Trans-spinal Ganglionectionomy for Relief of Intercostal Pain*

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Any approach to the surgical relief of pain must be oriented to the problems of understanding pain itself, particularly in relation to its organic and psychological variables. Even from the organic standpoint, this understanding is difficult inasmuch as the role of the somatic and visceral systems in relaying stimuli is not clearly defined because of associated neuro-anatomical and neurophysiological complexities. The purpose of this paper is to relate our experiences with surgical treatment of one type of pain problem, the burning segmental thoracic discomfort termed "intercostal causalgia." The 10 cases described, except for one, have had pain following either thoracotomy or thoracic herpes zoster.

The first such patient in our series was a 66-year-old woman referred to us after thoracotomy because of diffuse pain in the chest wall associated with extension of pulmonary cancer. We performed a high cervical cordotomy, which relieved the diffuse pain by producing loss of pain perception up to the acromial level. However, the patient soon began complaining of burning pain and hypersensitivity to light touch in the segment of the thoracotomy scar. We sought an approach for interrupting the pathways relaying this segmental causalgia, since it was not possible to perform a classical transthoracic approach for sympathectomy of the intercostal segments concerned with her pain because of the carcinoma invading the pleural surface of the chest wall.

Surgical Procedure

The trans-spinal procedure (Fig. 1) was designed to sever neural fibers between the intercostal segment and the sympathetic chain. This consisted of lateral thoracic laminotomy with rhizotomy through the dural cuff proximal to the ganglion, unroofing of the intervertebral foramen, and lysis of the rami communicantes at the pleural margin of the pulmonary cavity, followed by section of the intercostal nerve distal to its bifurcation into dorsal and ventral branches. Section of the intercostal nerve distal to its bifurcation insured lysis of all of the rami communicantes. This same procedure was performed one level above and one level below the intercostal nerve involved in the pain syndrome (Fig. 2).

If there was some question about the exact level, the procedure was extended one additional level above the suspected segment. Silver clips were applied to the dural cuff and distal nerve end at each intercostal segment for postoperative x-ray identification of the levels treated.

The operation is performed with the patient lying in the prone position, and the surgical exposure is made to allow lateral laminotomy at multiple levels. When the lateral edge of the dura has been exposed, one searches for the cuff of the spinal nerve to determine the extent of the additional laminar resection necessary. The position of the nerve may vary from one space to another. In unroofing the intervertebral foramen for full exposure of the spinal nerve ganglion, one should carefully note the edges of the bony surface to avoid avulsion of the ganglion with curette or other surgical instrument. As the margin of the pulmonary cavity is approached, one can readily note the rami communicantes, which are easily avulsed with a nerve hook. Excessive traction on the intercostal nerve may cause bleeding from intercostal vessels, but hemostasis is easily obtained with electrocoagulation. Application of a silver clip to the ventral division of the intercostal nerve is recommended before it is severed. Gelfoam is laid over the small exposed area of the pulmonary cavity. Perforation of the pleura has not occurred at any of the levels exposed in any of the cases treated.

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Results

The success of our first case inspired us to treat other cases suffering from intractable causalgic pain similarly. A summary of 10 cases treated in this manner is given in Table 1. Seven had post-thoracotomy pain, one had involvement of the chest wall by bronchogenic malignancy without thoracotomy, and two had post-herpetic causalgia.

In reviewing the results of ganglionectomy in these cases, it is interesting to note that one patient (Case 8) who had had rightsided thoracotomy for mitral commissurotomy in 1964, had no relief from causalgic pain following the first rightsided ganglionectomy at T5-7 in March, 1967. She stood out as a glaring failure in a series where the other cases had been relieved. Later the thoracic surgeon mentioned that thoracotomy had actually been at the fourth intercostal space, which was higher than we had assumed because of the curvilinear incision below the breast margin. When we performed a second ganglionectomy at T3-4 in November, 1968, the patient obtained relief from her causalgic pain.

Of the two patients having malignant lung tumor, the first case remained free of causalgia until she died 13 months after neuroganglionectomy. The other tumor patient was relieved of his pain and had an uneventful course for 2 weeks postoperatively without requiring morphine sulfate, which had been necessary at frequent intervals preoperatively. At the time when arrangements were being made for discharge, he developed bronchopneumonia associated with his pulmonary neoplasm and died following aspiration of gastric contents 3 weeks after ganglionectomy. There has been no mortality nor significant complication related to the surgical procedure itself in the other cases.

Discussion

Inasmuch as relief of disabling pain is a relative matter, there were no simple criteria for evaluating relief of pain. All of our 10 cases have gained relief although not from all symptoms. One of the most uniformly accepted standards of evaluation is withdrawal from drugs. None of the surviving patients is on narcotics, although tranquilizers and various forms of analgesics were still used by patients constitutionally oriented to develop...
Fig. 2. Postoperative x-ray film showing position of silver clips. At each of three levels, the medial silver clip placed on the dural cuff proximal to the ganglion, prior to section. The lateral silver clip was placed on the main branch of the intercostal nerve prior to amputation of the nerve, and lies in the extra-pleural periphery of the pulmonary cavity.

causalgia in the first place. One most practical point was that these patients no longer demanded definitive therapy, but required only general supportive measures or none at all.

As related by Richards,\textsuperscript{7} the original description of causalgia was made by Mitchell, \textit{et al.},\textsuperscript{5} in reference to Civil War cases of peripheral nerve injuries. Contributions have been added by many, including Head and Sherren,\textsuperscript{2} Leriche,\textsuperscript{4} and White and Sweet.\textsuperscript{8}

Ablation procedures have been developed to relieve causalgia, but we still have not documented the interneural relationships that produce causalgia. The observations of Nordenbos\textsuperscript{6} in regard to changes in stimuli velocity according to post-traumatic variations in nerve fiber diameter have provided an interesting explanation for painful response to non-noxious stimuli. But the unidentified enigma is the excruciating pain which causalgic patients perceive at times without any apparent external stimuli. Also, we would like to point out that some of our patients with intercostal causalgia had intercostal neurectomy without relief of their symptoms, thus de-emphasizing the role of fiber spectra.

We feel that patients with long-term postherpetic neuralgia are really suffering from causalgia and should be labeled as such. Their symptoms may be confused with the neurological complaints present in early stages of herpes zoster, but their findings are defect of somatic sensation and hypersensitivity to stimuli of light touch, in a true causalgic pattern. We have not had experience with the classical rhizotomy for post-herpetic causalgia. The operation we have described may relieve intercostal causalgia following repair of diaphragmatic hernia, but of course cannot be expected to terminate the gastrointestinal manifestation of psychological imbalance. Selection of cases for the original thoraco-abdominal surgery is therefore important.

Thoracic trans-spinal ganglioneurectomy serves to isolate the intercostal nerve and spinal ganglion from the sympathetic chain and spinal cord. The rationale behind this operation, implies that simple dorsal rhizotomy may be unsuccessful in relieving pain

<table>
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<tr>
<th>Case No.</th>
<th>Age</th>
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<th>Nature of Segmental Causalgia</th>
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<tbody>
<tr>
<td>1</td>
<td>65</td>
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<td>post-thoracotomy, hiatus hernia</td>
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<tr>
<td>3</td>
<td>59</td>
<td>F</td>
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<tr>
<td>4</td>
<td>59</td>
<td>M</td>
<td>post-thoracotomy, vagotomy</td>
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<td>67</td>
<td>M</td>
<td>cancer of lung invading chest wall</td>
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<td>6</td>
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<td>F</td>
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<td>68</td>
<td>M</td>
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</table>
Intercostal Neuralgia

since afferent fibers might convey pain from the spinal ganglion to the sympathetic chain and then enter the spinal cord at higher or lower levels, as indicated in Fig. 1. Foerster, et al., and Leriche assumed that pain-conducting fibers run via the sympathetic chain, but others have denied this. Our observations support those of Foerster and Leriche, implicating the ganglion itself in causalgia. Certainly the herpes zoster virus, in attacking the ganglion, seems to have provided a causalgic pattern. In cases of peripheral nerve injury, attention has been focused on the nerve and size of conduction fibers, but detailed investigation, possibly with the electron microscope and uni-cellular electrodes, may give information relative to changes in ganglionic cells and their neurophysiologic reaction.

**Summary**

The surgical procedure of thoracic transspinal neuroganglionectomy has been described for relief of post-thoracotomy causalgia and thoracic post-herpetic causalgia. The procedure is designed to isolate the spinal ganglion of the involved segment from autonomic and somatic central pathways at the level of the involved intercostal segment, and at least at one level above and below. It has been suggested empirically that the spinal ganglion may be the site of abnormal interrelationships producing causalgia.

**References**