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Patients with chronic whiplash can be subgrouped on the basis of symptoms of sensory hypersensitivity and posttraumatic stress

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ABSTRACT

The lack of efficacy of rehabilitative approaches to the management of chronic whiplash-associated disorders (WAD) may be in part due to heterogeneity of the clinical presentation of this patient population. The aim of this study was to identify homogeneous subgroups of patients with chronic WAD on the basis of symptoms of PTSD and sensory hypersensitivity and to compare the clinical presentation of these subgroups. Successive *k*-means cluster analyses using 2, 3 and 4 cluster solutions were performed by using data for 331 (221 female) patients with chronic (>3 months) WAD. The 4 cluster solution was identified as the most clinically relevant, yielding 4 distinct clusters: no to mild posttraumatic stress symptoms and no sensory hypersensitivity (nPnH), no to mild posttraumatic stress symptoms and sensory hypersensitivity (nPH), moderate to severe posttraumatic stress and no sensory hypersensitivity (PnH) and moderate to severe posttraumatic stress and sensory hypersensitivity (PH). The nPnH cluster was the largest cluster, comprising 43.5% of the sample. The PH cluster had significantly worse disability, pain intensity, self-reported mental health status and cervical range of motion in comparison to the nPnH and nPH clusters. These data provide further evidence of the heterogeneity of the chronic WAD population and the association of a more complex clinical presentation with higher disability and pain in this patient group.

1. Introduction

Whiplash-associated disorders (WAD) pose a high socioeconomic cost to the community [14]. This is due to the propensity for patients with WAD to develop chronic pain, with up to 50% of those injured reporting ongoing symptoms at long-term follow-up [11,24]. The mechanisms underlying persistent pain and disability in this population are poorly understood [12], and there is a lack of strong evidence for the efficacy of any single conservative management approach in patients with chronic WAD [60,61,65]. This may be due to the complex clinical presentation of patients with chronic WAD, which includes not only neck pain and related disability but also psychological distress and signs of central sensitisation such as sensory hypersensitivity [26,32,51,54,58,63,64]. This likely reflects a confluence of underlying biopsychosocial factors contributing to the maintenance of pain and disability in this patient population.

Symptoms of posttraumatic stress disorder (PTSD) and sensory hypersensitivity (mechanical and cold hyperalgesia) are features of chronic WAD, and their early presence is predictive of poor functional recovery [18,26,29,54,68]. There seems to be a complex interaction between pain and disability, symptoms of PTSD and sensory hypersensitivity [13,49]. Patients with WAD who are most likely to report moderate or severe pain and disability at long-term follow-up are also more likely to experience more severe symptoms of PTSD [49]. Further, the presence of sensory hypersensitivity increases the risk for ongoing high levels of both disability and PTSD in this population [49]. The relationship between pain and PTSD has been widely reported [25], and it has been hypothesized that pain and PTSD may share common neurobiological processes [17,31,35,44].

Despite the evidence linking PTSD and sensory hypersensitivity to poor outcome, patients with chronic WAD can present clinically without these features [49]. Identification of homogeneous subgroups of patients with chronic WAD will aid in the exploration of the factors contributing to ongoing disability in this population. Previously reported methods for subgrouping patients with WAD do not include measures of both posttraumatic stress and sensory hypersensitivity [25,28,47]. Although these methods can have value in predicting those at high risk of a poor outcome [25] or identifying clinically distinct subgroups of patients with chronic WAD

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[47], the presence of sensory hypersensitivity and PTSD in patients with chronic WAD may represent differential mechanisms underlying the maintenance of pain and disability. These differential mechanisms may result in differences in clinical presentation and response to current management strategies amongst patients with chronic WAD. Identification of homogeneous subgroups on the basis of these factors may allow for the development of more efficacious assessment and management approaches in this population.

The aim of this study was to investigate if it is possible to identify homogeneous subgroups of patients with chronic WAD on the basis of symptoms of PTSD and sensory hypersensitivity and to compare the clinical presentation of these subgroups.

2. Methods

2.1. Participants

Data for the present study were obtained from previous longitudinal investigations of patients with WAD, including predictive studies [15,22,23,50] and clinical trials [37,56]. Patients with WAD were included provided they could be classified as WAD grade II or III according to the Quebec Task Force guidelines [48], had a history of not less than 3 months of neck pain as the result of a motor vehicle collision (MVC) and were between 18 and 65 years of age. Exclusion criteria were WAD grade IV (fracture/dislocation of the cervical spine), loss of consciousness as a result of the MVC, presence of inflammatory or other pathological condition of the spine and presence of any other potentially relevant medical condition (including psychological or psychiatric conditions). Baseline data were included for 146 patients enrolled in clinical trials of treatments for chronic whiplash. Data for 185 patients enrolled in longitudinal predictive studies were taken from the first available data point, which was 3 months or more after injury. In total, data for 331 (221 female) patients with chronic (>3 months) WAD were available. Ethical clearances were obtained from all relevant institutional ethics committees, and participants provided written informed consent before participation.

2.2. Outcome measures

2.2.1. Neck Disability Index

Neck pain and related disability was measured with the Neck Disability Index (NDI). The NDI is a validated, reliable and responsive measure [66] consisting of 10 items rated on a 6 point scale from no disability (0) to complete disability (5). An overall score is calculated by totalling the scores for each item and multiplying by 2.

2.2.2. Current pain intensity

Pain levels over the past 24 h were measured with a 10 cm visual analogue scale (VAS) with anchors of 0 (no pain) and 10 (worst pain imaginable).

2.2.3. Posttraumatic Stress Diagnostic Scale

The Posttraumatic Stress Diagnostic Scale (PDS) is a reliable self-reported measure of PTSD symptoms consisting of 49 items with a short checklist identifying the traumatizing event [16]. For the purposes of this research, the traumatizing event was the MVC associated with the neck injury. The frequency with which the cardinal symptoms of PTSD have been experienced by the participant over the past 30 days is rated on 17 items with a 4 point scale with the anchors 0 (not at all) to 3 (more than 5 times a week/almost always). The total symptom severity score is calculated as the sum of the responses to these 17 items. Total symptom severity scores of $\leqslant$10 indicate mild symptoms of PTSD, 11–20 moderate symptoms, 21–35 moderate/severe symptoms and $\geqslant$36 severe symptoms [16].

2.2.4. Short Form 36 (SF-36)

The Short Form 36 (SF-36) is a self-report questionnaire which measures general health and well-being across 8 dimensions. The mental health subscale of the SF-36 (SF-36 MH) was used to provide a measure of mental health not-specific to PTSD. The SF-36 MH is scored as a percentage, with higher percentages indicating higher mental health status.

2.2.5. Range of motion

Active cervical range of motion (ROM) was measured by 1 of 2 methods. An electromagnetic motion-tracking device (Fastrak; Polhemus, Colchester, VT, USA) or bubble inclinometer (Fabrication Enterprises Inc, New York, NY, USA). Active ROM was measured for cervical flexion, extension and rotation according to previously published protocols [43,51]. For all movements, triplicate measures were taken and the mean used for further analysis. In order to limit the number of comparisons between groups, a total ROM score was calculated as the sum of the mean ROM for flexion, extension and left and right rotation.

2.2.6. Pressure pain thresholds

Pressure pain thresholds (PPT) were measured with a pressure algometer with a probe size of 1 cm^2 and an application rate of 40 kPa/S (Somedic AB, Farsta, Sweden). Triplicate measures were obtained bilaterally at the proximal third of the muscle belly of tibialis anterior (TA) and over the cervical spine (Cx). Participants were instructed to indicate the onset of the first sensation of pain through depressing a patient-controlled switch. The pressure (kPa) at the onset of pain was recorded, with higher values indicating less sensitivity to mechanical stimuli. The mean of the 3 measures was used for further analysis. Because of the collation of data across several studies, PPT for the cervical spine was collected for some participants at the spinous process of the C2 vertebra, for others over the spinous process of C5 and for some subjects from both these sites. For those participants with data for both the C5 and C2 sites ($n = 197$), the bivariate correlation between PPT values from these sites were calculated. A very high, statistically significant correlation was observed ($r = 0.88$, $P < .001$). Data for PPT from the C2 and C5 were therefore pooled and treated as a single variable, Cx PPT.

2.2.7. Cold pain thresholds

Cold pain thresholds (CPT) were measured bilaterally over the mid to lower regions of the cervical spine with the MSA Thermotest system (SomedicAB, Farsta, Sweden). The thermode was preset to 30°C and cooled at a constant rate of 1°C/s. Participants were instructed to depress a patient-controlled switch when the cold sensation first became painful. The temperature of the thermode (°C) at the time of depression was recorded. Lower temperatures indicate less sensitivity to cold stimuli. Triplicate recordings were taken and mean values used for further analysis. Data collected from separate studies included CPT measured bilaterally over the cervical spine and CPT measured centrally over the cervical spine. For those participants with bilateral measures, bivariate correlations of the CPT for each side were conducted. A strong, statistically significant correlation was detected ($r = 0.84$, $P < .001$). The mean of the CPT for the left and right sides was calculated for these subjects and combined with central CPT measures to give 1 variable for cervical CPT.

2.3. Procedures

Before collection of physical data, participants completed the questionnaires. The physical measures were performed by an