Manual Therapy 15 (2010) 48–53

Contents lists available at ScienceDirect

Manual Therapy

journal homepage: www.elsevier.com/math

Original Article

Sensory hypoaesthesia is a feature of chronic whiplash but not chronic idiopathic neck pain

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ARTICLE INFO

Article history:
Received 29 December 2008
Received in revised form
15 May 2009
Accepted 26 May 2009

Keywords:
Whiplash
Neck pain
Quantitative Sensory Testing

ABSTRACT

Both sensory hypersensitivity and hypoaesthesia are features of chronic whiplash associated disorders (WAD). Sensory hypersensitivity is not a consistent feature of chronic idiopathic (non-traumatic) neck pain but the presence of hypoaesthesia has not been investigated. This study compared the somatosensory phenotype of whiplash and idiopathic neck pain. Comprehensive Quantitative Sensory Testing (QST) including both detection and pain thresholds as well as psychological distress were measured in 50 participants with chronic WAD, 28 participants with chronic idiopathic neck pain and 31 healthy controls. The whiplash group demonstrated lowered pressure pain thresholds (PPTs) at all sites compared to the controls ($p < 0.01$) but there was no difference between the two neck pain groups ($p > 0.05$) except at the tibialis anterior site ($p = 0.02$). The whiplash group demonstrated lowered cold pain thresholds compared to idiopathic and control groups ($p < 0.03$). For detection thresholds, the whiplash group showed elevated vibration ($p < 0.04$), heat ($p < 0.02$) and electrical ($p < 0.04$) thresholds at all upper limb sites compared to the idiopathic neck pain group and the controls ($p < 0.04$). Sensory hypoesthesia whilst present in chronic whiplash is not a feature of chronic idiopathic neck pain. These findings indicate that different pain processing mechanisms underlie these two neck pain conditions and may have implications for their management.

1. Introduction

Whiplash associated disorders (WAD) are heterogeneous with some individuals demonstrating widespread sensory hypersensitivity that is associated with both higher levels of pain and disability and poor functional recovery (Sterling et al., 2003). This phenomena is not unique to WAD and has been shown to be present in patients with cervical radiculopathy (Chien et al., 2008b) but in contrast does not appear to be a feature of chronic neck pain of a non-traumatic nature (idiopathic neck pain) (Scott et al., 2005; Elliott et al., 2008). Sensory hypersensitivity likely reflects augmented central pain processing mechanisms (Curatolo et al., 2001; Sterling et al., 2003) and its presence or not may indicate that different pain processes underlie various neck pain conditions.

We have recently demonstrated that in addition to sensory hypersensitivity, increased detection thresholds or sensory hypoaesthesia is also present in individuals with chronic whiplash (Chien et al., 2009). Similar findings have been demonstrated in other musculoskeletal conditions such as chronic diffuse upper limb pain and patellofemoral pain (Jensen et al., 2007b; Tucker et al., 2007) and may indicate the involvement of central inhibitory processes related to nociceptive input (Voerman et al., 2000; Tucker et al., 2007; Chien et al., 2008b). Apkarian et al. (1994) suggested that prolonged nociceptive input into the central nervous system (CNS) may cause an inhibitory effect which in turn "dampens" the CNS's ability to perceive and interpret afferent sensory input. If central inhibitory mechanisms are involved in the somatosensory dysfunction seen in neck pain subsequent to whiplash injury, it could be expected that patients with chronic idiopathic neck pain would also demonstrate similar sensory changes. However, previous studies have examined only sensory hypersensitivity (decreased pain thresholds) and not hypoaethesia (increased detection thresholds) in chronic idiopathic neck pain.

The aim of the current study was to compare the somatosensory phenotype of non-traumatic (idiopathic neck pain) to that of

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doi:10.1016/j.math.2009.05.012

patients with chronic whiplash as well as healthy asymptomatic controls, particularly with respect to detection thresholds to various sensory stimuli. This may provide further insight into the underlying mechanisms of the two neck pain conditions.

2. Materials and methods

2.1. Participants

A cross sectional study design was used to allow comparison between the two neck pain groups (chronic whiplash and chronic idiopathic neck pain) and a control group.

The whiplash group comprised 50 participants (39 females; mean age 37.2 ± 10.4 years) with persistent neck pain as a result of a motor vehicle crash (MVC) (>3 months but less than 2 years). All of the participants with whiplash injury fulfilled the criteria of WAD II (without clinical neurological signs) as defined by the Quebec Task Force (Spitzer et al., 1995). Participants were excluded if they experienced concussion, loss of consciousness or head injury as a result of the MVC and if they had been diagnosed with a psychiatric disorder. The participants with whiplash were recruited via primary care practises and through print media advertisement.

The idiopathic neck pain group comprised of 28 participants (20 females; mean age 32.3 ± 8.7 years) reporting ongoing, insidious-onset (non-traumatic) neck pain for more than 3 months and less than 3 years in duration. Participants were excluded if the onset of their neck pain was related to a MVC or other forms of trauma or if they had been diagnosed with any neurological or musculoskeletal disorders and/or a diagnosed psychiatric disorder that may influence Quantitative Sensory Testing (QST) results. The participants were recruited via local medial advertisement.

Thirty-one healthy volunteers (25 females) were also recruited from the general community provided they had no complaints of spinal, upper or lower limb pain and had never experienced trauma or injuries to the cervical spine, head, and upper quadrant or knee regions requiring medical treatment. The mean age of the control group was 31.4 ± 8.9 years.

The study was approved by the institutional medical research ethics committee. All the participants were unpaid volunteers and all gave written informed consent before inclusion.

2.2. QST measures

The QST measures utilised in the current study are sub-divided into 2 types: pain threshold measures and detection threshold measures. We have used these measures in previous studies of whiplash and neck pain and their validity and reliability is established (Chien et al., 2008a, b, Chien et al., 2009).

2.3. Pain threshold measures

2.3.1. PPTs

PPT's were determined using a pressure algometer with a probe size of 1 cm^2 and application rate of 40 kPa/s (Somedic AB, Farsta, Sweden). Bilateral test sites included the articular pillars of C5/6, nerve trunk of the median nerve near the elbow and at the muscle belly of tibialis anterior (Sterling et al., 2003). The participants were asked to press a button when the sensation under the probe changed from being pressure alone to pressure and pain. The procedure was repeated 3 times at each site with the mean score used for analysis.

2.3.2. Cold pain thresholds

Thermotest (Somedic AB, Farsta, Sweden) was used to determine cold pain thresholds. The thermode was applied directly over the skin of mid-cervical region as well as the dorsal aspect of the hand bilaterally. The temperature was preset to decrease at a rate of 1 °C/s from a baseline of 30 °C. The participant was given a switch to identify when the cold sensation first became painful (Sterling et al., 2003). The Thermotest had a cut-out temperature of 5 °C. If the cold pain threshold was not reached before the minimum cut-out temperature, the minimum cut-out temperature was recorded for that trial. The mean of three trials at each site was calculated for analysis.

2.4. Detection threshold measures

2.4.1. Vibration thresholds (VTs)

A vibrometre (Somedic AB, Stockholm, Sweden) with a tissue displacement range of 0.1 ± 400 was used to supply vibration stimulation to the hand. In order to familiarise the participants with the vibration stimulus, 3 trials of the test stimuli, or until the participant was able to consistently indicate the onset of the stimulus, were applied over the muscle belly of brachioradialis. Readings were then taken over areas of the hand innervated by distal aspect of the C6 (palmar aspect of the 1st metacarpal), C7 (palmar aspect of 2nd metacarpal) and C8 dermatomes (dorsum of the 5th metacarpal) (Chien et al., 2008b). These tests were done bilaterally for all groups. Participants indicated when the vibration first appeared (the perception threshold (VPT)) and when it disappeared (the disappearance threshold (VDT)). The VT was then noted as the average of VPT and VDT.

2.4.2. Thermal (hot, cold) detection thresholds (TDTs)

Utilising the method of limits, the Thermotest (Somedic AB, Farsta, Sweden) with a 25×50 thermode was used. Detection thresholds were measured over areas of the hand innervated by the C6 and 7 (dorsum over the 1st and 2nd metacarpal) and C8 (dorsum of the 5th metacarpal) dermatomes (Chien et al., 2008b). The temperature was preset to either increase or decrease at a rate of 1 °C/s from a baseline of 30 °C. The participant was asked to press a button as soon as they first detected the sensation of warmth or cold.

2.4.3. Current perception thresholds (CPTs)

A non-noxious method of electrocutaneous stimulation was used in a method of limits procedure to allow determinations of CPT. The Neurometer CPT/C device (Neurotron., Baltimore, USA) delivers continuous trains of constant current electrical stimuli to the skin through a pair of 1 cm diameter gold electrodes coated with a thin layer of conductive gel and taped to the test site. Sites tested were those innervated by C5/6 (lateral elbow, inferior to elbow joint line), C7 (distal phalanx of index finger); C8 (distal phalanx of 5th digit) and tibialis anterior as a remote site (Chien et al., 2008b). The method of limits at a frequency of 250 Hz was utilised where the participants were asked to report when they first perceive the sensation (perception threshold). The intensity was then decreased until participants identified the threshold at which they can no detect the sensation (VDT). The detection threshold was calculated as the mean of the perception and VDT. The procedure was repeated three times and recorded for analysis.

2.5. Questionnaires

All participants with neck pain completed the Neck Disability Index (NDI) (Vernon and Mior, 1991) as a measure of self-reported pain and functional disability. In order to account for the potential