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Risk factors for complex regional pain syndrome in patients with surgically treated traumatic injuries attending hand therapy

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ABSTRACT

Study Design: Prospective cohort study.
Introduction: Identification of risk factors for CRPS development in patients with surgically treated traumatic injuries attending hand therapy allows to watch at-risk patients more closely for early diagnosis and to take precautionary measures as required.
Purpose of the Study: The aim of this study was to evaluate the risk factors for the development of complex regional pain syndrome (CRPS) after surgical treatment of traumatic hand injuries.
Methods: In this prospective cohort, 291 patients with traumatic hand injuries were evaluated 3 days after surgery and monitored for 3 months for the development of CRPS. The factors assessed for the development of CRPS were age, sex, manual work, postoperative pain within 3 days measured on a Pain Numerical Rating Scale (0-10), and injury type (crush injury, blunt trauma, and cut laceration injury).
Results: CRPS was diagnosed in 68 patients (26.2 %) with a duration of 40.10 ± 17.01 days between the surgery and CRPS diagnosis. The mean postoperative pain score was greater in patients with CRPS than in those without CRPS ($P < .001$). Patients with pain scores ≥ 5 had a high risk of developing CRPS compared with patients with pain scores <5 (odds ratio: 3.61, confidence interval = 1.94-6.70). Patients with crush injuries were more likely to develop CRPS (odds ratio: 4.74, confidence interval = 2.29-9.80).
Conclusions: The patients with a pain score of ≥5 in the first 3 days after surgery and the patients with crush injury were at high risk for CRPS development after surgical treatment of traumatic hand injuries.
Level of Evidence: II b.

Introduction

Complex regional pain syndrome (CRPS) is a descriptive term for a set of symptoms and signs, including disabling pain at rest or at the slightest movement, swelling, and vasomotor instability (changes in color, temperature, and sweating).[1] The upper extremity is involved more frequently than the lower extremity, and fracture is the most common causative effect.[2] Why some patients develop CRPS but some do not is unclear. CRPS is a multifactorial disorder that is associated with an aberrant host response to tissue injury.[3]

Although the exact incidence is unknown, CRPS development is a not a rare complication seen after an emergent or elective hand surgery.[2,4-8] CRPS may complicate recovery by causing swelling, joint stiffness, tendon adhesions and/or muscle atrophy, delayed return to work, and diminished health-related quality of life and increase the likelihood of poor outcomes after hand surgery.[8] Therefore, the identification of risk factors for CRPS development in those patients allows hand therapists and clinicians to watch at-risk patients more closely for early diagnosis and to take precautionary measures as required during the early weeks after injury.

Risk factors contributing to the development of CRPS have been mainly studied in wrist fractures and early baseline pain, high-energy injuries, and severe fractures and female gender has been reported as risk factors for CRPS development.[9-14] Not much is known about the risk factors contributing to the development of CRPS after surgically treated traumatic hand injuries. In a retrospective observational study, with a undefined sampling method, it was reported that female gender and motor nerve injury were found to be the potential risk factors for CRPS development after mechanical traumatic hand injury surgery isolated to hand or forearm.[15]

Conflict of interest: none.

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The aim of this study was to evaluate the risk factors for complex regional pain syndrome in patients with surgically treated traumatic injuries attending hand therapy.

Patients and methods

Study design

The present study was a prospective cohort study of 291 consecutive patients who had undergone surgery for traumatic hand injury. The study was conducted between May 2015 and December 2015. All patients were referred from the inpatient clinic of plastic and reconstructive surgery of the same institution for hand rehabilitation. Participants were assessed on the third day postoperatively and were monitored for the following 3 months in the hand rehabilitation unit of the Physical Medicine and Rehabilitation Department.

The exclusion criteria were the following: (1) age <18 years, (2) previous hand and/or forearm operations, (3) hand burns, (4) brachial plexus injury, (5) history of psychiatric diseases such as dementia and psychotic diseases which affect cognitive skills, (6) history of peripheral polyneuropathy or peripheral nerve entrapment, (7) history of metabolic or endocrine diseases, and (8) prior history of chronic pain or use of opioids. Written informed consent was obtained from all participants, and the protocol was approved by the institutional medical ethical committee.

Patients were evaluated on the third day postoperatively, weekly for three weeks, at 2 months, and at 3 months by a fourth year physical medicine and rehabilitation resident. The presence of tendon injury and/or fracture and/or nerve injury was recorded. A controlled passive motion protocol was prescribed for flexor tendon injuries, and early active motion protocol was prescribed for extensor tendon injuries. All patients with tendon injuries were prescribed an orthosis according to their rehabilitation protocol and told to wear it 24 hours a day for 3 to 4 weeks. The patients were told to come to control immediately if they had worsened pain, skin color or temperature asymmetry, edema or sweating asymmetry, or hair, nail, or skin changes in their injured hand. Hand therapists were told to send the patients to our PM&R Outpatient Clinic for evaluation when they are in doubt for CRPS during therapy sessions.

Sample size analysis was made by using Power Analysis and Sample Size Software program for confidence interval (CI) for one proportion to exclude type 1 error. The proportion was accepted 50%, 95% CI, and the lowest prevalence 40%. Sample size was calculated as 104. All hand injury patients who have been surgically treated and referred for hand rehabilitation were included in the study ($n = 291$).

The demographic data collected were age, sex, educational level (primary school, secondary school, high school, college, and university), and occupation. A patient was defined as a manual worker when the patient worked 35 hours or more per week in a manual labor job. Manual labor jobs were defined as employment in nonmanagerial jobs in industries such as landscaping, construction, restaurant work, hotel work, child care, and manufacturing.[16]

Clinical data

Clinical data evaluated were injury-related features and pain. The injury-related features examined in the study were injury to the dominant hand, the nature of the injury (crush injury, blunt trauma, or cut laceration injury), and injured tissues (tendon, nerve, and bone). A hand injury was defined as a crush injury when a compressive type of force was applied, and the hand was squeezed between 2 objects or when the fingers, hand, or forearm caught in a wringer or roller machine; it was defined as blunt trauma when a traumatic injury was effected by a blunt object or force; and it was defined as a cut laceration injury when hand tissues were cut by a sharp object.[17]

Average pain over the first 3 days after surgery was assessed using a 0-10 Pain Numerical Rating Scale (PNRS), with 0 being no pain at all and 10 being the worst pain imaginable. The PNRS is frequently used and a well-validated measure of pain intensity in the clinical setting.[18] A score of ≥ 5 on PNRS was accepted as a possible risk factor.[9] The present study defines a risk factor as a factor contributing to a likely association of the onset of CRPS. This association is not necessarily causal.[12]

When a patient's symptom or signs were indicative of CRPS in the outpatient clinic controls that patient was sent to a Physical Medicine and Rehabilitation specialist (S.S.) who was unaware of the results of the baseline assessments for the final diagnosis. A diagnosis of CRPS was made using the proposed clinical diagnostic criteria (for research purpose) modified from Harden et al[19] (Table 1). The duration (in days) between the surgery and the date of CRPS diagnosis was noted. The patients were divided into 2 groups: those diagnosed with CRPS and those without CRPS.

Statistical analysis

Descriptive statistics (arithmetic means ± standard deviation, frequency) were used to summarize the demographic and injury-related features of the cohort. The normality of distribution for continuous variables was tested by using the Kolmogorov-Smirnov test. All independent variables were evaluated using a chi-square test under nonparametric conditions. The difference between numerical variables (mean ± standard deviation) was tested using a t test. A P value of less than .05 was considered statistically significant. Then, statistically significant variables were introduced into a multivariate logistic regression analysis using the "enter" method to identify the independent predictors of CRPS and calculate sex-adjusted odds ratios (ORs). The independent variables introduced into the multivariate model were sex, a pain score ≥ 5 on PNRS and crush injury.

Results

A total of 291 patients were enrolled in this study. Thirty-one patients were excluded because they were not available for follow-up examinations, and 260 patients completed the study.

Table 1
Proposed clinical diagnostic criteria for CRPS (modified from Harden et al[19])

1. Continuing pain, which is disproportionate to any inciting event
2. Must report at least one symptom in all four 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 one 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 temperature sensation and/or deep somatic pressure and/or joint movement)
   - Vasomotor: evidence of temperature asymmetry (>1°C) 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

For research purposes, diagnostic decision rule should be at least one symptom in all 4 symptom categories and at least 1 sign observed at evaluation in 2 or more sign categories.