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Narrative Review & Case Series

The use of dry needling as a diagnostic tool and clinical treatment for cervicogenic dizziness: a narrative review & case series

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ABSTRACT

Study design: Narrative Review & Case Series.
Background: No "gold standard" test presently exists to confirm a diagnosis of cervicogenic dizziness, a condition whereby the neuromusculoskeletal tissues of the cervical spine are thought to contribute to imbalance and dizziness. Clusters of tests are presently recommended to provoke signs and symptoms of the condition. In this regard, dry needling may provide a valuable diagnostic tool. Targeting the musculoskeletal structures of the upper neck with dry needling may also provide a valuable treatment tool for patients that suffer from cervicogenic dizziness. While dry needling has been used to treat various musculoskeletal conditions, it has not been specifically reported in patients with cervicogenic dizziness.
Case description: Three patients were screened for signs and symptoms related to cervicogenic dizziness in an outpatient physical therapy clinic. These patients presented with signs and symptoms often associated with (though not always) cervicogenic dizziness, including a positive flexion-rotation test, altered cervical range of motion, and tenderness with manual assessment of the upper cervical extensors. In addition, dry needling targeting the obliquus capitis inferior muscle was used diagnostically to reproduce symptoms as well as to treat the patients.
Outcomes: Two of the patients reported full resolution of their dizziness and a significant improvement in their function per standardized outcome measures. While the third patient did not report full resolution of her cervicogenic dizziness, she noted significant improvement, and dry needling was helpful in guiding further treatment. Importantly, the effect of the treatment was maintained in all three patients for at least 6 months.
Discussion: This case series with narrative review covers various testing procedures for cervicogenic dizziness and explores the use of dry needling targeting the suboccipital muscles to evaluate and treat this patient population. The physiologic changes that occur in the periphery, the spine and the brain secondary to dry needling and their potential relevance to the mechanisms driving cervicogenic dizziness are discussed in detail.

1. Introduction

The treatment of dizziness is a challenging and often frustrating endeavor for clinicians due to the complexity of the condition and the number of systems involved (Chandrasekhar, 2013; Wipperman, 2014). Interactions between the vestibular, ocular, and somatosensory system all relay afferent information to the central nervous system via a number of reflex pathways so as to maintain general balance and stability (Kristjansson and Treleaven, 2009). While disagreement between these systems can lead to appropriate alterations of reflexive posture, unresolved differences can cause symptoms of dizziness (Kristjansson and Treleaven, 2009; Treleaven, 2008a).

Notably, the cervical spine can contribute to dizziness. Bow-Hunter's syndrome (i.e. rotational vertebral artery compression) and Barré-Liéou syndrome (i.e. sympathetic vertebral plexus irritation) are disorders of cervical origin that cause dizziness (Brandt, 2001; L'Heureux-Lebeau et al., 2014; Yacovino and Hain, 2013). Moreover, some investigators have suggested that proprioceptive dysfunction in the cervical spine may be the most common finding

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associated with cervicogenic dizziness (Hain, 2015). This is likely due to the role of the suboccipital muscles and upper cervical joints, which communicate important information to and from the central nervous system to alter postural stability, cervical reflexive proprioception, head & eye movement control and, ultimately, balance (Armstrong and McNair, 2008; Dutia, 1991; Fernandez-de-Las-Penas et al., 2007; Hain, 2015; Hulse, 1983; L'Heureux-Lebeau et al., 2014; McLain, 1994; Morningstar et al., 2005; Reichel and Stenner, 2013; Treleaven et al., 2011; Watson and Colebatch, 1998).

While clinicians have several tools to diagnose cervical proprioceptive dysfunction as the cause of dizziness (Al-Saif et al., 2012; Chen and Treleaven, 2013; Ellis et al., 2015; L'Heureux-Lebeau et al., 2014; Treleaven et al., 2003, 2005a), the absence of a gold standard places limits on the diagnostic accuracy and inter-examiner reliability of such a diagnosis (Hain, 2015; Huijbregts and Vidal, 2004; Li and Peng, 2015; Yacovino and Hain, 2013). Moreover, the etiology of cervicogenic dizziness is still not completely understood, and the best conservative treatment for the condition continues to be a topic of debate in the literature (Lystad et al., 2011). As such, the purpose of this paper is to explore the rationale of using dry needling as a diagnostic test and a potential treatment for cervicogenic dizziness.

2. Background

2.1. The pathophysiology of cervicogenic dizziness

In the cervical spine, the suboccipital muscles play an important role in the positioning of the head in space. These muscles can be reflexively altered by the vestibular system and are implicated in conditions such as chronic tension-type headache and dystonic torticaput (Armstrong and McNair, 2008; Fernandez-de-Las-Penas et al., 2007; Reichel and Stenner, 2013; Watson and Colebatch, 1998). Similarly, the suboccipital muscles also provide feedback to the vestibular system on the dynamic position of the head and neck. The cervical spine has an extremely well developed proprioceptive system, as evidenced by the density of gamma-muscle spindles in the deep segmental upper cervical muscles. Per Kristjansson and Treleaven, "Gamma muscle spindle system afferents are particularly important as they initiate the afferent proprioceptive feedback, while other mechanoreceptors such as the joint receptors and Golgi tendon organs fine tune the muscle spindle information, predominantly by reflex effects on the gamma motor neurons" (Kristjansson and Treleaven, 2009).

Type 1 mechanoreceptors and proprioceptors from the facet joints of the upper cervical spine deliver information to the central nervous system via the spinal nerves (Reid and Rivett, 2005). According to Borg-Stein et al., the C1-C2 dorsal roots of the spinal nerve provide afferent information to the abducens nuclei of the vestibular nerve (Borg-Stein et al., 2001). If the joints are dysfunctional, however, improper information could be sent to the vestibular nuclei, resulting in imbalance and dizziness (Cagle, 1995; Reid and Rivett, 2005).

It is perhaps also worth noting that afferent pain information from the structures of the upper cervical spine (i.e. facet joints, muscles, intervertebral discs, etc.) synapse with dorsal horns neurons, which overlap with the trigeminocervical nucleus (Li and Peng, 2015; Yacovino, 2012). The reciprocal connections between the trigeminocervical nucleus and the vestibular nuclei have been implicated in migraine headaches and vertigo (Li and Peng, 2015; Yacovino, 2012). Interestingly, the overlap of the trigeminocervical nucleus with the C1-C2 dorsal horns has also been linked to cervicogenic headaches, which are often accompanied by dizziness (Brown, 1992). This may explain why Lystad et al., found a moderate level of evidence for the use of manual therapy with or without vestibular therapy for the treatment of cervicogenic dizziness (Lystad et al., 2011; Wrisley et al., 2000). It also may account for the recent evidence supporting the use of spinal manipulation for cervicogenic headache and/or dizziness (Chaibi and Tuchin, 2011; Dunning et al., 2016; Lystad et al., 2011).

From a biomechanical perspective, the suboccipitals are considered to have a role in active motion of the head on the neck. However, the obliquus capitis inferior (OCI) appears to play a key role in proprioception of the upper cervical spine (Bexander et al., 2005). During active rotation in healthy individuals, Bexander, et al. found that there is a co-activation of the OCI bilaterally, instead of a unilateral contraction (Bexander et al., 2005). The high muscle spindle density of this muscle further suggests that the OCI plays a predominately proprioceptive role in the upper neck and is an ideal candidate for sensing joint position (Kulkarni et al., 2001). Given its role in the cervico-collic reflex, the splenius capitis, splenius cervicis, and the rectus capitis posterior major may also play a role in cervicogenic dizziness (Morningstar et al., 2005).

Bexander also found that OCI activity was altered following cervical injury such as whiplash associated disorder (WAD), leading to increased activation of neck rotatory muscles with changes in eye position (Bexander and Hodges, 2012). As such, patients that experience cervical trauma often experience impaired ocular coordination abilities and dizziness, which has been correlated with sustained cervical pain (Chen et al., 2006; Heikkilä and Wenngren, 1998; Hildingsson et al., 2009; Treleaven et al., 2006; Wrisley et al., 2000). A number of clinicians have suggested that the alteration in somatosensory function occurs secondary to direct trauma, muscle inhibition, fatty infiltration and atrophy (Chen et al., 2006; Elliott et al., 2006; Kristjansson and Treleaven, 2009; McPartland et al., 1997; Uhlig et al., 1995). Interestingly, smooth pursuit and saccade disturbances have also been related to cervical afferent dysfunction. (Eva-Maj et al., 2013; Hildingsson et al., 2009; Treleaven, 2008b). While smooth pursuit and neck disturbances can be found in patients with idiopathic neck pain and in the absence of dizziness, greater deficits in head and eye movement and postural stability have been measured in patients following a trauma to the neck (Tjell et al., 2002; Treleaven et al., 2005a,b).

Pain may also play a significant role in cervicogenic dizziness (Li and Peng, 2015). In addition to WAD, spondylosis and/or spasm at the cervical spine can be a cause of vertigo due to different "sensorial strategies in posture". Per Li & Peng, an injection of anesthetic into the posterior neck muscles in patients with mechanical derangements has been shown to reduce pain and dizziness, suggesting that the upper neck is likely a key player in cervicogenic dizziness (Li and Peng, 2015). Notably, experimentally induced cervical pain targeting the paraspinal muscles at C2/C3 has been shown to cause significant repositioning error and decreased proprioception, leading to dizziness in some patients (Eva-Maj et al., 2013), a finding consistent with other muscle physiology studies (Chen et al., 2006; Le Pera et al., 2001; Thunberg et al., 2001).

There are several reflexes that also play an important role in upright positioning of the body and maintenance of normal balance. Of note, the cervico-collic, vestibulo-ocular, cervico-ocular, vestibulo-collic and the vestibulo-spinal reflex play an essential role in the maintenance of upright body positioning. Importantly, these reflexes can affect and/or be affected by information from the cervical spine (Brandt, 2013; Bronstein and Hood, 1986; Chambers et al., 1985; Field et al., 2008; Han and Lennerstrand, 1996; Horak and Hlavacka, 2001; Lennerstrand et al., 1996; Morningstar et al., 2005; Sjöström et al., 2003; Wapner et al., 1951). While a full discussion of these reflexes is outside the scope of this paper, the crosstalk between these reflexive systems and mechanoreceptors, proprioceptors, and nociceptors of the upper neck further suggests

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