

RESEARCH PAPER

## Perceived spasticity in chronic spinal cord injured patients: Associations with psychological factors

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### Abstract

**Purpose.** To explore the association between perceived spasticity and psychological factors (pain sensations, coping strategies, and illness cognitions) in chronic spinal cord injured (SCI) patients.

**Methods.** Cross-sectional study using a set of questionnaires was designed for chronic complete patients with SCI and with self-reported leg spasticity. Outcome measures were Visual Analogue Scale for average perceived leg spasticity (VAS<sub>Spasticity</sub>), VAS<sub>Pain</sub> for average perceived pain sensations in the leg, Utrecht Coping List (UCL) including its seven subscales, and Illness Cognition Questionnaire (ICQ) with its three subscales. Psychological factors with a bivariate correlation with VAS<sub>Spasticity</sub> of  $p < 0.2$  were selected for regression analyses.

**Results.** Nineteen patients with SCI (response rate 86%) participated. Bivariate correlations of  $p < 0.2$  were found between VAS<sub>Spasticity</sub> and VAS<sub>Pain</sub>, UCL<sub>Active approach</sub>, UCL<sub>Seeking social support</sub>, UCL<sub>Reassuring thoughts</sub>, ICQ<sub>Acceptation</sub>, and ICQ<sub>Helplessness</sub>. Only UCL<sub>Reassuring thoughts</sub> (Beta  $-0.59$ ,  $p = 0.01$ ) and ICQ<sub>Helplessness</sub> (Beta  $0.50$ ,  $p = 0.02$ ) were retained in the multivariate model, explaining 44% of the variance in VAS<sub>Spasticity</sub> ( $R^2$  adjusted).

**Conclusions.** Perceived spasticity appeared associated with psychological factors in complete patients with SCI: Those with higher levels of reassuring thoughts and lower levels of helplessness reported relatively lower levels of perceived spasticity. Large prospective cohort studies are recommended.

**Keywords:** Spinal cord injury, spasticity, helplessness, reassuring thoughts

### Introduction

Each year, about 11–83 new cases of spinal cord injury (SCI) per million inhabitants are registered worldwide [1], most often caused by traffic-, sports-, or work-related accidents. The direct consequences of SCI, e.g. loss of motor and/or sensory function below the level of lesion, make the impact of the injury on an individuals' life dramatic. At some time after the lesion, usually in the subacute phase, a large number of the patients with SCI develop spasticity [2]: Among patients with cervical and thoracic SCI

(ASIA Impairment Scale A) 93% and 72% report leg spasticity, respectively [3]. Spasticity can be defined as a sensori-motor disorder that is characterized by involuntary muscle contractions due to an upper motor neuron lesion (UMNL) [4]. Besides the direct interference of these involuntary muscle contractions and induced movements with activities of daily living, secondary consequences such as joint deformities and pain are common and contribute to disability as well. Therefore, optimal management of spasticity is an important goal in the rehabilitation process of patients with SCI.

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Preliminary results of this study were presented to congress participants at the European Congress on Physical and Rehabilitation Medicine, in Bruges, June 2008.

In clinical practice, the effectiveness of spasticity management is predominantly evaluated subjectively, integrating the opinions of both the clinician and the patient [5,6]. Most often, clinicians use the Ashworth scale to assess spasticity. This ordinal scale grades the level of resistance to passive movement, which is assumed to be the resultant of involuntary muscle activity evoked by passive stretch [7]. The patient, on the other hand, plays an equally important role in clinical practice as he can provide unique information regarding the experience of spasticity and its impact on daily life activities. Historically, the opinion of the patient was inventoried only verbally, but more recently standardized measures such as patient-ratings using the Visual Analogue Scale (VAS) [8–10] have gained popularity. Although this approach likely reflects higher methodological quality than the verbal inventories, further exploration is needed to understand what exactly is being assessed using this approach.

Recent research has shown that patient ratings are only marginally associated with spastic muscle activity in the upper leg [11]. This suggests that the subjective experience of the intensity of spasticity may be affected by other factors than involuntary muscle activity alone. The results of an earlier study by Lechner et al. [9] offered evidence for this notion, by demonstrating that patient ratings do not strongly correspond to ratings performed by clinicians. The authors concluded that other factors, in particular perceived pain sensations, are relevant for the perception of spasticity by the patient as well. Pain sensations are common in SCI, with prevalence rates of about 70–80% [12]. Pain and spasticity are often present simultaneously in a patient, and because spasticity can be evoked by sensory/noxious stimuli, a direct association between pain and spasticity can be hypothesized.

Besides pain sensations, Lechner et al. [9] and Mahoney et al. [13] suggested that other psychological factors may affect the level of spasticity experienced by the patient. Because spasticity is a challenging condition interfering in a subjects' life, it can be hypothesized that the way people think about spasticity (illness cognitions) and how they deal with it (coping strategies) interferes with the perception of the patient on spasticity intensity. Indeed, Wollaars et al. [14] demonstrated that coping strategies and illness cognitions play an important role in SCI, but the direct association with spasticity was not explored.

Hence, the results of several studies suggested an association between spasticity experienced by patients with SCI and psychological factors such as pain, coping strategies, and illness cognitions, but so far no studies have been conducted to objectify these associations. For this purpose, the

current, cross-sectional study was designed. Although this design does not justify conclusions with regard to causality, the results will contribute to our knowledge and understanding of factors influencing patients' spasticity experience and may serve as a starting point for further prognostic studies and, eventually, translation of new knowledge into treatment programs for patients with spasticity.

## Materials and methods

### *Study design and patients*

For this cross-sectional study, patients with SCI were recruited from an in- and outpatient department of a local rehabilitation center. Inclusion criteria were:

- Diagnosis motor complete SCI (ASIA grade A or B), with an Injury level or zone of partial preservation of Th12 or higher, to ensure that no voluntary contractibility of the leg muscles was present.
- Presence of leg spasticity, verified by simply asking patients whether or not they suffered from leg spasticity.
- Stable medical condition, at least 6 months after injury.
- Sufficient hand function to be able to independently handle a pencil to complete a set of questionnaires.

We approached potential participants that were included (or approached for inclusion) in a larger project on the development of a long-term monitoring tool for objective assessment of spasticity during the activities of daily living. This project was approved by the local Medical Ethics Committee and all patients signed written informed consent prior to participation.

### *Protocol*

Patients were approached by telephone and selected according to the inclusion criteria. Patients who satisfied the criteria were sent a set of questionnaires by ordinary mail, which could be returned in an enclosed pre-stamped envelope. The set of questionnaires consisted of a measure for perceived spasticity and measures for the potentially associated psychological factors pain sensations, coping strategies, and illness cognitions.

*Spasticity.* Patients rated their average level of leg spasticity using a 100 mm VAS<sub>Spasticity</sub> [10].

**Pain.** Average perceived pain sensation in the legs was scored with a 100 mm VAS (VAS<sub>Pain</sub>).

**Coping strategies.** Coping strategies were measured with the Utrecht Coping List (UCL) [15], which characterizes behavior when confronted with problems or events requiring adaptation, such as spasticity. The UCL has seven subscales, together comprising 44 items: i.e. 'active approach' (seven items), 'palliative response' (eight items), 'avoidance' (eight items), 'seeking social support' (six items), 'passive response pattern' (seven items), 'expression of emotions' (three items), and 'reassuring thoughts' (five items). Answers are given on an ordinal scale ranging from 1 (never) to 4 (very often), and, for each of the subscales scores, 5-point norm values are available. These norm scores classify the score of the patient on that particular subscale as being 'very high', 'high', 'average', 'low', or 'very low', compared with a healthy control population stratified for gender and age. The validity of the UCL has been shown in a large sample of non-disabled subjects [15]. Cronbach's alpha in the current SCI population appeared high for the subscales 'passive response pattern' (0.75), 'seeking social support' (0.86), and 'active approach' (0.90), and moderate for the other subscales (0.51–0.66).

**Cognitions.** Cognitions with regard to spasticity were measured with the 18-item Illness Cognition Questionnaire (ICQ) [16] which consists of the subscales 'helplessness', 'acceptation', and 'disease benefit', each comprising of six items. Answers are scored on a 4-points Likert scale (do not agree – strongly agree), which means that the maximum score is 24 and the minimum is 6. Analogous to Wollaars et al. [14], the wording of the questions was slightly adapted to refer to, in this case, spasticity after SCI. The ICQ has previously been used in patients with SCI [14] and appeared reliable and valid in another group of patients with UMNL, i.e. Multiple Sclerosis [16]. Cronbach's alpha in the current SCI population was sufficient to high (0.72–0.90).

#### Statistical analysis

Descriptive statistics were used for calculating and presenting average group scores on spasticity, pain, coping, and cognitions. For the UCL, individual scores were also categorized according to the norm score of a non-disabled, healthy population stratified for age and gender: Very low ( $\leq 5$ th percentile), low (5th percentile < score < 20th percentile), average (20th < score < 80th percentile), high (80th percentile < score < 95th percentile), and very high ( $\geq 95$ th percentile) [15].

First, Spearman correlations were calculated between the dependent variable VAS<sub>Spasticity</sub>, and the independent variables VAS<sub>Pain</sub>, and UCL and ICQ subscales. Based on the results only associated variables ( $p < 0.2$ ) were selected for subsequent multivariate linear regression. Stepwise backward elimination was used, leaving only variables with a  $p$ -value of  $\leq 0.05$  in the final exploratory model. It was also investigated whether correction for potential confounding, sociodemographic variables was needed (gender, time since lesion, ASIA score, and level of injury). Regression coefficients were presented together with the  $R^2_{\text{adjusted}}$  for the percentage of explained variance. Analysis was performed with SPSS 11.5 and alpha was set at 0.05 for statistical significance.

## Results

**Patients.** Twenty-six patients were approached for participation by telephone; 22 fulfilled the inclusion criteria and expressed their willingness to participate. The response rate was 86% ( $n = 19$ ) (see Table I).

#### Questionnaires

Mean VAS<sub>Spasticity</sub> was 44.6 (sd 18.2, range 20–80); the median VAS<sub>Pain</sub> was 36, ranging between 0 and 70. All but four patients reported pain (79%).

Median (and range) values on each UCL scale, including classifications according to norm scores when compared with a healthy population, are presented in Table II. Patients were most often classified as being 'average'. For 'active approach' a 'high' classification was most common, which means that in this SCI population an active coping strategy was more prevalent compared with the healthy norm population. Patients scored mostly high on the passive coping strategies 'palliative reaction' and 'avoidance' compared with a healthy population.

Most patients reported average scores for the ICQ subscales 'helplessness' (median 8; range, 6–15) and 'disease benefits' (9; range, 6–19). Mostly, high

Table I. Sociodemographic characteristics.

<i>n</i>	19
Age (median and range in years)	41.2 (25.7–62.6)
Gender (m/f)	15/4
Time since lesion (median and range)	115 (6–299)
ASIA Impairment Scale (A/B)	17/2
SCI motor level (C/Th)	10/9*

\*For C3, C4, Th4, Th6, Th7, and Th9  $n = 1$ ; for C5 and Th8  $n = 2$ ; for Th3  $n = 3$ ; for C6  $n = 6$ .

scores were found for the subscale 'acceptance' (20; range, 8–24).

### Associations

Among the independent variables pain, coping, and cognitions, six bivariate associations with  $VAS_{Spasticity}$  were found ( $p < 0.2$ ) (see Table III).

These bivariate correlations indicate a moderate (0.36–0.53) association between  $VAS_{Spasticity}$  on the one hand, and  $VAS_{Pain}$ , the subscales of the ICQ 'helplessness' and 'acceptation' and the UCL subscales 'reassuring thoughts', 'active approach', and 'seeking social support' on the other hand. Higher levels of perceived pain sensation and feelings of helplessness were associated with higher levels of spasticity, whereas 'acceptance', 'reassuring thoughts', 'active approach', and 'seeking social support' went along with lower levels of experienced spasticity.

Multivariate linear regression resulted in the inclusion of two factors in the final model: 'Helplessness' and 'reassuring thoughts'. Sociodemographic variables appeared non-significant confounders and were left out of the final model. The level of explained variance ( $R^2$ ) was 0.51; this value was 0.44 when corrected for the number of variables included in the model, also accounting for the relatively small sample size ( $R^2_{adjusted}$ ) (see also Table IV).

### Discussion

This is the first study that shows that the level of spasticity as reported by motor complete spinal cord injured patients is significantly associated with the patients' psychological characteristics. Especially, 'helplessness' and 'reassuring thoughts' were strongly associated with perceived spasticity, suggesting that patients who have high levels of helplessness and who are not able to reassure themselves, experience relatively high levels of spasticity.

Helplessness ('there is nothing I can do in this situation') is an important construct in psychology, and indicates that a person feels an inability to control a particular situation. Translating this construct to this study, it suggests that patients with SCI and with high levels of helplessness may feel unable to control spasticity, or that spasticity makes them feel out of control. Hancock et al. [17] showed that patients with SCI experience higher levels of helplessness compared with a healthy control population. Helplessness is associated with e.g. depression, external locus of control, passivity, and with a lower level of perceived health. Wollaars et al. [14] showed a negative association between helplessness and well-being in patients with SCI and a positive association with depression. Depression occurs in 24–26% of the patients with SCI [18] and some authors have suggested that it results, among other things, from dealing with spasticity [19]. This association would be of interest to explore in future research.

Table II. Median (range) UCL subscale values and percentage norm scores.

	Median (range)	Very high (%)	High (%)	Average (%)	Low (%)	Very low (%)
Active approach	21 (13–26)	27	33	27	13	0
Palliative reaction	19 (13–24)	7	40	53	0	0
Avoidance	15 (12–24)	12	6	82	0	0
Seeking social support	13 (6–18)	12	18	53	6	12
Passive reaction	10 (7–18)	18	24	35	24	0
Expression of emotions	6 (3–9)	6	12	59	8	12
Reassuring thoughts	11 (7–17)	6	24	41	24	6

Grey cells highlight largest percentage of subjects classified in this norm class.

Table III. Bivariate Spearman correlation coefficients between patient-rated spasticity and psychosocial factors ( $p < 0.2$ ).

	$VAS_{Spast}$	$VAS_{Pain}$	$ICQ_{Helplessness}$	$ICQ_{Acceptation}$	$UCL_{Active\ approach}$	$UCL_{Seeking\ social\ support}$
$VAS_{Pain}$	0.42*					
$ICQ_{Helplessness}$	0.53†	0.12				
$ICQ_{Acceptation}$	–0.40‡	–0.60†	–0.08			
$UCL_{Active\ approach}$	–0.36‡	–0.42‡		0.71†		
$UCL_{Seeking\ social\ support}$	–0.38‡	–0.34‡	–0.15	0.27	0.38‡	
$UCL_{Reassuring\ thoughts}$	–0.50†	–0.50†	0.07	0.62†	0.64†	0.39‡

No symbol:  $p > 0.20$ .

\* $0.05 \leq p \leq 0.10$ .

† $p \leq 0.05$ .

‡ $0.10 \leq p \leq 0.20$ .

Table IV. Final multivariate regression model.

	Unstand. coefficients		Stand. coefficients		Sig.	95% confidence interval for B	
	B	Std. error	Beta	t		Lower bound	Upper bound
(Constant)	58.37	18.33		3.19	0.01	19.07	97.68
ICQ <sub>Helplessness</sub>	3.81	1.44	0.50	2.64	0.02	0.72	6.89
UCL <sub>Reassuring thoughts</sub>	-3.90	1.25	-0.59	-3.11	0.01	-6.58	-1.21

Having 'reassuring thoughts' ('everything will be ok') was associated with lower levels of spasticity, which suggests that either patients reduce their level of experienced spasticity by applying this coping strategy, or that with lower levels of spasticity it is easier to have reassuring thoughts. The concept of 'reassuring thoughts' is rather well defined by Schreurs et al. [15], but little is written in the medical literature about it. The construct might to some extent be a counterpart of the construct of catastrophizing, which can be described as the tendency to magnify and ruminate about sensations. Catastrophizing has shown to be a relevant determinant of perceived pain and psychosocial functioning in many different patient groups, including patients with SCI [20].

Despite a relevant bivariate association with perceived spasticity, pain, coping strategies 'active approach' and 'seeking social support', and illness cognition 'acceptation', were not retained in the multivariate model. This does not necessarily mean that these variables are not relevant: It is likely that a complex inter-relation exists between these variables and perceived spasticity. This can be illustrated by the fact that a rather strong bivariate relation was observed between spasticity and pain, as well as between pain and 'reassuring thoughts', whereas only 'reassuring thoughts' remained in the multivariate model. An additional complexity is the potentially multidimensional nature of pain, comprising psychological, and pathophysiological components. Further work on this is required.

'Helplessness' and 'reassuring thoughts' together explained 44% of the variance in perceived spasticity. In contrast, another study, in which 14 of the 19 participants of this study participated, showed that spastic muscle activity explained significantly less variance in perceived spasticity [11]. This might suggest that psychological factors are more relevant for the perception of spasticity than spastic muscle activity. However, the two different outcome measures (muscle activity and psychological factors) were not simultaneously obtained and patient populations were not completely identical. Therefore, we need to be careful when interpreting these findings.

This study does not provide any evidence with regard to causality in the relation between perceived

spasticity and psychological characteristics. For this purpose a prospective study should be performed with a larger sample, including, besides the coping strategies and illness cognitions that appeared relevant in this study, also other psychological constructs that are potentially relevant like catastrophizing and depression. It is strongly recommended to either validate or develop validated measures for the SCI population to be used in such a study, as this would strengthen the findings and corresponding conclusions. Simultaneous inclusion of the assessment of spastic muscle activity would offer valuable information and enlarge our understanding of the perception of spasticity in patients with complete SCI.

## Conclusions

This study shows that in patients with chronic SCI perceived spasticity is related to psychological factors. Larger prospective studies are required to expand our knowledge by studying causality and to further explore associations between spasticity on the one hand and psychological factors, such as catastrophizing and depression, as well as spastic muscle activity, on the other hand. When psychological characteristics indeed appear determinants of perceived spasticity, this will have important implications for spasticity management. Within this context, we should be aware of the potentially different effect of spasticity on function in different patients: Although it has a negative annotation in a significant subset of patients, other patients, on the contrary, may benefit from spasticity when it facilitates the performance of some activities of daily living. Herewith, the manifestation of spasticity plays an important role and should also be taken into account when making decisions regarding treatment.

## Clinical messages

- Experienced spasticity in chronic spinal cord injured patients is associated with psychological patient characteristics.

- Chronic spinal cord injured patients reporting higher levels of experienced spasticity were prone to display higher levels of helplessness.
- High levels of coping strategy 'reassuring thoughts' appeared associated with reduced spasticity levels.
- Causality of these findings needs to be evaluated in large prospective trials.

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