Evaluation of Cold Sensitivity, Pain, and Quality of Life After Upper Extremity Nerve Injury

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Abstract

Background: The purpose of this study was to evaluate the relationship between reported cold sensitivity, pain, and impact on quality of life (QoL) after upper extremity nerve injury. **Methods:** This cross-sectional study included adults more than 6 months after an upper extremity nerve injury. Assessment included the Pain Evaluation Questionnaire (pain descriptors, questionnaire, pain intensity, impact on QoL), and Cold Intolerance Severity Scale (CISS). Statistical analyses evaluated the relationships between the Pain Evaluation Questionnaire, CISS, and independent variables. **Results:** There were 70 patients (mean age 42 ± 16 years). There were high levels of pain, cold sensitivity, and impact on QoL reported. Patients selecting the adjective “coldness” had significantly higher CISS scores ($P = .005$), pain intensity ($P = .008$), and impact on QoL ($P < .006$). Impact on QoL and CISS ($r = .35$) were moderately correlated. There were significant correlations ($P < .01$) between the level of cold-induced pain and CISS ($r = .78$), overall pain intensity ($r = .58$), pain descriptor score ($r = .49$), and impact on QoL ($r = .32$). **Conclusions:** Cold-induced pain is associated with higher cold sensitivity scores and greater impact on QoL. Reporting a single descriptor “coldness” and ranking cold-induced symptoms were strongly associated with higher cold sensitivity scores and impact on health-related QoL. This may have important implications for quick screening to identify patients with cold sensitivity, and future studies in larger patient samples are necessary to provide additional evidence.

Keywords: cold sensitivity, pain, quality of life, evaluation

Introduction

Severe symptoms of cold sensitivity and pain have been reported following upper extremity trauma and negatively affect outcome and health-related quality of life (QoL).^{3,5-8,10,14-16} The assessment of cold sensitivity has included objective measures such as skin temperature and rewarming patterns and self-report questionnaires.^{2,10,11,17-19,21} These evaluation methods have illustrated a wide range of responses that occur with cold provocation and cold sensitivity after upper extremity trauma. The self-report symptoms associated with cold sensitivity range in the degree of severity and in the qualitative description from increased pain intensity to alteration in sensation of coldness. Neuropathic pain following traumatic injury and cold-induced pain have been associated with increased upper extremity disability.^{14,15}

The purpose of this study was to evaluate the relationship between self-reported cold sensitivity, pain, and impact on QoL after upper extremity nerve injury. We hypothesized that in patients with long-standing nerve injury, (1) higher levels of cold sensitivity and pain would

be associated with a higher impact on QoL, and (2) patients who selected a single descriptor of “coldness” would have more severe pain, higher cold sensitivity scores, and higher impact on QoL.

Methods

This cross-sectional retrospective study included adult patients more than 6 months after an upper extremity nerve injury. Patients were excluded if one or more questionnaires were not completed by the patient at the initial consultation appointment. Standard assessment included completion of a Pain Evaluation Questionnaire and the Cold Intolerance Severity Scale (CISS). Demographic data (age, sex, nerve

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injured, time from injury) were recorded. Institutional Ethics Board approval was obtained for this study.

Pain Evaluation Questionnaire

The Pain Evaluation Questionnaire consists of 4 sections: 20 pain descriptors, 21 items in a questionnaire, and 6 visual analog scales (VASs).¹³ Patients were asked to select the words that describe their symptoms and the total number selected was scored (range 0-20). Each item in the questionnaire was scored and summated to calculate the score (scale 0-70). Each VAS was measured from the 100-mm VAS line and pain intensity (average level), stress and coping (at home and at work), and impact on QoL (range 0-100) were assessed. For pain intensity, QoL, and stress and coping scales, a higher value indicated a more severe pain, higher impact on QoL, more stress, and less coping.

Cold Intolerance Severity Scale

The CISS was used to assess cold sensitivity.^{1,10,20} This questionnaire assesses the severity, frequency, and impact of cold sensitivity. Each item is scored and a total score is calculated (range 0-100). Higher scores indicate more severe cold sensitivity. In cases of missing data items, linear trend regression analysis was used to impute the missing score for each individual item.¹²

Statistical Analyses

Data were summarized with means and standard deviations for the continuous variables and frequencies for the categorical variables. Correlation coefficients were used to evaluate the relationships between the components of the Pain Evaluation Questionnaire and the CISS and level of cold-induced pain. Unpaired *t* tests were used to evaluate the relationships between patients who chose the pain descriptor “coldness” compared with those who did not and the impact on QoL, CISS, and pain.

Results

There were 70 patients (25 women, 45 men) with a mean age 42 ± 16 years. The median time since injury was 14 months (range 6-167 months). The nerves injured included brachial plexus ($n = 35$), radial ($n = 14$), median ($n = 8$), ulnar ($n = 7$), digital ($n = 1$), and combined median/ulnar ($n = 4$) and median/radial ($n = 1$).

There were high levels of pain, cold sensitivity, and impact on QoL reported (Table 1). In the Pain Evaluation Questionnaire, 24 patients selected the adjective “coldness” from the list of pain descriptors. Patients who selected

Table 1. Overall Mean Scores for Questionnaires.

	Mean $\pm$ SD	Total score range
Pain Evaluation Questionnaire	16 ± 4.2	0-70
Pain descriptors	5.0 ± 3.5	0-20
Impact on quality of life	6.8 ± 3.0	0-10
Pain intensity	4.2 ± 2.8	0-10
Stress		
At home	5.2 ± 3.0	0-10
At work	4.6 ± 3.2	
Coping		
At home	3.0 ± 2.2	0-10
At work	2.9 ± 2.6	
Cold Intolerance Severity Scale	34.2 ± 24.6	0-100

“coldness” had significantly higher CISS scores ($P < .005$), average level of pain intensity ($P = .008$), and reported a higher impact on QoL ($P = .006$) compared with those who did not select “coldness” (Figure 1). There were significant correlations ($P < .01$) between impact on QoL and CISS scores ($r = .35$) and age ($r = .34$).

Each patient ranked pain with cold exposure on a scale from 0 to 10 and the mean value was 3.5 ± 3.48 . The level of pain with cold exposure was significantly correlated ($P < 0.01$) with CISS score ($r = .78$), average pain intensity ($r = .58$), pain descriptor score ($r = .49$), and impact on QoL ($r = .32$).

Discussion

Cold-induced symptoms after nerve injury are associated with a negative impact on QoL. In our study of patients with peripheral and brachial plexus nerve injuries, there were high levels of cold-induced symptoms, and reporting a single pain descriptor of “coldness” was associated with more severe cold sensitivity, higher pain intensity, and greater impact on QoL.

Complex assessment measures that evaluate physical impairments, self-report symptoms, and disability can present challenges to the patient and examiner. Previous studies have described valid and reliable methods to assess cold sensitivity from an impairment perspective and from the perception of the patient.^{3,4,9-11,20-22} Cold water assessment of patients with no history of trauma or cold sensitivity found no correlation between self-report measures and skin temperature recovery.²¹ The lack of correlation may indicate that these measures assess different constructs related to cold sensitivity. This may reflect the complexity of cold sensitivity and emphasizes the importance of assessing physical impairment related to skin temperature and self-report to assess how these physical impairments affect function and participation.

Figure 1. Bivariate analyses between “coldness” selected as a pain adjective and quality of life, pain, and cold sensitivity. Selection of the pain adjective “coldness” was associated with a significantly higher impact on QoL, CISS scores, average level of pain intensity, and pain with cold exposure.

* $P < .05$.

Standardized questionnaires utilize items selected by the developers to provide the opportunity to use composite scores to assess a single construct. The standardization of items allows for valid comparisons between individuals. However, depending on the complexity of the questionnaire and construct being measured, these questionnaires can impose a substantial burden to the patient to complete the questionnaire and to the examiner to calculate the score. Also, standardized items and questionnaires may not capture the components and symptoms that were relevant to all patients and may not be of equal importance to all individuals.

The study limitations include a select group of patients who sustained an upper extremity traumatic nerve injury and did not have complete recovery. The patients in this study represent a variety of nerve injuries, range of duration, and assessments at various climate times of the year that may be important factors related to cold sensitivity. However, the small sample size in each group did not provide sufficient power to perform the subanalyses. This study evaluated self-reported data and did not include specific measures of physical impairment and motor or sensory recovery that may be associated with persistent cold-induced symptoms and these comparisons require further investigation.

This study highlights the high levels of cold sensitivity in patients with nerve injury and the negative impact that these symptoms have on health-related QoL. Reporting a single descriptor “coldness” and ranking cold-induced symptoms were strongly associated with higher cold sensitivity scores and impact on health-related QoL. This may have important implications for quick screening to identify patients with cold sensitivity, and future studies in larger patient samples are necessary to provide additional evidence.

Ethical Approval

This study was approved by our institutional Research Ethics Board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from all patients for being in the study.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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