INTRODUCTION

Cervicogenic dizziness (CGD) is a feeling of disorientation in space arising from the cervical spine. A large number of research articles are published in the last 5 years related to physical therapy (PT) management of CGD. According to current literature, there is no specific test that could assess patients with CGD. Plenty of varied interventions for CGD create a dilemma among clinicians regarding the choice of intervention. The amount of scientific literature mandates a review that would highlight the best evidence to be used in PT practice. All the major databases such as CINAHL, COCHRANE CONTROLLED TRIALS REGISTER, EMBASE, GOOGLE SCHOLAR, MEDLINE, PEDRO, SCOPUS, SPORTS DISCUS, and WEB OF SCIENCE were searched. Keywords used to search the literature were CGD, cervicogenic headache, vertigo, PT modalities, assessment, and evaluation. Relevant literature was extracted from the database and original articles written in English, which were available from January 2014 to September 2019. The aim of this review is to provide a pragmatic approach to the physical therapists involved in the management of CGD.

Key words: Dizziness, neck, physical therapy modalities, vertigo

ETIOLOGY OF CERVICOGENIC DIZZINESS

There are some suggested mechanisms responsible for producing CGD. These include vertebral artery compression, the abnormal sympathetic nervous system activity at the cervical spine, and anomalous proprioceptive signals from the cervical spine.[11] Muscular tightness or spasm in the cervical spine region can cause the mechanical compression of the vertebral artery network and can lead to symptoms similar to vertebra-basilar insufficiency (VBI).[12] Subclavian arteries arise from the arch of the aorta; which gives rise to the right and left vertebral arteries. The vertebral artery travels through

CGD are usually not as intense as vestibular-driven dizziness and it rarely includes vertigo.[9] There is scientific evidence supporting the effectiveness of PT management of patients with CGD, but its usage is limited to research labs.[10] The effective clinical management of cervical originated dizziness is an essential part of improving balance.[10] The literature published since 2014 was included in the formation of comprehensive assessment and treatment in CGD.

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the transverse foramen of the lower six cervical vertebrae then passes horizontally around the posterior aspect of the first cervical vertebra, finally entering the foramen magnum and join to form a basilar artery.[13] During the anatomical course from the vertebra-basilar arterial network, navigating through the muscular and bony structures is prone to mechanical compromise.[14] In the presence of the upper cervical spine muscle tightness or a muscle imbalance, the neck rotation might compromise the vertebra-basilar and collateral arteries, leading to temporary brainstem ischemia and symptoms consistent with VBI.[15] Bony abnormalities and poor cervical spine posture can also contribute to vertebral arterial compression and symptoms similar to VBI.[16]

Another cause of CGD is the abnormal activity of the cervical sympathetic nervous system. The superior cervical sympathetic ganglion proximity to the second and third cervical vertebrae can sometimes get complicated following the tightness in the upper neck muscles, bony abnormalities, and/or poor neck posture, causing vertebral and carotid arterial network hypoperfusion and CGD.[17] The smooth functioning of cervical and vestibular reflex contributes to a stable head and neck orientation (cervical-colic reflex and vestibule-colic reflex), postural control (cervical-spinal reflex and vestibulospinal reflex), and oculomotor control (cervical-ocular reflex and vestibular-ocular reflex).[18] These reflexes are essential to maintain normal postural balance and visual stability.

Trauma to the extensor cervical musculature causing ischemia, inflammation, and fatigue may affect the proprioceptive system at the cervical spine resulting in imbalance and CGD.[19] Other disorders such as cervical whiplash trauma also hamper somatosensory information from the cervical spine resulting in whiplash-associated disorder (WAD).[20] The WAD is associated with cervical muscle fatigue, abnormal extraocular motor function, and altered kinesthetic (joint position) sense of the cervical spine. Researchers also have explained that the altered sensory information from the cervical spine affects the vestibular ocular reflex causing impaired dynamic gaze.[21]

**METHODOLOGY**

**Study objective**
1. To review the literature concerning the PT intervention of CGD
2. To provide up-to-date, high-quality literature for rational decision-making of CGD PT intervention
3. To increase the power and precision of CGD treatment effects and exposure risks.

**Study design**
Review.

**Inclusion criteria**
1. We included articles published from 2014 to 2019
2. We included articles written in the English language
3. Articles include patients who had dizziness and either simultaneous complaints of pain or stiffness in their cervical spine
4. Articles include patients who had dizziness brought on by cervical spine movements or positions
5. Articles include patients who had dizziness brought on after any whiplash injury mechanism.

**Exclusion criteria**
1. Articles not translated from the foreign language
2. Articles include patients who had postoperative cervical spine area
3. Articles include ear nose and throat, central nervous system, cardiovascular, and benign positional paroxysmal vertigo (BPPV) patients.

**Search strategy and results**
A comprehensive search of the literature was run, which included the following databases CINAHL, COCHRANE CONTROLLED TRIALS REGISTER, EMBASE, GOOGLE SCHOLAR, MEDLINE, PEDRO, SCOPUS, SPORTS DISCUS, and WEB OF SCIENCE from January 2015 to September 2019. Keywords and search terms used in the literature search were “cervicogenic dizziness,” “cervicogenic vertigo,” “whiplash injury associated with dizziness,” “whiplash injury associated with vertigo,” “dizziness,” “Migraine associated vertigo,” and within disciplines of PT, medical doctor, osteopaths, and chiropractors. Synonyms of the keywords, alternate spelling, and a truncated version of ailment and treatment methods were included. In addition, reference lists from the selected articles, un-publication articles from experts in vestibular rehabilitation, abstracts, and thesis and conference proceedings got from the Saudi digital library were screened for eligibility. Relevant gray literature was retrieved from nongovernment organizations and medical equipment technology company.

**PHYSICAL THERAPY EXAMINATION**
A thorough PT examination is required to make a sound clinical decision based on the best available evidence. This process includes must subjective and physical examination components. The subjective examination is a mandatory first step in guiding the physical therapist to formulate a clinical hypothesis. During the subjective examination, the physical therapist reviews the patient’s past medical history and asks questions aimed at assessing specific signs and symptoms related to a patient’s dizziness. In order for the clinical hypothesis to ultimately arrive at CGD, competing causes of dizziness must be eliminated [Figure 1].

In particular, the tempo, symptoms, circumstances, and the intensity of the patient’s dizziness must be determined. Patients with CGD typically demonstrate dizziness as an episodic event (tempo) lasting several minutes to several hours.[22] Symptoms are often described as a vague sense
of disequilibrium or lightheadedness often accompanied by ocular disturbances. In addition, the clinician should find the intensity of dizziness as well as the range of dizziness over the previous 72 h using the modified visual analog scale.\(^{23}\) By collecting subjective information, the physical therapist begins establishing a clinical hypothesis.

The physical examination includes a medical screening followed by specific tests to assist diagnose CGD. Canadian C-spine rule\(^{24}\) is used to identify the presence of serious trauma at the cervical spine. Integrity and stability are also assessed by the Sharp Purser Test and Alar Ligament Test, whereas vascularity is assessed by the cervical arterial dysfunction test.\(^{25}\) In case any of the above-stated tests are positive, the patient is immediately referred to a physical therapist.\(^{26}\) Otherwise, physical therapists continue with postural analysis, cervical palpation, and the range of motion testing.\(^{27}\) Those who show signs and symptoms of dizziness from peripheral vestibular systems such as BPPV or vestibular-ocular reflex dysfunction are dealt with an appropriate vestibular rehabilitation protocol.\(^{28}\) If vestibular testing is normal or inconclusive and dizziness is still persistent, then the therapist performs specific tests to decide if the dizziness is originated from the cervical spine.

To assess CGD, therapists perform the neck torsion nystagmus test (NTNT). NTNT is a reliable and valid test to assess CGD.\(^{29}\) In this test, the patient needs to rotate the body with a stationary head. The test is positive if the patient develops nystagmus. Another test to detect the side

\[\text{Figure 1: Diagnostic flowchart}\]
affected is smooth pursuit neck torsion test (SPNTT). In this test, the therapist observed the ocular smooth pursuit while the head is fixed in a neutral position. The test is then repeated with the patient's body is rotated while the head is still. NTSPPT is positive when the smooth pursuit is normal in a neutral position and abnormal when the body/neck is rotating. The Neck Position Provocation Test (NPPT) is similar in that the patient rotated their body under a stabilized head. The NPPT is positive if their symptoms are produced in the latter position. The Joint Position Error Test (JPE) is performed by the patient by wearing a pair of foveal glasses, then looking at a stable target on a wall. Foveal vision testing requires modified glasses which occlude all peripheral vision. The patient then closes their eyes and actively rotates their head and neck to end range. With eyes closed, the patient actively returns to what they think was the initial starting position than with their eyes opens. The JPE test is positive if the patient is not able to return to their starting position. The JPE test can also be performed using a head-mounted laser pointer by measuring the distance from the initial position to the final position in centimeter. The manual traction test involves gentle vertical traction and compression of the cervical spine manually by the therapist. The test is positive if compression causes or triggers dizziness and traction relieve it.

Dizziness handicap inventory developed by Reid et al., comprising of 25 items categorized into physical, emotional, and functional statements related to the disability of a person suffering from CGD. The max score on the scale is 12 and score over 9 signifies CGD. The scale is reported to have sensitivity 0.83% (confidence interval [CI]: 0.69–0.91) specificity 0.68% (CI: 0.51–0.77), diagnostic odds ratio 8.91% (CI: 3.36–23.60). The scale lacks strong scientific validity.

PHYSICAL THERAPY EXERCISES

PT treatment targets specific impairments identified during the comprehensive PT examination. Cervical spine pain and inflammation, hypomobility, defective proprioception, and cervical-ocular motor dysfunction are dealt with effectively with specific PT treatment. Neck pain and inflammation are treated with modalities such as ice massage, heat therapy, therapeutic ultrasound therapy, and cervical spine traction, whereas cervical spine hypomobility requires manual therapy techniques, muscle energy techniques, and age-specific stretching programs. Proprioception impairments of the cervical spine are usually managed by postural awareness training; the gentle passive movement of the head in the horizontal and vertical plane while the patient is instructed to fix the gaze on the target marked on the wall.

Foveal vision exercises are performed actively by moving the head side to side with foveal glasses worn by the patient. The patient is instructed to fix their gaze on a stationary wall-mounted target. The patient closes their eyes and actively rotates their head, then returns to the neutral position and opens their eyes. If the patient is unable to see the target through foveal glasses, the patient is either asked to reduce the speed of the cervical movement or keep the eyes open and continues moving their head until they can see the wall-mounted target.

Adaptation training for cervical-ocular motor function can be accomplished by the following steps. Step 1: Eyes follow the moving target with the head stationary. Step 2: The patient keeps the head steady while following a target and shifts the gaze on another target when prompted. Step 3: The patient moves the head from side to side while fixing the gaze on the target. Step 4: The patient is instructed to move the head from side to side while fixing his gaze on the moving target. Step 5: Manipulation of speed, frequency, and complexity of the exercise to make it more challenging to the patient.

MANUAL THERAPY

One of the recent review articles reported that manual therapy treatment resulted in a significant change in the frequency and intensity of CGD (Level 3 evidence) as compared to the placebo group. Brian Mulligan, a manual therapist from New Zealand, recommended a manual therapy technique for CGD, namely sustained natural apophyseal glides (SNAGs). Similarly, Geoff Maitland also had proposed passive manual therapy for CGD. The techniques lacked strong scientific evidence, but newly published articles support the use of Mulligan and Maitland’s manipulation in CGD.

MULLIGAN MANIPULATION IN CERVICOGENIC DIZZINESS

The therapists use thumbs one over the other to perform a sustained natural apophyseal gliding (directed toward the patients’ eyeballs) over the spinous or transverse process of an upper cervical vertebra. If the direction of dizziness is flexion or extension, the glide is applied over the C2 spinous process. If rotation produces dizziness, the glide is applied over the C1 transverse process. In either of the conditions, patients are instructed to move in the direction of dizziness. Mulligan emphasized the importance of these manipulations being pain-free. The movement is usually repeated 6 times in the first treatment session, and after the second treatment session, patients are taught to administer self-SNAG using patients’ fingers or straps.

MAITLAND MANIPULATION IN CERVICOGENIC DIZZINESS

The Maitland mobilization technique is performed passively by a therapist with the patient in a prone position. Vertical pressure is applied by the thumbs reinforcing one
over the other of the therapist over the spinous process of cervical vertebrae. The mobilization is applied at three painful joints. Each passive mobilization or anterior glides lasts for 30 s and 3 times at each level.

CHIROPRACTIC SPINAL MANIPULATIVE THERAPY USING THE GONSTEAD METHOD

The Gonstead method\(^\text{[45]}\) is a fundamental spinal manipulation technique widely used among chiropractors. The technique involves a comprehensive examination of the patient involving history taking, spinal radiograph, spinal palpation, and standard chiropractic tests to the identification of a malaligned spinal segment. The technique involves specific contact, high velocity, low-amplitude, short-lever, with no recoil post spinal adjustment directed to spinal biomechanical dysfunction. The patient is positioned in a prone position on a bench, namely Zenith 2010 HYLO, the direction of manipulation is posterior-anterior by placing the one palm reinforced with the other hand on top over the area of spinal dysfunction. The manipulation is deemed effective when the manipulation results in an audible crack, immediate relief of pain, and increased range of motion. There is little scientific evidence on the effectiveness of chiropractic therapy for the treatment of CGD.

CHUNA MANUAL THERAPY

Developed as indigenous medical practices in Korea. Chuna techniques consist of the stimulation of the meridian system, correcting the alignment of bones and joints, and specific exercises based on symptoms and the results of a comprehensive assessment. Like chiropractic techniques, Chuna involves thrust mobilization of the spine and joints, soft tissue and visceral manipulation, and craniocervical therapy. A recent review\(^\text{[46]}\) comparing Chuna manual therapy (CMT) with other methods of musculoskeletal disorders reported CMT as safe and effective in reducing pain in many musculoskeletal disorders, although the study also suggested that the therapy requires more randomized controlled trials to prove its effectiveness.

ALTERNATE THERAPIES

The double-helical carbon nanotubes\(^\text{[47]}\) is a method of applying helical patches over the posterior aspect of the neck and upper thorax. The authors reported that these patches emit heat absorbed by the muscles restoring the impaired blood supply elevating the pain and dizziness. The author reported a reduction in pain and dizziness scores.

Recommendations

1. It is crucial for a physical therapist to identify cervical pathologies such as carotid artery dissection or cervical spine instability. The best tool to exam cervical spine trauma is the Canadian C-spine rule

2. Dizziness handicap inventory can also be used as a tool to identify the severity of the disability. Cervical relocation test is a simple assessment tool to evaluate cervical spine proprioception as well as the progress of the treatment

3. Manual therapy and cervical exercise have revealed a positive effect on CGD.

CONCLUSION

CGD is a condition that can lead to considerable disability. It is very important to rule out the conditions which can mimic CGD. Manual therapy and exercises seem promising treatment approaches for this condition, but more randomized controlled trials are needed.

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Conflicts of interest
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