonvulsant drugs and steroids have all had only modest success in alleviating the post-herpetic pain. Scar excisions, the undermining of affected skin, rhizotomies, thalamotomies, and cingulotomies have only been of benefit to a minority of patients.

Early reports have demonstrated that dorsal root entry zone (DREZ) lesions have successfully alleviated the central pain which follows brachial plexus avulsion injuries and spinal cord injuries. In an earlier series, a small number of patients who had undergone DREZ lesions for post-herpetic pain were reported to have obtained good pain relief. This has encouraged us to employ a more refined technique of producing DREZ lesions in another group of patients with post-herpetic pain. We are now reporting the results of DREZ lesions in the treatment of 12 patients with post-herpetic pain who were operated on jointly by two of the authors.

Clinical Material and Methods

Patient Population

This report includes those patients treated in our clinic for post-herpetic pain who did not respond to medical therapy. Most of these patients had undergone a preoperative trial of carbamazepine, amitriptyline, and transcutaneous nerve stimulation without satisfactory resolution of their pain. Pertinent clinical data concerning the 12 patients are summarized in Table 1. The patients’ clinical status has been monitored for 6 to 21 months following surgery. Although one patient was only 44 years of age, the remainder of the patients ranged in age from 58 to 84 years. In all but one patient, the pain was confined to the thoracic dermatomes.

The patients described the pain as being burning and aching in nature, exacerbated by light touch, and alleviated by pressure over the affected dermatomes. Although the rash was usually confined to a single
Treatment of post-herpetic pain

TABLE 1
Clinical data in 12 patients with DREZ lesions for post-herpetic neuralgia

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Duration of Pain</th>
<th>Distribution of Pain</th>
<th>Treatment*</th>
<th>Postoperative Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>68, F</td>
<td>5 mos</td>
<td>T3-6</td>
<td>TENS, Elavil</td>
<td>good, paraspinal aching pain residual band of pain at T-4, relieved at 2nd surgery</td>
</tr>
<tr>
<td>2</td>
<td>44, F</td>
<td>18 mos</td>
<td>T5-7</td>
<td>TENS</td>
<td>good</td>
</tr>
<tr>
<td>3</td>
<td>68, M</td>
<td>28 mos</td>
<td>T11-L1</td>
<td>TENS, DMSO, Dilantin, Talwin, nerve blocks</td>
<td>poor</td>
</tr>
<tr>
<td>4</td>
<td>74, F</td>
<td>2 yrs</td>
<td>T5-8</td>
<td>acupuncture, TENS, codeine propoxyphene</td>
<td>good, residual 1-in. band of pain above lesion</td>
</tr>
<tr>
<td>5</td>
<td>72, F</td>
<td>10 yrs</td>
<td>T5-8</td>
<td>Elavil, TENS</td>
<td>fair, 1-in. band of pain above lesion</td>
</tr>
<tr>
<td>6</td>
<td>67, M</td>
<td>15 yrs</td>
<td>T9-11</td>
<td>Tegretol, Elavil</td>
<td>good relief for 8 weeks, then pain recurred</td>
</tr>
<tr>
<td>7</td>
<td>79, M</td>
<td>20 mos</td>
<td>T9-12</td>
<td>Elavil, TENS</td>
<td>excellent</td>
</tr>
<tr>
<td>8</td>
<td>84, M</td>
<td>8 yrs</td>
<td>T6-8</td>
<td>TENS, Elavil, Tegretol, Dilantin</td>
<td>excellent</td>
</tr>
<tr>
<td>9</td>
<td>68, M</td>
<td>11 yrs</td>
<td>T4-8</td>
<td>TENS, Elavil</td>
<td>excellent</td>
</tr>
<tr>
<td>10</td>
<td>58, F</td>
<td>3 yrs</td>
<td>T9-12</td>
<td>Tylenol #3, Tegretol</td>
<td>good, small area of residual aching pain</td>
</tr>
<tr>
<td>11</td>
<td>74, F</td>
<td>8 yrs</td>
<td>S-1</td>
<td>TENS, Dilantin, Tegretol</td>
<td>excellent</td>
</tr>
<tr>
<td>12</td>
<td>62, M</td>
<td>2 yrs</td>
<td>T6-8</td>
<td>Elavil, Tegretol, TENS</td>
<td>excellent</td>
</tr>
</tbody>
</table>

* TENS = transcutaneous electrical nerve stimulation; Elavil = amitriptyline hydrochloride; DMSO = dimethyl sulfoxide; Dilantin = phenytoin; Talwin = pentazocine; Tegretol = carbamazepine; Tylenol = acetaminophen.

dermatome, physical examination revealed that the hyperesthesia extended over two to three dermatomes. The pink scars were hypesthetic. No patient had signs of a concomitant myelopathy. The average time interval from the resolution of the patient's rash until the DREZ lesions were performed was 6 years.

Procedure

The procedure of DREZ coagulation has been described previously. All patients received high doses of steroids 1 day before and 4 days after surgery. Laminectomies were performed two vertebral levels above the affected dermatomes. The DREZ to be coagulated was localized with the assistance of direct spinal cord evoked potentials. Prior to surgery, a monopolar stimulating electrode was placed percutaneously next to an intercostal nerve root that was adjacent to the area affected by the herpetic. The spinal level of the stimulating electrode was determined by a preoperative chest roentgenogram. After the dura was opened, the intercostal nerve was stimulated at less than 4 Hz, 0.05 to 0.5 msec, and 0.5 to 5 V, and recordings were obtained from the spinal cord at or near the root entry zone.

Records were made using two techniques. A monopolar silver-ball wand-type electrode which was held in a manipulator attached to the retractor could be moved to successive levels for consecutive root entry recordings. The records in Fig. 1 were made in this manner. Simultaneous multiple recording from the entry of several adjacent dorsal roots were made with an Avery plate electrode consisting of four platinum-iridium discs, each 1.5 mm x 2 mm, separated by 1 cm, held in a Silastic-coated Dacron web. The records in Fig. 2 were obtained with this electrode. In both cases, the reference lead was made to the retractor. After amplification, the signals were directed to a Nicolet 1170

Computer (173 plug-in), where the responses to eight to 128 stimulus repetitions were averaged. Averaging was necessary to eliminate background electrical activity and increase the clarity of the signal. The normal recordings consisted of an initial triphasic spike or compound action potential which was the presynaptic electrical activity in the dorsal root and dorsal columns. If the recording electrode was placed within two to three segments of the stimulated root, this triphasic spike would be followed by a series of slow negative waves which were postsynaptic in origin, representing nerve cell activity in the dorsal horn. Relative reductions in amplitude of the signals and slowing of conduction velocity may be observed after stimulation of diseased roots. The location of the DREZ of the intercostal nerve being stimulated was determined by noting

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Fig. 1. Monopolar recording from the S-1 dorsal root entry zone following stimulation of the L-5 root (upper) and S-1 root (lower). Note that when the L-5 root is stimulated and the record is taken from the S-1 root entry zone, the latency is slightly longer, and the action potential is reduced in amplitude. Also, the large delayed negative wave due to postsynaptic dorsal horn activity is lost.
to determine the spinal level by tracing a nerve root of
by intraoperative x-ray films. Unfortunately, interpre-
was made from the C-8 root entry zone, the more the amplitude
decays and the latency increases.

FIG. 2. Compound action potentials obtained from a series
of electrodes placed on the dorsum of the spinal cord spanning
from C-4 to C-7 (upper to lower). The C-8 root was stimulated
at 0.6 V, 0.05 msec, 3.3 Hz. Note that the further the recording
was made from the C-8 root entry zone, the more the amplitude
decays and the latency increases.

the location of the recording electrode which demon-
strated the maximal electrical signal and the earliest
appearance of propagated waves. Attempts were made
to determine the spinal level by tracing a nerve root of
which the exit foramen position had been ascertained
by intraoperative x-ray films. Unfortunately, interpre-
tation of the intraoperative films proved difficult and
unreliable.

In the first four patients, DREZ coagulations were
produced employing an insulated steel wire, 0.018 in.
in diameter, with a 2-mm uninsulated tip. The Radion-
ics coagulation unit* was set to deliver 30 to 35 mA for
15 seconds. In the subsequent eight patients, the lesions
were made by means of a 0.25-mm thermistor with a
2-mm uninsulated tapered tip. The tip was heated
to 75° to 80°C for 15 seconds for each lesion.

The lesions were made by inserting the coagulator
tip along the entrance of the dorsal nerve root into the
spinal cord to a depth of 2 mm. The operating micro-
scope was employed to determine the exact position at
which the rootlets entered the cord. The lesions were
placed 0.5 to 1 mm apart so that approximately 25
lesions were made per spinal segment.

Operative Results

Eight patients (66%) reported good pain relief, with
a follow-up period ranging from 6 to 21 months. A
ninth patient (Case 5) obtained satisfactory pain relief,
but the superior 1 cm of the original painful area
was not included in the distribution of the DREZ lesions.
In two patients, the DREZ lesions had to be extended
superiorly at a second procedure to completely encom-
pass the painful area. Two patients had immediate relief
of their symptoms but noted an unsatisfactory recur-
rence of deep pain approximately 2 months later. Only
one patient failed to receive even short-term pain relief.
The hyperesthesia and the burning pain was consist-
tently relieved by the DREZ lesions. Three patients
(Cases 1, 2, and 9) noted the persistence of a small area
of deep aching pain or formation following their
operation. This discomfort is described as being insig-
nificant compared to the original burning pain.

Our first four patients, whose DREZ lesions were
performed without lesion temperature monitoring, suf-
fured significant ipsilateral leg weakness and ipsilateral
hypesthesia below the level of the DREZ lesion during
the immediate postoperative period. Three of the four
were able to ambulate independently within weeks of
the operation. One of these early patients noted the
insidious onset of dysesthesias from the level of the
DREZ lesions through the entire ipsilateral leg and foot
3 months following surgery. Although the mechanism
of these symptoms remains unclear, it must be assumed
that they are somehow related to the operation.

The subsequent eight patients were treated with
smaller thermally monitored DREZ lesions. These pa-
tients had mild postoperative weakness confined to the
ipsilateral iliopsoas and quadriceps muscles, but each
patient was able to ambulate independently by the 5th
postoperative day without noticeable deficit.

All patients complained of tightness and aching at
the site of the laminectomies. This discomfort was most
pronounced when the laminectomies involved the up-
ner thoracic lamina. Despite the fact that each patient
underwent a preoperative cardiac evaluation, one pa-
tient (Case 6) suffered a myocardial infarction on the
2nd postoperative day. In four patients, sensory nerve
rootlets were biopsied. Histological examination dem-
strated a lymphocytic infiltrate and marked loss of
myelin sheaths and axon cylinders.

Discussion

Herpes zoster is thought to result from a recrud-
cence of a latent varicella zoster viral infection. This
recrudescence is most prevalent in the aged. It is esti-
mated that an attack of herpes zoster will occur in 50%
of individuals who live to the age of 85 years. Although
this painful malady usually subsides spontaneously
coincident with the scarification of the rash, in 10% of
patients the pain persists and intensifies. The incidence
of post-herpetic neuralgia increases sharply with age,
occurring in about 50% of octogenarians who have a
bout of herpes zoster.

The etiology of the post-herpetic pain remains an
enigma. Several investigations have assumed that post-
herpetic pain is a form of deafferentation pain. Noor-
denbos8 and others12,26 have noted a relative decrease
in the number of large myelinated fibers relative to
small unmyelinated fibers in the intercostal nerves and
skin in the areas afflicted with post-herpetic pain. No
correlation has been shown between the amount of
fibrosis and the presence or absence of post-herpetic

* Coagulation unit manufactured by Radionics, Inc., Bur-
lington, Massachusetts.
Treatment of post-herpetic pain

neuralgia in a small group of patients studied by light and electron microscopy. Although most emphasis has been placed on the inflammation and cell destruction seen within the dorsal root ganglion, the inflammatory process may spread along the dorsal root to involve the dorsal horn and adjacent meninges. The severe dorsal horn destruction is analogous to the pathology seen following dorsal root avulsion injuries. In these two conditions, the pain may arise primarily from alterations within the DREZ.

Certain regimens have been helpful in averting post-herpetic pain. Controlled studies have indicated that patients treated with corticosteroids during an episode of herpes zoster are less likely to contract post-herpetic pain. The use of this regimen has not been generally accepted because of the risk of a generalized herpes infection. Topical application of 40% idoxuridine in dimethyl sulfoxide (DMSO) to the area of the rash has also been shown to reduce the incidence of post-herpetic neuralgia. Adenosine arabinoside reduces the duration of the pain and rash associated with herpes zoster, but its effect on the incidence of post-herpetic pain remains unknown. Sympathetic nerve blocks reduce the pain in the acute phase of the disease but have not been successful in the treatment of post-herpetic neuralgia.

Although many medical regimens have been described, none has consistently afforded significant relief to more than 50% of patients suffering with post-herpetic pain. Cooling the painful area with ethyl chloride or applying pressure to the painful area has afforded relief to some of these patients. Carbamazepine and clomipramine have been reported to produce significant pain relief in this condition. Transcutaneous nerve stimulation has been reported to benefit some patients.

Surgical therapy for post-herpetic pain has been equally discouraging. Excision or undermining the painful areas has met with limited success as has peripheral neurectomy, ganglionectomy, and posterior rhizotomy. White and Sweet have pointed out that those patients who will respond to local excision or neurectomy will usually obtain temporary pain relief from local infiltration with lidocaine or procaine. Cervical cordotomy has met with some success in those patients where a solid level of surgical analgesia extended from three to four levels above the infected dermatomes. Thalamotomy and cingulotomy have not been helpful in the management of this disorder. The treatment of herpetic pain is made more difficult by the fact that operations on pain pathways may themselves result in painful dysesthesias.

The etiology of post-herpetic pain remains unknown. Whether the pain stems from deafferentation, direct damage within the dorsal horn, or a more “central mechanism” is unclear. Our success in treating this condition with DREZ lesions seems to indicate that the DREZ is the seat of the pain. Although our series is still small, it appears that the DREZ lesions are more effective in alleviating the superficial burning pain and hyperesthesia than in relieving the deep ache that is associated with the syndrome.

Damage to the adjacent corticospinal tract and dorsal columns by the DREZ lesion was an early problem, but this damage has been greatly reduced by employing smaller lesions. The most persistent postoperative complaint expressed by our patients has been the discomfort and stiffness associated with the high thoracic laminectomy. This discomfort may be avoided by performing the DREZ lesions through a hemilaminectomy.

The mode of action of the DREZ lesion remains as much an unknown as the mechanism of post-herpetic pain. Although our series is small, these preliminary results are encouraging and indicate that the DREZ lesions may be of benefit in cases of prolonged post-herpetic pain that remain intractable to conventional medical therapy. As the good results found by one worker in the treatment of post-herpetic pain have not been confirmed by others, continued long-term follow-up review is necessary to establish this mode of therapy.

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References


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