Predictors of Long-Term Outcome of Thoracic Sympathectomy in Patients with Complex Regional Pain Syndrome Type 2

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■ BACKGROUND AND OBJECTIVE: **Long-term results of sympathectomy in patients with complex regional pain syndrome (CRPS) type 2 varies widely among studies due to nonspecific or vague criteria of diagnosis and absence of outcome predictors that help good patient selection. The objective was to determine the predictors of long-term outcome of sympathectomy in patients with upper limb CRPS type 2.**

■ METHODS: **A retrospective cohort, in which those who underwent thoracic sympathectomy for upper limb CRPS type 2 from 2007 to 2014, were included. Demographic and clinical data of patients, in addition to stellate ganglion block (SGB) details and percent of pain relief at the end of follow-up, were collected and used for statistical analysis.**

■ RESULTS: **Our study included 53 patients, with a mean age of 47 ± 7 years, and 60% females. Using bivariate correlations; age, sex, nerve injured, type of injury, and occupation were not significantly correlated to outcome. Multiple linear regression analysis of correlated variables revealed that duration of pain relief after SGB and degree of sympathetic overactivity were positive predictors ($\beta = 0.286$, $P = 0.027$, and $\beta = 0.257$, $P = 0.003$, respectively), whereas presence of allodynia was a negative predictor ($\beta = -0.280$, $P = 0.041$) of the final pain relief. Final pain relief was better in those patients who experienced extended relief of their pain >2 days after SGB ($P = 0.001$, Kruskal Wallis test).**

■ CONCLUSIONS: **Thoracic sympathectomy may prove more effective than reported in carefully selected CRPS patients with prominent sympathetic overactivity, no or early allodynia, and pain relief >2 days after SGB.**

INTRODUCTION

Complex regional pain syndrome (CRPS) type 2 is a post-traumatic pain syndrome, previously known as causalgia, and characterized by the presence of a peripheral nerve injury as the initiating factor, together with sensory, motor, vasomotor, and sudomotor disturbances affecting the limb.[1] The cornerstone in management of CRPS type 2 is pain control, which allows functional restoration of the affected limb. Several pain treatment modalities were described; one of the most effective and popular is surgical sympathectomy. However, two types of pain associated with CRPS type 2 should be differentiated before sympathectomy (sympathetically maintained and sympathetically independent pain) according to whether or not pain responds to preoperative stellate ganglion block (SGB). Although sympathectomy is considered the treatment of choice for patients with the former type of pain, it is considered ineffective in the latter.[2-5] However, other investigators found no correlation between the clinical outcome to sympathectomy and the response to preoperative SGB.[6] These studies discussed the response of the patients to SGB in general terms like; pain relieved or not by sympathetic block. Most studies either used old nonspecific criteria of patient selection or did not mention their selection criteria.[3-6] The studies neither

Key words
- CRPS
- Outcome
- Sympathectomy

Abbreviations and Acronyms
CISS: Cold intolerance symptom severity
CRPS: Complex regional pain syndrome
IQR: Interquartile range
PID: Pain intensity difference
SD: Standard deviation
SGB: Stellate ganglion block
VAS: Visual analogue scale

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analyzed the details of patients' response to SGB nor correlated it to long-term outcome after sympathectomy. In addition, the effect of individual's clinical manifestations on the long-term response to sympathectomy was not well-appreciated. The aim of the present study is to explore the various demographic, clinical, and management-related variables that are correlated to the final percent of pain reduction after sympathectomy and to determine the predictors of long-term outcome.

PATIENTS AND METHODS

Design and Population

This is a retrospective cohort study done by reviewing the records of patients with the diagnosis of upper limb CRPS type 2 who underwent thoracic sympathectomy in the departments of neurosurgery and vascular surgery in Mansoura University Hospital during a period of about 7 years until the end of 2014.

Criteria of Selection

All patients had a history of upper limb nerve injury followed by the development of continuing pain. The pain syndrome should have met the Budapest diagnostic criteria for CRPS type 2 (Table 1) to avoid bias in selection criteria. Cases selected are those who underwent sympathectomy within 3–12 months after the start of symptoms. Patients who underwent early sympathectomy within 3 months from onset, and neglected cases that underwent delayed sympathectomy >12 months from onset were excluded.

Table 1. Budapest Clinical Diagnostic Criteria for Complex Regional Pain Syndrome

1. Continuing pain, which is disproportionate to any inciting event
2. Must report at least 1 symptom in 3 of the 4 following categories:
   - Sensory: reports of hyperesthesia and/or allodynia
   - Vasomotor: reports of temperature asymmetry and/or skin color changes and/or skin color asymmetry
   - Sudomotor/edema: reports of edema and/or sweating changes and/or sweating asymmetry
   - Motor/trophic: reports of decreased range of motion and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nail, skin)
3. Must display at least 1 sign at time of evaluation in 2 or more of the following categories:
   - Sensory: evidence of hyperalgesia (to pinprick) and/or allodynia (to light touch and/or deep somatic pressure and/or joint movement)
   - Vasomotor: evidence of temperature asymmetry and/or skin color changes and/or asymmetry
   - Sudomotor/edema: evidence of edema and/or sweating changes and/or sweating asymmetry
   - Motor/trophic: evidence of decreased range of motion and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nail, skin)
4. There is no other diagnosis that better explains the signs and symptoms

Taken from reference 1.

Patients who underwent sympathectomy without preoperative SGB and those who underwent sympathectomy despite reported failure of SGB were also excluded from the study. Those with preoperative SGB with either reliable or unreliable success were included (i.e., an effective block). Various criteria for patient selection were gathered in Table 2. Reliable success of SGB was defined as the development of Horner's syndrome and difference in hand temperature between ipsilateral and contralateral sides of $\geq 1^{\circ}C$. Unreliable success meant the presence of Horner's syndrome with $<1^{\circ}C$ of differential hand temperature. Effective SGB was that of a block achieving $\geq 50\%$ of pain intensity difference (PID). The percent of PID was found to be a more consistent and standardized approach to the evaluation for pain therapies than raw PID,[7] and was calculated using the following formula:

$$\%PID = (\text{VAS baseline} - \text{VAS current value})/\text{VAS baseline} \times 100$$

If the percent of PID after SGB remained at $\geq 50\%$, we considered the block still effective. Relapse of pain intensity with reduction in the percent of PID to $<50\%$ was considered an end of pain relief. The duration of pain relief between the effective block and relapse of pain was recorded. Throughout this article, the percent of pain relief means the percent of PID and may be referred to simply as PID.

Ethical Approval

The study was reviewed and approved by the local committee for medical research, MFM-IRB (code: R/16.01.99). Informed written

Table 2. Selection Criteria of Patients

Inclusion criteria
- Patients with history of upper limb peripheral nerve injury followed by a pain syndrome that met the Budapest diagnostic criteria for complex regional pain syndrome with an adequate nerve repair done within 24 hours after injury during the period of 2004 to 2011.
- Age between 18 and 60 years
- Failure of physiotherapeutic and pharmacotherapeutic programs including at least a tricyclic antidepressant and an atypical antiepileptic (e.g., pregabalin) for at least 3 months
- Patients who underwent sympathectomy after preoperative trial of stellate ganglion block (SGB).

Exclusion criteria
- Patients diagnosed and managed according to International Association for Study of Pain criteria before application of Budapest criteria.
- Patients with duration of symptoms >12 months before sympathectomy
- Patients with history of chemical nerve injuries that may account for massive tissue destruction and diffuse pain affecting the limb
- Patients with current or history of psychiatric problems
- Patients who underwent preoperative unsuccessful or successful ineffective SGBs
- Patients beyond reach for follow-up (no clinic visits, no telephone contact)