Role of autonomic function tests (AFT) in the diagnosis of CRPS validated and effectiveness of spinal cord stimulation (SCS) determined in prospective study of 42 CRPS patients referred to neurosurgeon after failing non-interventional treatment.

Index Terms--

I. INTRODUCTION
A prospective study of 42 CRPS (complex regional pain syndrome) patients referred to a neurosurgeon for management and treatment of chronic pain after failing non-interventional multi-disciplinary treatment at a Pain Clinic was conducted in order to validate the role of autonomic function tests (AFT) in the diagnosis of CRPS and to determine the effectiveness of spinal cord stimulation (SCS).

II. METHODS
Diagnoses of CRPS type I and II were made/confirmed using the Putative Diagnostic Criteria for Reflex Sympathetic Dystrophy as proposed by Wilson. AFT obtained included Resting Sweat Output (RSO), Quantitative Sudomotor Axon Reflex Test (Q-SART), and Themography.

Putative Diagnostic Criteria for RSD

<table>
<thead>
<tr>
<th>Clinical Signs/Symptoms</th>
<th>Laboratory Results</th>
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<tbody>
<tr>
<td>Burning pain</td>
<td>QSART/Thermography</td>
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<tr>
<td>Hyperpathia/allodynia</td>
<td>Bone X-ray studies</td>
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<td>Temperature/color changes</td>
<td>Three phase bone scan</td>
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<tr>
<td>Edema</td>
<td>Sympathetic blocks</td>
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<td>Hair/nail growth changes</td>
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A score of 6 or more was categorized as “probable RSD” (55%), 3-5 as “possible RSD” (17.5%), and under 3 as “unlikely RSD” (15%). 12.5% either refused testing or results are pending. The diagnoses was further classified into CRPS-I (reflex sympathetic dystrophy) and CRPS-II (causalgia) according to whether a nerve injury was recorded or not.

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manual/construction, health/personal care giver, administrative, and service genres. The miscellaneous category was comprised of 3 motor vehicle accidents, 5 non-work related traumas, angina pectoris, cerebral palsy, cervical spondylotic radiculopathy, and cervical spondylotic myelopathy.

The racial and gender composition of the CRPS cohort was compared to the racial and gender composition of the netire patient population referred to the neurosurgery clinic of the neurosurgery author (RS) during the time of the study.

III. RESULTS

Resting sweat output is unreliable because patients may have anhidrosis or hypohidrosis requiring a high gain. Q-SART response morphology was variable.

Output was abnormal in 53%. 100% of the thermographic studies were abnormal revealing asymmetry (symptomatic limb warmer or colder). 74% were colder and 26% were warmer. The ratio of colder over warmer for CRPS was 4/1. Patterns of autonomic testing abnormalities revealed 54% had positive thermography and QSART, 42% had positive thermography negative QSART, and 1% had negative thermography positive QSART. There were no reported cases of negative thermography and QSART.

Ten out of 15 patients succeeded a three-day SCS trial and underwent implantation of an Itrel® Generator. A Resume® lead was placed in four cervical and one lumbar cases, and a Pisces-Quadripolar lead placed in two cervical and four lumbar cases. Follow up ranged from eight to 62 months with a mean of 40 months. Pain control was rated as excellent in five cases, very good in 3, good in 2, and poor in 1. AFTs were again obtained approximately three months after SCS implant. Post-operative thermography resulted in improvement in 82%, unchanged in 9%, and worsening in 9%. Post-operative QSARTs resulted in improvement in 50%, unchanged in 40%, and worsening in 10%. Of those refusing SCS, two patients refused an SCS trial opting for sympathectomy, and one patient chose re-neurolysis. SCS trials are pending for two patients in litigation. Of the remaining patients, 16 are being treated with non-interventional modalities, and four patients are completing testing. One patient requested removal of her stimulator due to contra-lateral FBSS symptoms in spite of improvement of CRPS-II. RSO decreased 0.59 ml (0.9-1.71) in four and increased (0.18-0.23) in five. QSART increased 3.01 ml (0.58-7.55) in four while decreasing 2.33ml (0.28-7.76) in seven. Temperatures increased in 10/11 cases, average 2.5°C (0.5-7). AFT deteriorated in one experiencing recurrence of symptoms with generator exhaustion. AFT did not deteriorate in patients reporting worsening of symptoms coinciding with litigation without objective findings. Migration occurred in four patients confirmed with AFT.

We wish to report in detail one special case of a female discontinuing a medication regime successfully controlling her CRPS to have a spinal cord stimulator implanted in order to become pregnant without risking possible teratogenic effects of the medications. The patient is a 31-year old right-handed white female employed as a neonatal nurse who developed left hand burning pain, swelling, coldness and weakness following a motor vehicle accident. EMG demonstrated a mild left brachial plexus injury. The weakness resolved, but she developed CRPS symptoms consisting of burning pain graded as 8/10, and a temperature asymmetry of 1-5°C was evidenced by thermography. She was evaluated at a multi-disciplinary pain clinic and with a pharmacological regime of Neurontin, Trazadone, Tramadol, Vicodin, and Motrin, she obtained satisfactory pain control. However, she married and wanted to become pregnant and was afraid of possible teratogenic effects of these medications. The pain clinic referred her for evaluation for an interventional pain control procedure (SCS) which would allow discontinuation of medication. A baseline psychological evaluation did not reveal contra-indications. No animal or human studies regarding possible teratogenic effects or fetal/maternal risk using SCS at the time of conception, pregnancy, delivery, or labor were available, and this was explained to the patient who signed an informed consent. In July, 1997, she underwent a successful three-day trail of cervical SCS, with a Resume® TL thin line lead at the left dorsal epidural quadrant, with the 0 electrode at the C2-3 level and an Itrel-III pulse generator was implanted in the upper gluteal region instead of the abdomen because of the patient’s concern of discomfort during pregnancy and risk of damage if a cesarean section would be necessary. She had excellent pain control (close to 100%) and dramatic decrease of her
allodynia/hyperpathia. She was successfully tapered off medications and got pregnant. She delivered a healthy, five-pound baby female five weeks early. Both mother and baby were discharged in two days. At no time during the labor and delivery was the SCS turned off.

IV. CONCLUSION

We found that the use of AFT has been helpful not only in validating the diagnosis of CRPS, the use of AFT is able valuable in objectively assessing improvement with treatment in patients with CRPS. We have obtained significant improvement in the control of signs and symptoms of CRPS with SCS. We have found that SCS may lead to normalization or improvement from both excessive or deficient sweat production. That would support the hypothesis that reflex pattern changes in post-ganglionic cutaneous vasoconstrictor neurons in CRPS are related to central (dorsal horn?) changes. We speculate this is obtained by central modulation of the sudo motor reflex by afferent stimulation.