Sympathectomy for complex regional pain syndrome

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Background: With the easier and earlier recognition of complex regional pain syndrome (CRPS), a reappraisal of its therapy, particularly the role and timing of sympathectomy, is warranted.

Patients and Methods: Over a 9-year period, 42 patients with CRPS type II of the upper extremity were referred for sympathectomy. Patients were categorized according to the duration of the symptoms (group I, <3 months; group II, >3 months). All patients underwent initial medical treatment; stellate ganglion blocks were performed when symptoms persisted beyond 6 weeks. Patients were referred for thoracoscopic sympathectomy on persistence of the pain syndrome. A visual linear analogue scale was used to evaluate outcome of sympathectomy.

Results: Thoracoscopic dorsal sympathectomy was successfully undertaken in 32 patients. In the remaining 10 patients, thoracoscopy was not technically feasible and open sympathectomy was performed. There was an overall improvement in all 42 patients undergoing sympathectomy (P < .001, Wilcoxon signed rank test). The outcome in group I was significantly better than in group II (P < .003, Mann-Whitney U test). The diagnosis of sympathetically mediated pain with stellate blockade did not correlate with clinical outcome. Patients undergoing thoracoscopic sympathectomy had a better outcome than those undergoing open sympathectomy. There were no complications, and the hospital stay was shorter in the thoracoscopic group.

Conclusion: Early recognition of CRPS and prompt recourse to surgical sympathectomy is a useful option in the management of CRPS. (J Vasc Surg 2003;37:508-11.)

In 1854, Weir Mitchell first described the syndrome of causalgia during the American Civil War. Since then, the term causalgia has been redefined several times. The term complex regional pain syndrome (CRPS) is currently used to describe the constellation of symptoms previously described as causalgia, reflex sympathetic dystrophy, Sudeck’s atrophy, or mimocausalgia, among others.

The International Association for the Study of Pain classification of the chronic regional pain syndromes (CRPS types I and II) affords the early clinical recognition of this condition and provides clearer definitions. The four diagnostic criteria (three of which must be present to confirm the diagnosis) for CRPS type I (previously reflex sympathetic dystrophy) are 1-3: 1, the presence of an initiating noxious event or a cause of immobilization; 2, continuous pain (disproportionate to an inciting event), allodynia, or hyperalgesia; 3, edema, changes in skin blood flow, or sudomotor activity in the region of pain; and 4, exclusion of conditions that would otherwise account for the degree of pain. CRPS type II has a peripheral nerve injury as the initiating factor together with criteria 2 to 4 as described for CRPS type I.

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Competition of interest: none.

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The traditional therapeutic approach to CRPS is a conservative one. With respect to the upper limb, surgical intervention with cervical sympathectomy is usually indicated when the condition becomes refractory to medical treatment and is responsive to sympathetic blockade. We describe our experience with the treatment of CRPS type II involving the upper limb in an attempt to define the role and, in particular, the timing of surgery.

PATIENTS AND METHODS

Over a 9-year period from October 1992 to September 2001, all patients with upper limb CRPS type II referred to the Pain Clinic at King Edward VIII and Addington Hospitals, Durban, South Africa, were evaluated. Patients were arbitrarily categorized according to the duration of their symptoms; group 1 patients had symptoms evident for less than 3 months after the injury, and group 2 patients had symptoms for greater than 3 months after the injury. This period of 3 months was chosen because, by this time, patients who have not responded to optimal medical and ancillary therapies usually remain refractory to persistence with such therapy. Initial management was pharmacologic. This comprised a combination of a tricyclic antidepressant (Prothiaden [Knoll, Ludwigshafen, Germany]), a membrane-stabilizing agent (Tegretol [Novartis, Johannesburg, South Africa]), a calcium channel blocker (Gabapentin [Parke-Davis, Cape Town, South Africa]), and a nonsteroidal antiinflammatory agent. This therapeutic schedule was maintained for as long as the pain persisted. When symptoms persisted for more than 6 weeks after medical treatment began, a stellate ganglion block (SGB) was performed with local anesthesia to ascertain whether the pain was
sympathetically maintained. The block was deemed successful when a Horner’s syndrome developed and the pain diminished or disappeared; surgical sympathectomy was considered if pain relief only lasted the duration of the SGB. When an equivocal response was seen, the block was repeated. The pharmacologic treatment was maintained in all patients in the interim. Active and passive physiotherapy was rendered from the first consultation. The number of sympathetic blocks performed per patient was documented. Patients with poor responses to medical therapy and SGB were referred for surgical management irrespective of the response to SGB.

All patients were asked to score their pain on a visual linear analogue scale, with zero cm signifying no pain and 10 cm the most extreme pain. In all patients, thoracoscopic dorsal sympathectomy was attempted. A limited second thoracic ganglionectomy was performed when thoracoscopic copy was possible. When thoracoscopy was technically not feasible, an open sympathectomy was undertaken with the supraclavicular route. The excised ganglion was routinely submitted for histology to verify completeness of sympathectomy.

The difference in the preoperative and postoperative pain scores was calculated. After discharge, the patients were reviewed at 10 days and asked to score their pain in the same fashion as before surgery. A reduction in the postoperative pain score by less than 2 was deemed a poor outcome, between 2 and 4 was satisfactory, and more than 4 was an excellent outcome. Patients were reviewed at 4 weeks, 3 months, and 6 months. Continued follow-up was reserved for those patients needing pharmacologic measures to control pain. Patients who remained pain free were given an open appointment to return if pain recurred. The outcome in those undergoing sympathectomy within 3 months of onset of symptoms was compared with those undergoing sympathectomy with symptoms of greater than 3 months duration.

Statistical analysis was performed with SPSS software (SPSS 9.0, SPSS Inc, Chicago, Ill). Data were summarized in terms of median and range. The Wilcoxon signed rank test and the Mann-Whitney U test were used to compare endpoints. A P value of .05 was taken as a level of significance.

RESULTS

Results are found in Table I. Forty-two patients underwent upper limb sympathectomy. The median duration of symptoms was 9.5 weeks (range, 4 to 200 weeks) at the time of presentation for surgery. There were 27 males, and the median age was 32 years (range, 17 to 64 years).

The median duration of symptoms in patients in group 1 (n = 24; symptoms < 3 months) was 6.5 weeks (range, 4 to 11 weeks). The median duration of symptoms in patients in group 2 (n = 18; symptoms > 3 months) was 26.5 weeks (range, 14 to 200 weeks).

Surgery. Sympathectomy was successfully performed in all patients referred for the procedure. Thoracoscopic dorsal sympathectomy was attempted in all patients. This was successful in 30 patients. In 12 patients, sympathectomy had to be performed with the open route. In the latter group, the thoracoscopic approach was abandoned either because of dense adhesions involving the lung apex or pleural thickening totally obliterating an adequate view of the proximal sympathetic chain.

The higher rate of open sympathectomy in group 2 patients correlated with the larger number of SGB administered to this group compared with the patients in group 1. Patients in group 1 had a median of one block (range, 1 to 2 blocks) and patients in group 2 had a median of 3.5 blocks (range, 1 to 5 blocks) administered.

Predictive value of SGB (Table II). Of the 42 patients referred for surgery, only 25 patients had appreciable pain relief from SGB that confirmed the presence of sympathetic mediated pain. In the remaining 17 patients, there was no response to SGB.

In the 25 patients with relief from SGB (group 1, n = 18; group 2, n = 7), the outcome after sympathectomy was noted to be excellent in 14 patients (group 1, n = 13; group 2, n = 1). The outcome was noted to be good in five group 1 patients and satisfactory in one group 2 patient. A poor outcome was noted in five group 2 patients. The difference in outcome between group 1 and group 2 was not significant (P = .288, Mann-Whitney U test).

In the 17 patients with a poor response to SGB (group 1, n = 6; group 2, n = 11), the outcome after sympathectomy was noted to be excellent in six patients (group 1, n = 4; group 2, n = 2). In the remaining patients with a poor response to SGB, a good outcome was noted in seven patients (group 1, n = 2; group 2, n = 5); satisfactory (n = 2) and poor (n = 2) clinical outcomes were noted in the

### Table I. Results of sympathectomy

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Group I (n = 24)</th>
<th>Group II (n = 18)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>17 (80.9%)</td>
<td>3 (23.5%)</td>
<td>.003</td>
</tr>
<tr>
<td>Good</td>
<td>7 (19.0%)</td>
<td>5 (29.4%)</td>
<td>.288</td>
</tr>
<tr>
<td>Poor clinical response</td>
<td>0</td>
<td>7 (35.3%)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Satisfactory clinical outcome</td>
<td>24 (100%)</td>
<td>11 (64.7%)</td>
<td>.003</td>
</tr>
</tbody>
</table>

### Table II. Outcome of sympathectomy after SGB

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Group I (n = 25)</th>
<th>Group II (n = 18)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive SGB</td>
<td>18</td>
<td>7</td>
<td>.288</td>
</tr>
<tr>
<td>Excellent</td>
<td>13</td>
<td>1</td>
<td>.288</td>
</tr>
<tr>
<td>Good</td>
<td>5</td>
<td>0</td>
<td>.288</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>0</td>
<td>1</td>
<td>.288</td>
</tr>
<tr>
<td>Satisfactory clinical outcome</td>
<td>6</td>
<td>9</td>
<td>.288</td>
</tr>
<tr>
<td>Poor clinical outcome</td>
<td>0</td>
<td>2</td>
<td>.288</td>
</tr>
</tbody>
</table>
remaining group 2 patients. The difference in outcome between group 1 and group 2 was also not significant (P = .288, Mann-Whitney U test).

**Pain response to sympathectomy.** The overall improvement in all 42 patients from a median preoperative score of 9.0 (range, 7 to 10) to a median postoperative score of 2.0 (range, 0 to 9.4) was noted to be significant (P < .001, Wilcoxon signed rank test). The clinical improvement in visual linear analogue scale in group 1 patients was a decline from a median preoperative score of 9 (range, 7.5 to 10) to a median postoperative score of 1.65 (range, 0 to 4.2). Because of the minimal impact of pharmacotherapy and progressive debility, SGB was undertaken in two patients within 4 weeks of commencement of therapy.

In patients in group 2, the clinical improvement was a decline from a median preoperative score of 9.1 (range, 7 to 10) to a median postoperative score of 4.2 (range, 0.2 to 9.4). The outcome in group 1 versus group 2 was noted to be significantly better in the former group (P < .003, Mann-Whitney U test). The poorest results were in seven patients from group 2 who had been symptomatic for 29 to 192 weeks. The beneficial effect noted on day 10 and at 6 months after sympathectomy persisted during the median follow-up period of 40.6 months (range, 2 to 73 months). Three patients were lost to the 6-month review.

**Surgical outcome.** All patients who had thoracoscopic dorsal sympathectomy were discharged within 24 hours of admission. There were no complications after the procedure.

In contrast, the average inpatient stay after open sympathectomy was 2.5 days. Complications after open sympathectomy included Horner’s syndrome in one patient and wound hematoma in two patients. In all patients, the submitted ganglia confirmed the histologic presence of neuronal ganglionic tissue.

**DISCUSSION**

Although various theories have been proposed for the pathophysiology of CRPS, this condition remains poorly understood. It is hardly surprising that there is not a uniform approach to therapy. Functional restoration of the affected limb can only be established with relief of pain. This encourages movement, prevents contractures, maintains limb function, reduces vascular stasis, and prevents osteoporosis. The analgesic methods available include pharmacologic agents, regional anesthesia, or neuromodulation. The sequence of application of these methods varies from center to center, depending on the personal experience and the expertise of the attendant physician. The preferred therapy has little scientific basis. There is, however, unanimity that CRPS may progress from an acute to a dystrophic and then to an atrophic stage. Each clinical stage may last from several weeks to months. The acute phase may be considered reversible, and resolution is possible with medical therapy. A good result may also be anticipated when the analgesia provided with regional sympathetic or SGB extends beyond the duration of the block itself. Although SGB might prove useful as a therapeutic method, it was shown to be a poor predictor of outcome to surgical sympathectomy in both groups 1 and 2.

The dystrophic phase usually has a poor response to stellate or regional blockade. Spontaneous resolution is uncommon. The atrophic stage represents the final and unforgiving phase of CRPS that is usually unresponsive to therapy. This temporal progression of CRPS may have therapeutic implications. In choosing the appropriate therapeutic algorithm, it is imperative that it is time contingent. Early recognition during the acute phase stage is crucial because it may readily afford a favorable outcome after either drug therapy or sympathectomy. The mainstay of an early diagnosis is clinical awareness. Laboratory, radiologic, histologic, and neurophysiologic studies have little value in this regard.

The range of pharmacotherapeutic options advocated includes nonsteroidal antinflammatory agents, corticosteroids, biphosphonates, calcitonin, antidepressants, anticonvulsants, opioids, and sympatholytic drugs. Among the latter are oral agents (phenoxybenzamine) and transdermal agents (clonidine hydrochloride). These agents are prescribed in combination and may have disconcerting side effects and underscore the failure of a suitable pharmacologic option. In concert with medical treatment, physiotherapy and occupational therapy are crucial in expediting functional restoration. Given the complexity of the condition and its management, it is advisable that a multidisciplinary team affiliated with a pain clinic manages patients. This affords access to pharmacologists, anesthetists, physiotherapists, physicians, and surgeons, each of whom may have a role to play. Compensation neurosis is an underappreciated factor in these patients, and the role of a psychologist, occupational therapist, and welfare agency early in the management may be of salutary benefit.

SGB is undertaken in our practice when, at the end of 6 weeks, medical treatment proves to be ineffectual. SGB may be both diagnostic and therapeutic. It has been suggested that if performed accurately, sympathetic blockade may define the so-called sympathetic mediated pain, thereby justifying the role of sympathectomy. Furthermore, if undertaken in the early or acute phase, the procedure may prove to be therapeutic in itself. However, the drawbacks to SGB are manifold: the procedure is operator dependant and its universal accuracy unknown. Furthermore, the stellate ganglion is distant from the second thoracic ganglion that is now considered pivotal in affecting upper limb sympathetic denervation. Also, alternate neural pathways to the brachial plexus bypass the stellate ganglion and may not be blocked with a standard SGB. Thus, SGB may underestimate the true incidence of sympathetic mediated pain and thereby deny patients a potentially beneficial outcome from sympathectomy. In this series, a beneficial outcome to sympathectomy was noted in 20 of 25 patients identified with sympathetic blockade as having sympathetic mediated pain and in 15 of 17 patients with a poor response to SGB. Thus, contrary to the experience of others, the response to sympathectomy did not corre-
late with the response to SGB. The experience of the anesthesiologist undertaking the SGB, variations in SGB technique, and change in personnel during the period of the study may provide reasons for this. Furthermore, SGB has numerous variables that cannot be standardized; the proximity of the brachial plexus and the likelihood of varying degrees of somatosensory blockade may impact on the interpretation of SGB.

Open sympathectomy was necessary in two of 24 patients (8.4%) in group 1 and in 10 of 18 patients (55.5%) in group 2. Because there was no antecedent history of pulmonary infection or chest trauma, these admissions and pleural thickening obscuring the sympathetic chain were considered to be a consequence of repeated SGB. In our practice, early recourse to surgical intervention when nonoperative measures are proving to be ineffectual eliminates the use of repeated SGB for these patients.

Three months was the arbitrary period chosen to distinguish early from late onset CRPS because this stage pharmacologic options are usually exhausted, with limited options available to achieve pain relief other than with surgical intervention. Clinical assessment of response to therapy by a consistent medical team is important. Persistence of a conservative approach does not guarantee spontaneous resolution of symptoms, and this has to be balanced against the prospect of progress to the dystrophic stage that is disastrous for most patients, particularly manual laborers.

Spurling originally described sympathectomy as an effective treatment for CRPS in 1930, when he successfully treated a patient (then described as having causalgia) with a sympathetic denervation. The second thoracic ganglionectomy taken with the thoracoscopic approach has been shown to be a safe option with a better outcome than open sympathectomy limited to the second thoracic ganglion under endoscopic transthoracic electrocautery of the sympathetic chain for palmar and axillary hyperhidrosis. Br J Surg 1996;83:127-33.

When sympathectomy is undertaken beyond this stage, a favorable outcome is not guaranteed and only eight of 18 patients (44.4%) had a good or excellent outcome. Overall, sympathectomy was noted to have a good or excellent outcome in 32 of our patients (76.2%). The results in this series and the range of available therapies suggest that a placebo-controlled trial may not be feasible or indeed ethical. In current surgical practice, sympathectomy limited to the second thoracic ganglion undertaken with the thorascoscopic approach has been shown to be easy and safe in consistently obtaining upper limb sympathetic denervation. The second thoracic ganglionectomy effectively interrupts the sympathetic outflow proximal to the alternate neural pathways (such as the nerve of Kuntz), long considered as important causes of persistent activity after an apparently successfully sympathectomy.18-21

In this study, thorascoscopic sympathectomy has been shown to be a safe option with a better outcome than open surgery. Results in the latter category of patients were adversely influenced by the longer duration of symptoms. The greater number of SGB undertaken in this group may have contributed to apical thickening and adhesions that precluded thorascoscopic sympathectomy and thereby the benefit of a minimally invasive procedure. Early clinical recognition without persistent SGB affords the opportunity of successfully accomplishing thorascoscopic sympathectomy, an option that may be invaluable in the management of CRPS.

REFERENCES


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