Cross-Sectional Study

Widespread Pressure Pain Hyperalgesia in Chronic Nonspecific Neck Pain with Neuropathic Features: A Descriptive Cross-Sectional Study

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Background: Neck pain has an elevated prevalence worldwide. Most people with neck pain are diagnosed as nonspecific neck pain patients. Poor recovery in neck disorders, as well as high levels of pain and disability, are associated with widespread sensory hypersensitivity. Nevertheless, there is controversy regarding the presence of widespread hyperalgesia in chronic nonspecific neck pain (CNSNP); this lack of agreement could be due to the presence of different pathophysiological mechanisms in CNSNP.

Objectives: To determinate differences in pressure pain thresholds (PPTs) over extracervical and cervical regions, and differences in cervical range of motion (ROM) between patients with CNSNP with and without neuropathic features (NF and No-NF, respectively). In addition, this study expected to observe correlations in these 2 types of CNSNP of psychosocial factors with PPTs and with cervical ROM separately.

Study Design: Descriptive, cross-sectional study.

Setting: A hospital physiotherapy outpatient department.

Methods: This research involved 53 patients with CNSNP that had obtained a Self-completed Leeds Assessment of Neuropathic Symptoms and Signs pain scale (S-LANSS) score ≥ 12 (pain with NF, NF group); 54 that had obtained a S-LANSS score < 12 (pain with No-NF, No-NF group), and 53 healthy controls (control group, CG). Measures included: PPTs (suboccipital muscle, upper fibers trapezius muscle, lateral epicondyle, and anterior tibial muscle), cervical ROM (flexion, extension, rotation, and latero-flexion), pain intensity (Visual Analog Scale [VAS]), neck disability index (NDI), kinesiophobia (Tampa Scale of Kinesiophobia-11 [TSK-11]), and Pain Catastrophizing Scale (PCS).

Results: A statistically significant effect was observed for the group factor in all assessed measures ($P < 0.01$). Both CNSNP groups showed statistically significant differences compared to the CG for PPTs in the cervical region (suboccipital and upper fibers trapezius muscles), but only the NF group demonstrated statistically significant differences for PPTs in the lateral epincondyle and anterior tibial muscle when compared to the CG or No-NF group. The largest statistically significant correlation found in the NF group was between PPT in the anterior tibial muscle and TSK-11 ($r = -0.372$; $P < 0.01$), while in the No-NF group it was between PPT in the suboccipital muscle and NDI ($r = -0.288$; $P < 0.05$). Statistically significant differences were found between the 2 CNSNP groups and CG in all cervical ROMs, but not between both CNSNP groups. The largest statistically significant correlation observed in the NF group was between cervical total rotation and TSK-11 ($r = -0.473$; $P < 0.01$), while in the No-NF group it was between cervical total latero-flexion and PCS ($r = -0.532$; $P < 0.01$).

Limitations: Although the S-LANSS scale has been validated as a screening tool for pain with NF, currently there is no "gold standard," so these findings should be interpreted with caution.

Conclusions: Widespread pressure pain hyperalgesia was detected in patients with CNSNP with NF, but not in patients with CNSNP with No-NF. Patients with CNSNP presented bilateral pressure pain hyperalgesia over the cervical region and a decreased cervical ROM compared to healthy controls. However, no differences were found between the 2 CNSNP groups. These findings suggest differences in the mechanism of pain processing between patients with CNSNP with NF and No-NF.

Key words: Neck pain, chronic pain, neuropathic pain, pain threshold, mechanical hyperalgesia, range of motion, pain catastrophizing

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Neck pain is a common musculoskeletal disorder (1-3) and one of the most common disabilities that causes elevated economic consequences (primary care, absenteeism from work, and labor productivity decrease) (4-7). This condition has an elevated prevalence worldwide, especially in North America and Western Europe (8). Neck pain usually becomes chronic in middle-aged women (8-10). Most people with neck pain are diagnosed as nonspecific neck pain patients, owing to the complicated identification of pain causes (2,11).

Poor recovery in musculoskeletal pain (especially in neck disorders), as well as high levels of pain and disability, are associated with widespread sensory hypersensitivity (12-16). Research shows, through pain threshold assessment, the presence of widespread hyperalgesia in patients with chronic whiplash-associated disorders (13,16-19).

Additional studies report central hypersensitivity in chronic musculoskeletal pain patients (12) such as primary headache (20-22), fibromyalgia (23,24), cervical radiculophaty (25), lateral epicondylitis (26), and carpal tunnel syndrome (27,28) (most patients with carpal tunnel syndrome also suffered from neck pain, because of its influence in central hypersensitivity) (29). Nevertheless, there is controversy regarding the presence of widespread hyperalgesia in chronic nonspecific neck pain (CNSNP), since some studies support it (30,31) but others found only a peripheral sensitization (18,32,33); this lack of agreement could be due to the presence of different pathophysiological mechanisms in CNSNP. In addition, most of the musculoskeletal pain conditions with widespread hyperalgesia listed above have neuropathic signs and/or symptoms (17,25-28,34,35). Hence, the authors classify CNSNP as dependent on the presence of pain with or without neuropathic features (NF or No-NF, respectively), using the Self-report version of the Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS) pain scale, which could clarify the discussion about CNSNP physiopathology.

On the other hand, psychological factors are associated with poor outcomes in neck pain and neck pain becoming chronic (36-40); among these psychological factors is kinesiophobia, whose increase is associated with a decreased cervical range of motion (ROM) (41). Hence, it would be expected that chronic neck pain conditions with associated psychological factors have limited cervical movement, which is largely supported by the literature (19,42-47). In addition, pain intensity and disability are also correlated with a reduced cervical ROM (41,48-50). Keeping in mind that neuropathic pain usually has a greater intensity and disability than nociceptive pain (51-53), the authors hypothesize that patients with CNSNP with NF could have a reduced cervical ROM compared to patients with No-NF.

Thus, the aim of our study was to evaluate differences in pressure pain thresholds (PPTs) over extracervical and cervical regions, and differences in cervical ROM between patients with CNSNP with NF and No-NF. In addition, this study expected to observe correlations in these 2 types of CNSNP of psychosocial factors with PPTs and with cervical ROM separately.

Methods

Study Design

A cross-sectional study design was used to assess the differences in the motion and somatosensory clinical characteristics of patients with CNSNP with NF compared to patients with CNSNP with No-NF. In addition, a third group of asymptomatic controls was used as the control group (CG). The trial was conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (54). The ethics committee of the University Hospital La Paz (Madrid, Spaingave approval to conduct this study.

Raters

Five blinded examiners with over 5 years of experience in manual therapy were responsible for measuring the variables included in the study. Previous to the start of the study, the raters were trained on how to measure the cervical ROM and the PPTs. In this training session, they were trained in handling the instruments used to perform the measurements and were taught specific protocols in order to minimize measurement errors and intra- and inter-rater variability. The protocols used are described in more detail in the Outcome Measures section. The examiners did not speak with the participants about their condition. An independent investigator administered the S-LANSS in a separate room; next, the blinded examiners measured the remaining variables, starting with the self-reported measures and then evaluation of cervical ROM and PPTs.

Participants

Patients with CNSNP were recruited from the physiotherapy outpatient department of University Hospital La Paz (Madrid, Spain by referral. Healthy controls were recruited from print advertisements placed in the hospital.

Inclusion Criteria

Patients were selected from individuals aged 18 – 65 years with head and/or neck pain for at least 3 months and the ability to read and speak Spanish. Patients who obtained a S-LANSS score ≥ 12 were included in the NF group, while those with a S-LANSS score < 12 were included in the No-NF group. Healthy controls were between 18 – 65 years old and no had previous history of cervical, upper limb, orofacial, or upper thoracic pain in the previous 12 months.

Exclusion Criteria

Patients were also excluded if they presented the following exclusion criteria: rheumatologic diseases, any type of cancer, fibromyalgia, central or peripheral neurological dysfunction, cervical surgery in the past, cervical radiculopathy, myelopathy, whiplash trauma, or pregnancy. Healthy controls were also excluded on these general health status criteria. In addition, all participants were excluded if they had received some type of pain treatment, including medication and physical therapy, during the last 3 months.

All participants were unpaid volunteers and, after checking that they each met the inclusion/exclusion criteria, they provided informed consent.

Outcome Measures

Pressure Pain Threshold

The PPT is defined as the amount of pressure at which the sense of pressure first changes to pain (55). A digital algometer (FDX 25, Wagner Instruments, Greenwich, CT, USA) was used to measure PPTs. Thresholds were expressed in kg/cm2. PPTs were assessed bilaterally over the following anatomical landmarks and in this order: 1) suboccipital muscle, 2) upper fibers trapezius muscle (midway between C7 and the acromion), 3) lateral epicondyle, and 4) anterior tibial muscle (upper third of the muscle belly). All these anatomical landmarks were used previously by other researchers (18,30-33,56-58). Measurements were first performed on the right side and then on the left side. Triplicate recording, with an interval of 30 seconds between them, were performed at each site. The inter-rater reliability of pressure algometry is good [intraclass correlation coefficient (ICC) = 0.79 – 0.90] in patients with and without neck pain when the raters have been trained previously (59). In addition, PPT may have prognostic utility, especially in the case of widespread hyperalgesia (15,60).

Cervical Range of Motion

The CROM device (Performance Attainment Associates, Lindstrom, MN), used to measure the active cervical ROM, consisted of 3 inclinometers (one for each plane of motion) attached to a plastic frame. A standardized protocol was used in order to reduce potential bias (61). Trials were completed in the same order: flexion, extension, right rotation, left rotation, right latero-flexion, and left latero-flexion. Three measurements were performed in each direction with an interval of 30 seconds between each measurement. The CROM has good reliability for patients with and without neck pain (ICC = 0.87 to 0.94 in asymptomatic patients and ICC = 0.88 to 0.96 in neck pain patients) (62).

Self-Reported Measures

Neuropathic Features Pain

The S-LANSS is a validated self-report version of the LANSS and is a reliable instrument for the differential diagnosis of NF (63). It consists of 7 items, 2 of which are self-assessment items. A score ≥ 12 indicates pain with NF.

Pain Intensity

Pain intensity was measured with the Visual Analog Scale (VAS), which consists of a 100 mm line, on which the left side represents "no pain" and the right side "the worst pain imaginable" (64). The VAS is a reliable and valid measure of pain (65,66).

Neck Disability

The Neck Disability Index (NDI), a self-reporting instrument for the assessment of perceived pain and physical disability (67), consists of 10 items which are rated from no disability (0) to total disability (5); thus the total score ranges from 0 to 50. A higher score indicates greater pain and disability. The Spanish version of the NDI has shown good reliability and validity (68).

Kinesiophobia

Pain-related fear of movement was assessed using the 11-item Spanish version of the Tampa Scale of Kinesiophobia (TSK-11), whose reliability and validity have been demonstrated (69). Each item is scored using a 4-point scale (1 = strongly disagree; 4 = strongly agree). The final score can range between 11 and 44 points, with higher scores indicating greater perceived kinesiophobia.

Pain Catastrophizing

The Spanish version of the Pain Catastrophizing Scale (PCS) assesses the degree of pain catastrophizing (70). It is composed of 13 items, which must be answered by a numeric value between 0 (not at all) and 4 (all the time), having a maximum score of 52 points (higher scores indicates more catastrophizing). PCS is a reliable and valid measure of pain catastrophizing (71,72).

Sample Size

The sample size was calculated by G*Power® 3.1.7 software (University of Düsseldorf, Germany) (73). One-way fixed-effects analysis of variance (ANOVA) was used. Furthermore, a statistical power of 80% (1-β error probability) with an α error level probability of 0.05 was chosen to detect between-group differences in the PPTs (primary outcome measure). A medium effect-size of 0.25 was used, which was calculated by performing a pilot study (n = 46). Thus, it was estimated that at least 53 patients would be required for each group (a total of 159 patients).

Statistical Analysis

Statistical analysis was performed using The Statistical Package for Social Sciences (SPSS 21, SPSS Inc., Chicago, IL, USA). No statistically significant differences were found in the group*side interaction for the variables of PPT and cervical ROM (rotation and lateral-flexion), so the values obtained for each side were unified. Thus, the PPT values obtained for each side were unified by calculating the average of measurements on both sides. The scores obtained in the cervical ROM for the right side were added to the left side, so the following variables were created: (1) total rotation and (2) total latero-flexion. Descriptive statistics were used to summarize data for continuous variables and are presented as means ± standard deviation (SD), 95% CI, and categorical as absolute (number) and relative frequency (percentage). A chi-squared test with residual analysis was used to compare categorical variables. For continuous parametric data, one-way ANOVA was used to analyze the group factor (PPT in suboccipital muscle, PPT in upper fibers trapezius muscle, PPT in lateral epicondyle, PPT in anterior tibial muscle, cervical flexion, cervical extension, cervical total rotation, cervical total latero-flexion, VAS, and NDI, TSK-11, and PCS). Post hoc analysis with Bonferroni corrections was performed in the case of significant ANOVA findings for multiple comparisons between variables. The relationship between the self-reported measures with cervical ROM and all PPTs measures were examined separately for each group (No-NF, NF, and CG) using Pearson correlation coefficients. A Pearson correlation coefficient greater than 0.60 indicated a strong correlation, between 0.30 and 0.60 indicated a moderate correlation, and below 0.30 indicated a low or very low correlation (74). For all analyses, statistical significance was set at $P < 0.05$.

Results

A total of 171 patients initially participated in the study, 11 of whom were not included; 5 were excluded for not meeting inclusion criteria, while the remaining 6 decided not to participate in the study. One hundred sixty patients met the inclusion criteria and agreed to enter the study (NF, n = 53; No-NF, n = 54; CG, n = 53). The mean age of the total sample was 44.04 ± 13.73 (mean ± SD) years and most were women (77.5%). In addition, the duration of neck pain reported by the patients was, on average, 89.89 ± 81.22 months (NF: 92.87 ± 76.04 months; No-NF: 86.96 ± 86.62 months). The descriptive characteristics of the participants in each group are shown in Table 1.

Pressure Pain Thresholds

A statistically significant effect was observed for the group factor in PPTs [suboccipital muscle (F = 23.581, $P < 0.001$); upper fibers trapezius muscle (F = 30.173, $P < 0.001$); lateral epicondyle (F = 17.553, $P < 0.001$); anterior tibial muscle (F = 16.742, $P < 0.001$)]. Both CNSNP groups showed statistically significant differences compared to the CG for PPTs in the cervical region (suboccipital and upper fibers trapezius muscles), but only the NF group demonstrated statistically significant differences for PPTs in lateral epincondyle and anterior tibial muscle when compared to the CG. In addition, the NF group showed statistically significant differences compared to the No-NF group for PPTs in lateral epicondyle and anterior tibial muscle but not the cervical region. Post-hoc test results, showing the values as mean ± SD of each group and mean differences (95% CI), are shown in Table 2.

All of the statistically significant correlations observed among PPTs against self-reported measures were negative relationships (Table 3). The largest statistically significant correlation found in the NF group was between PPT in anterior tibial muscle and TSK-11, while in the No-NF group it was between PPT in suboccipital muscle and NDI. No statistically significant correlations were observed in the CG.

Table 1. *Demographic characteristics and neck pain duration of participants. Values are mean ± SD and n (%).*

	NF	No-NF	CG	*P* values
N	53	54	53	
Age years	43.27 ± 14.47	44.56 ± 14.44	44.25 ± 12.43	0.885*
Gender (female)	42 (79.2)	42 (77.8)	40 (75.5)	0,896†
Height (cm)	164.85 ± 8.33	164.31 ± 9.1	167.77 ± 6.79	0.065*
Weight (kg)	65.89 ± 11.44	65.06 ± 12.01	66.06 ± 11.92	0.895*
Neck pain duration				
3 to 12mo	6 (11.3)	11 (20.4)	-	0.362†
13 to 36mo	11 (20.8)	9 (16.7)	-	0.114†
37 and 60mo	5 (9.4)	8 (14.8)	-	0.094†
More than 60mo	31 (58.5)	26 (48.1)	-	0.126†

Abbreviations: NF, Pain with Neuropathic Features; No-NF, Pain without Neuropathic Features; CG, Control Group.
* Independent-samples Analysis of Variance (ANOVA).
† $\chi 2$ tests.

Table 2. *Descriptive data and multiple comparisons for pressure pain thresholds.*

	Mean ± SD			Mean difference (95% CI)
	NF	No-NF	CG	a) NF vs. No-NF b) NF vs. CG c) No-NF vs. CG
Suboccipital	2.04 ± 0.67	2.35 ± 0.68	2.99 ± 0.82	a) -0.31 (-0.64 to 0.03) b) -0.95 (-1.29 to -0.61) † c) -0.64 (-0.98 to -0.3) †
Upper Fibers Trapezius	2.35 ± 0.88	2.72 ± 1.02	3.87 ± 1.24	a) -0.37 (-0.86 to 0.12) b) -1.52 (-2.02 to -1.03) † c) -1.15 (-1.65 to -0.66) †
Lateral Epicondyle	2.59 ± 0.81	3.38 ± 1	3.61 ± 0.98	a) -0.79 (-1.22 to -0.35) † b) -1.02 (-1.46 to -0.59) † c) -0.23 (-0.67 to 0.2)
Anterior Tibial	4.23 ± 1.2	5.8 ± 2.07	6.14 ± 2.03	a) -1.57 (-2.42 to -0.72) † b) -1.91 (-2.76 to -1.06) † c) -0.34 (-1.19 to 0.51)

Abbreviations: NF, Pain with Neuropathic Features; No-NF, Pain without Neuropathic Features; CG, Control Group; CI, Confidence interval.
† $P < 0.01$.

Table 3. *Pearson correlation coefficient between pressure pain thresholds and physical-psychological outcomes in each group.*

Group		Suboccipital	Upper Fibers Trapezius	Lateral Epicondyle	Anterior Tibial
NF	VAS	-0.188	-0.096	0.135	-0.267
No-NF		-0.089	0.067	0.194	0.130
CG		-	-	-	-
NF	NDI	-0.354†	-0.354†	-0.274*	-0.220
No-NF		-0.288*	-0.192	-0.126	-0.045
CG		0.066	0.062	0.055	0.017
NF	TSK-11	-0.104	0.056	-0.147	-0.372†
No-NF		-0.252	-0.089	0.105	-0.013
CG		0.026	-0106	0.014	0.017
NF	PCS	-0.217	-0.235	-0.035	-0.159
No-NF		-0.248	0.120	0.131	0.116
CG		-0.119	-0.133	-0.191	-0.226

Abbreviations: NF, Pain with Neuropathic Features; No-NF, Pain without Neuropathic Features; CG, Control Group; VAS, Visual Analogue Scale; NDI, Neck Disability Index; TSK-11, Tampa Scale of Kinesiophobia-11; PCS, Pain Catastrophizing Scale.
* $P < 0.05$.
† $P < 0.01$.

Cervical Range of Motion

Statistically significant differences were observed between the 3 groups in cervical ROM [flexion (F = 5.691, *P* = 0.004); extension (F = 33.838, *P* < 0.001); total rotation (F = 22.061, *P* < 0.001); total latero-flexion (F = 15.007, *P* < 0.001)]. Statistically significant differences were found between the 2 CNSNP groups and CG in all cervical ROMs, but not between both CNSNP groups. Post-hoc test results, showing the values as mean ± SD of each group and mean differences (95% CI), are shown in Table 4.

Again, all the statistically significant correlations observed for cervical ROM against self-reported measures were negative relationships (Table 5). The largest statistically significant correlation observed in the NF group was between cervical total rotation and TSK-11, while in the No-NF group it was between cervical total latero-flexion and PCS. No statistically significant correlations were found in the CG.

Self-Reported Measures

Again, a statistically significant difference was found for the group factor in the self-reported measures [VAS (F = 504.836, *P* < 0.001); NDI (F = 209.459, *P* < 0.001); TSK-11 (F = 45.944, *P* < 0.001); PCS (F = 36.592, *P* < 0.001)]. Post-hoc testing showed statistically significant differences when both CNSNP groups were compared with the CG for psychological factors and neck disability. In addition, statistically significant differences were found between the NF and No-NF groups for pain intensity and neck disability; however, there were no differences between these groups for psychological factors. Post-hoc test results, showing the values as mean ± SD of each group and mean differences (95% CI), are shown in Table 4.

Table 4. *Descriptive data and multiple comparisons for cervical range of motion, pain intensity, cervical disability, and psychological factors.*

	Mean ± SD			Mean difference (95% CI)
	NF	**No-NF**	**CG**	**a) NF vs. No-NF** **b) NF vs. CG** **c) No-NF vs. CG**
Flexion	51.28 ± 11.62	50.57 ± 8.79	56.4 ± 8.43	a) 0.71 (-3.84 to 5.26) b) -5.11 (-9.68 to -0.55) * c) -5.82 (-10.37 to -1.28) †
Extension	52.54 ± 19.52	57.4 ± 14.26	75.42 ± 9.99	a) -4.86 (-11.92 to 2.2) b) -22.88 (-29.97 to -15.78) † c) -18.02 (-25.08 to -10.96) †
Total Rotation	111.75 ± 24.63	111.73 ± 20.29	134.1 ± 13.68	a) 0.02 (-9.37 to 9.39) b) -22.35 (-31.78 to -12.94) † c) -22.37 (-31.75 to -12.99) †
Total Latero-Flexion	66.54 ± 15	68.84 ± 17.87	80.93 ± 9.4	a) -2.3 (-9.11 to 4.5) b) -14.39 (-21.23 to -7.56) † c) -12.09 (-18.9 to -5.29) †
VAS	61 ± 12.93	53.37 ± 13.42	-	a) 7.63 (2.59 to 12.67) † b) - c) -
NDI	16.7 ± 5.12	12.83 ± 4.91	0.87 ± 1.13	a) 3.87 (1.92 to 5.81) † b) 15.83 (13.88 to 17.78) † c) 11.97 (10.02 to 13.91) †
TSK-11	31.11 ± 6	29.5 ± 7.51	19.77 ± 6.15	a) 1.61 (-1.47 to 4.7) b) 11.34 (8.24 to 14.44) † c) 9.73 (6.64 to 12.81) †
PCS	16.79 ± 9.62	13.69 ± 9.12	4.02 ± 4.11	a) 3.11 (-.65 to 6.86) b) 12.77 (9 to 16.54) † c) 9.67 (5.91 to 13.42) †

Abbreviations: NF, Pain with Neuropathic Features; No-NF, Pain without Neuropathic Features; CG, Control Group; CI, Confidence interval; VAS, Visual Analogue Scale; NDI, Neck Disability Index; TSK-11, Tampa Scale of Kinesiophobia-11; PCS, Pain Catastrophizing Scale.
* $P < 0.05$.
† $P < 0.01$.

Table 5. *Pearson correlation coefficient between cervical range of motion and physical-psychological outcomes in each group.*

Group		Flexion	Extension	Total Rotation	Total Latero-Flexion
NF	VAS	0.19	-0.453†	-0.241	-0.399†
No-NF		0.057	-0.115	0.056	-0.015
CG		-	-	-	-
NF	NDI	-0.321*	-0.269	-0.297*	-0.164
No-NF		-0.174	-0.187	-0.100	-0.097
CG		0.007	0.150	0.159	0.098
NF	TSK-11	0.146	-0.370†	-0.473†	-0.283*
No-NF		-0.167	-0.160	-0.047	-0.290*
CG		0.087	-0.105	-0.025	-0.269
NF	PCS	-0.091	-0.285*	-0.290*	-0.286*
No-NF		-0.301*	-0.335*	-0.390†	-0.532†
CG		0.196	-0.265	-0.106	-0.241

Abbreviations: NF, Pain with Neuropathic Features; No-NF, Pain without Neuropathic Features; CG, Control Group; VAS, Visual Analogue Scale; NDI, Neck Disability Index; TSK-11, Tampa Scale of Kinesiophobia-11; PCS, Pain Catastrophizing Scale.
* $P < 0.05$.
† $P < 0.01$.

Discussion

The results of our study showed widespread pressure pain hyperalgesia in patients with CNSNP with NF when compared to those with No-NF or healthy controls. In addition, both CNSNP groups obtained bilateral pressure pain hyperalgesia over the cervical region (suboccipital and upper fibers of trapezius muscles) compared to the CG.

Several studies confirmed our results about the existence of peripheral sensitization over the cervical region in CNSNP patients (18,30-33). It would be expected that if the peripheral sensitization became chronic, it could result in widespread hyperalgesia, suggesting a disturbance of central nociceptive processing due to peripheral maintained inputs (75). Nevertheless, in reviewing the limited literature that evaluated the presence of widespread hyperalgesia in CNSNP, ambiguous results were observed (18,30-33). This controversy could denote the existence of different pain processing in CNSNP. Most studies in CNSNP patients concluded an absence of widespread hyperalgesia (18,32,33); indeed, only investigations conducted by Javanshir et al (30) and Johnston et al (31) found widespread hyperalgesia in these patients. In particular, Johnston et al (31) classified office workers with neck pain depending on the NDI, and they only found widespread hyperalgesia in those with a score ≥ 30 on the NDI. In our study, neither of the 2 neck pain groups scored higher than 17 on the NDI, so there might be other factors that influence in the development of widespread hyperalgesia. Importantly, our study is the only one that classified CNSNP depending on whether it was a pain with NF and No-NF, which could explain the differences from the studies mentioned above. The perceived widespread hyperalgesia only showed in the NF group; it is more likely for these patients to present with somatosensory disturbances because they have neuropathic characteristics (17,25-28,34,35). The presence of these sensory disturbances, especially if they occur bilaterally, suggest the existence of central sensitization (16,23,76,77); therefore, our outcomes lead us to suspect an alteration of pain processing mechanisms at the central level in NF patients. Another possible explanation regarding these differences in hypersensitivity could be the association of widespread hyperalgesia with an increase in pain intensity and disability found in other cervical disorders (such as whiplash) (16), since our group of NF patients showed greater values on VAS and NDI than the other 2 groups. However, the last hypothesis loses consistency because studies that reported widespread hyperalgesia in CNSNP (30,31) presented lower pain intensity and neck disability than our No-NF group (group without presence of widespread hyperalgesia).

Both chronic pain groups showed a decreased cervical ROM when compared to healthy controls. These results were expected because there is ample evidence demonstrating a reduction in neck movements in chronic conditions of neck pain (19,42-47). Nevertheless, differences between both CNSNP groups were not found, thus our hypothesis about a possible cervical ROM reduction in patients with NF when compared to patients with No-NF was rejected. Cervical ROM is associated with psychosocial factors, such as kinesiophobia (41), so the lack of differences between CNSNP groups

in the evaluated psychosocial factors (catastrophism and kinesiophobia) could be the reason for the absence of differences in cervical ROM between these groups. Cervical ROM is also associated with disability and pain intensity (41,48-50). With this last point in mind, differences in cervical ROM between the 2 patient groups would be expected; however, although the NF group's pain was more intense and disabling than the No-NF group, the values of the mean differences did not exceed the minimal detectable change (78-80). Hence true clinical differences between both groups cannot be declared.

From the 4 self-measured variables, only neck disability showed a low-moderate negative correlation with all PPT measurements in the NF group, except for PPT in the anterior tibial muscle. These findings are similar with those reported in previous chronic neck pain studies (81-83). In our outcomes, almost all PPT measurements were not correlated with pain intensity or psychological variables in any CNSNP group, except between kinesiophobia and PPT in the anterior tibial muscle in the NF group, which could be explained by the fact that, although all of them are subjective measures, the PPT measurements refer to the recognition of a nociceptive stimulus as "new" (generated at the time), while the remaining variables are assessed within a broader concept due to the chronicity of the condition. In addition, the NF group showed a negative correlation (ranged from low to moderate) between cervical ROM and self-measured variables; pain catastrophizing and kinesiophobia outcomes were most strongly correlated with cervical ROM. These findings were expected because the influence of pain intensity, disability, and psychosocial factors in the cervical ROM was widely demonstrated in chronic neck pain patients (41,50,84). Nevertheless, we practically did not find correlations between cervical ROM and self-measured variables in the No-NF group, except for catastrophizing. This last point is strange to us, since numerous research articles demonstrate an association between catastrophizing and kinesiophobia (85-87) as well as between catastrophizing and disability (84,88-90); if there is a correlation between cervical ROM and catastrophizing, it would also be expected with the rest of the variables. The absence of correlations (as well as of stronger correlations) could be caused by the sample size, because it was calculated in accordance with our main objective instead of the secondary one. However, a plausible explanation of the differences in cervical ROM correlations found between both CNSNP groups is beyond our knowledge.

Limitations

The present study had several limitations. First, PPTs were evaluated as the only somatosensory variable, but did not evaluate mechanical, thermal detection/pain, or vibration detection thresholds, which would have allowed us to assess, more thoroughly, possible pre-existing somatosensory disturbances (for example, hypoesthesia) in CNSNP patients; in this way, our knowledge about the possible underlying pathophysiological mechanisms in these 2 types of pain (No-NF and NF) could be increased. Second, because of the involvement of psychosocial factors in CNSNP, this study assessed pain catastrophizing and kinesiophobia, but did not assess the involvement of other factors, such as anxiety, depression, self-efficacy, and/or coping style. Third, this is a cross-sectional design study (no causal implications can be drawn from the outcomes), so these findings should be confirmed by prospective studies in the future; the authors believe that studies resolving these limitations are needed. Last, although the S-LANSS scale is validated as a screening tool for pain with NF (91), currently there is no "gold standard," and this is a potential risk for error (91,92).

Conclusions

Widespread pressure pain hyperalgesia was detected in patients with CNSNP with NF, but not in patients with CNSNP with No-NF. Patients with CNSNP presented bilateral pressure pain hyperalgesia over the cervical region and a decreased cervical ROM compared to healthy controls; however, no differences were found between both CNSNP groups. These findings suggest differences in the mechanism of pain processing between patients with CNSNP with NF and No-NF. Future studies are needed to evaluate the differences in the motion and sensory clinical characteristics between pain with NF and No-NF to support these results.

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