<u>Cervicogenic vertigo</u>

By:

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<u>Abstract</u>

Vertigo is considered as the ninth most common complain leading patients to seek medical advice, rising to third among those aged 65 - 75 years and first among even older patients.

Cervicogenic vertigo is a process which tends to become chronic and affects the ability to work. Epidemiologic studies of cervicogenic vertigo are hampered by the absence of an easy to use gold standard to diagnose the disease. Therefore the true incidence and prevalence of cervicogenic vertigo are unknown and natural history data are scanty.

The contribution of the cervical region to balance has been studied experimentally in animals for 150 years. Strong connections have been demonstrated between the cervical dorsal roots and the vestibular nuclei with the neck receptors such as proprio-ceptors and joint receptors.

We aim from this work to review the literature about causes, pathogenesis, diagnosis and differential diagnosis of cervicogenic vertigo.

Mechanisms are suggested to explain the pathogenesis of cervicogenic vertigo either traumatic or non-traumatic. Also, non-traumatic are either vascular or non-vascular.

Traumatic soft tissue neck injury is known as hyperextension strain, acceleration-deceleration injury or whiplash injury which is a combined flexion-

extension soft-tissue injury of the cervical spine, common in road traffic accidents may also be caused by sports injuries, falls, work-related injuries or assaults.

Neck trauma and injuries may damage structures related to sensory information used as sensory input to assist in stabilizing vision and interacts with other types of vertigo to affect the balance.

Non-traumatic cervicogenic vertigo may be due to:

Vascular mechanisms as in vertebro-basilar insufficiency (VBI), compression or ischemia secondary to atherosclerosis or osteophytic compression of the vertebral arteries refers to a temporary set of symptoms due to decreased blood flow in the posterior circulation of the brain.

Non-vascular mechanisms are first described according to the work of Barre and Lieou in the 1920's, who experimentally induced dizziness, tinnitus and Horner's syndrome by injecting anesthetic into the upper cervical region.

Abnormal sensory input from neck proprio-ceptors is potential cause of cervical vertigo. Sensory information from the neck is combined with vestibular and visual information to determine the position of the head on the neck in space may be unreliable or absent.

Any insult that disrupts the calibration or balance between the two peripheral vestibular systems or between the vestibular system and its visual and proprio-ceptive input leads to the sensation of vertigo or loss of balance.

The diagnosis of an individual presenting with cervical spine dysfunction and associated complaints of vertigo may be a challenging experience.

Introduction

Vertigo is considered as the ninth most common complain leading patients to seek medical advice, rising to third among those aged 65 - 75 years and first among even older patients (Kroenke, et al. 1990).

Vertigo can be described as an unreal sense of movement. It should be distinguished from dizziness, which is defined as any kind of altered sense of orientation (Rosenberg and Gizzi**,** 2000).

Control of body balance is mediated by vestibular system, visual system, proprioceptive sensation of head rotation, body posture as well as spatial orientation.

Neck movements are associated with head movement. Thus, vertigo associated with neck movements could be due to a disorder in vestibular, visual, vascular, neurovascular, or cervico-proprioceptive mechanisms (Mergner, et al. 1991).

Guyton in 1991 states that, most important proprioceptive information needed for the maintenance of equilibrium is that derived from the joint receptors of the neck (Guyton, 1991).

Fitz-Ritson in 1991 tried assessing cervicogenic vertigo and stating that: if the patient experiences vertigo, it will be originated from the tissues of the cervical spine (Fitz-Ritson, 1991).

Lewit in 1991 stated that, cervical spine receptors are important for equilibrium, thus, vertigo is very frequently of cervical origin.

There are two potential causes of cervicogenic vertigo:

1- Vascular due to vertebro-basilar pathology or compression.

2- Abnormal sensory input from neck proprioceptors (Vibert, et al. 1993).

Evaluation of balance signals from peripheral vestibular nerve afferents, visual system, somato-sensory and proprioceptive signals normally occurs below a patient's awareness, making symptoms particularly difficult for the patient to describe and for the physician to categorize.

Clinical picture of patients suffering from cervicogenic vertigo tends to be vague. The symptoms include vertigo, vomiting, head fullness, heaviness and/or lightheadedness associated with neck pains. Symptoms may be worsened with computer use, reading or sustained neck positions.

The signs include muscle tenderness, stiffness and tenderness of the cervical region. Ocular motor signs, positional unsteadiness and postural instability noted especially on sudden head movements are frequently present (Wrisley, 2000).

The diagnostic evaluation includes complete head and neck exam, audiological testing, vestibular testing and imaging. Knowing the duration of the vertigo and the presence or absence of hearing loss allows for a narrowing of the differential diagnosis (Fetter, 2000).

Diagnosis of cervicogenic vertigo is generally uncertain and may be a challenging experience.

Inner ear disease, central vertigo, psychogenic vertigo, malingering, medical causes of vertigo and other entities need to be ruled out. There should be no abnormal hearing symptoms or findings.

If cervicogenic vertigo is still questionable after excluding reasonable alternatives, one next needs to look for positive confirmation.

Ordinary magnetic resonance angiography (MRA) and vertebral doppler procedures, magnetic resonance imaging (MRI) scan of the neck and flexion-extension X-ray films of the neck are suggested. The gold standard test for the vertebral arteries is vertebral angiography (Fitz-Ritson, 1991).

Static and dynamic studies as oculo-graphy, posturography, rotatory chair and measurements of cervico-spinal reflexes are reliable measures for establishing the diagnosis (Ruckenstein and Michael, 2000).

These patients generally improve with supportive or conservative care (medical or physical therapy). The small percent of medically uncontrolled patients can then be helped with surgical interventions and vestibular rehabilitation programs (Johnson and Lalwani, 2004).

Aim of the work

Cervicogenic vertigo is considered a major problem interfering with daily activity of the individuals suffering from it. We aim from this work to review the literature about causes, pathogenesis, diagnosis and differential diagnosis of cervicogenic vertigo.

Cervical Spine

Anatomy of the cervical spine:

The cervical spine consists of seven vertebrae (C1-7). The upper cervical spine (occipito-atlanto-axial complex) is unique and is made up of the base of the skull, atlas (C1), axis (C2) and several strong ligaments.

The atlas (C1) supports the occipital condyles in its lateral masses. This articulation allows for flexion and extension but no rotation. The articular surfaces of the atlas (C1) and axis (C2) are convex to each other allowing flexion, extension and especially rotation to occur. The transverse, accessory and alar ligaments are the primary stabilizing ligaments of the occipito-atlanto-axial complex.

The mid and lower cervical spine (C3 to C7) consists of vertebrae which are similar in size and shape. These vertebral bodies articulate with each other via their superior and inferior articular processes, enabling limited rotation and lateral flexion. The transverse processes of each of the cervical vertebrae are perforated by a foramen through which the vertebral vessels pass.

The first cervical vertebra is located immediately behind the angle of the mandible. The transverse process of the atlas is positioned between the angle of the mandible and the mastoid process. The hyoid bone is anterior to the level of C3, the thyroid cartilage is anterior to C4 and the cricoid cartilage is at the level of the sixth cervical vertebra (Levy, 2000).

The stable but flexible cervical spine is linked by both ligaments and disks. So, the cervical disks are prolapsed less than the lumbar disks, because of their major structural differences.

The cervical spine is more mobile, the superincumbent weight is less, the nucleus pulposus is located more anteriorly and unlike the lumbar spine the annulus is reinforced posteriorly in its entire width by the posterior longitudinal ligament.

The eight paired cervical spinal roots exit the intervertebral foramina between the superior and inferior pedicles except for the first cervical roots. The nerve roots exit the spinal canal above the level of the same numbered vertebra with the exception of the C8 nerve root which exits at the C7-T1 interspace (figure 1).

Unique to the cervical spinal roots, the ventral and dorsal roots are separate at the neural foramina in over half of cases. Therefore, isolated irritation of the dorsal (sensory) root posteriorly by an osteophyte may produce only sensory complaints. Similarly, ventral root (motor) compromise by a degenerative or herniated disk may produce only painless, progressive weakness.

The vertebral nerves from the dorsal root reenter the intervertebral foramina supplying sensory innervation to the ligaments of the spinal canal (Levy, 2000) (figure 1).

They supply the posterior longitudinal ligament anteriorly, the ligamentum flavum, meninges and associated vessels posteriorly. Ascending and descending branches supply the zygoapophyseal joints and provide position sense. It has been postulated that the receptors for the vertigo are in the deep neck ligaments and the intervertebral joints (Levy, 2000).

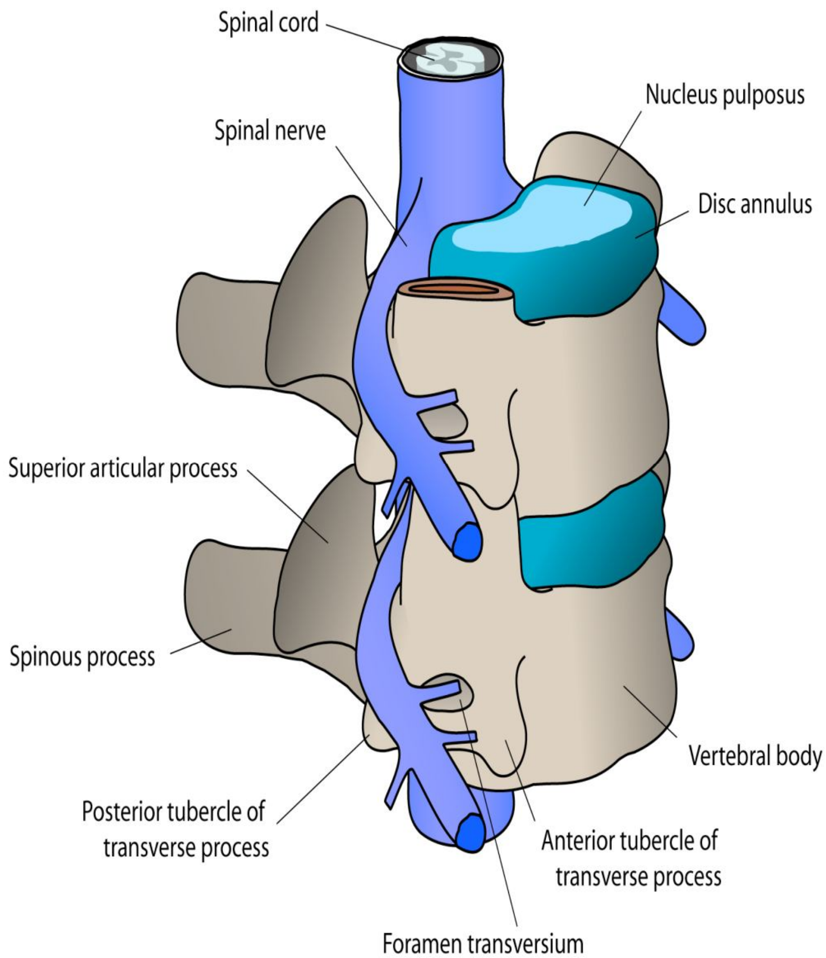

Figure (1): Illustration of the spinal cord with its nerve roots and it's relation to the cervical segments (Hain, 2007a)

Vertebro-basilar system

The vertebral artery is the first branch of the subclavian artery. It arises from the upper and back part of the first portion of the vessel. It is surrounded by a plexus of nerve fibers derived from the inferior cervical ganglion of the sympathetic trunk and ascends through the foramina in the transverse processes of the upper six cervical vertebrae.

It then, winds behind the superior articular process of the atlas and entering the skull through the foramen magnum to unite at the lower border of the pons with the vessel of the opposite side to form the basilar artery.

The vertebral artery may be divided into four parts: The first part runs upward and backward between the longus colli and the scalenus anterior. In front of it are the internal jugular and vertebral veins. It is crossed by the inferior thyroid artery. The left vertebral is crossed by the thoracic duct. Behind it are the transverse process of the seventh cervical vertebra, the sympathetic trunk and its inferior cervical ganglion.

The second part runs upward through the foramina in the transverse processes of the upper six cervical vertebrae. It is surrounded by branches from the inferior cervical sympathetic ganglion and by a plexus of veins which unite to form the vertebral vein at the lower part of the neck.

It is situated in front of the trunks of the cervical nerves, and runs upward and lateralward to the foramen in the transverse process of the atlas (Chen, et al. 2006).

The third part issues from the foramen on the medial side of the rectus capitis lateralis, curves backward behind the superior articular process of the atlas and entering the vertebral canal by passing beneath the posterior atlanto-occipital membrane. The first cervical or suboccipital nerve lies between the artery and the posterior arch of the atlas.

The fourth part pierces the dura mater and inclines medialward to the front of the medulla oblongata. At the lower border of the pons it unites with the vessel of the opposite side to form the basilar artery (Chen, et al. 2006) (figure 2 & 3).

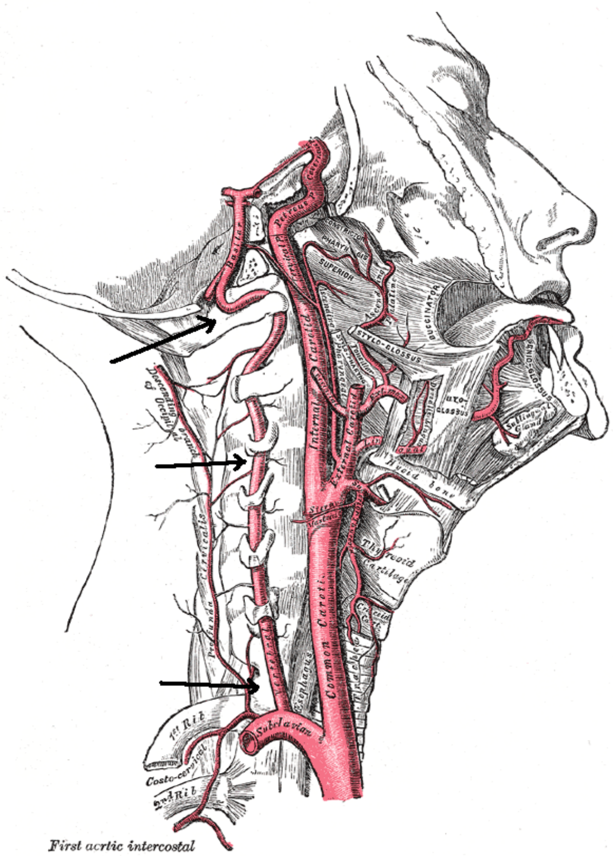

Figure (2): Arteries of the neck. The vertebral arteries arise from the subclavian arteries and join to form the basilar artery. It is pointed out, centermost of the three vertical arteries (Chen, et al. 2006).

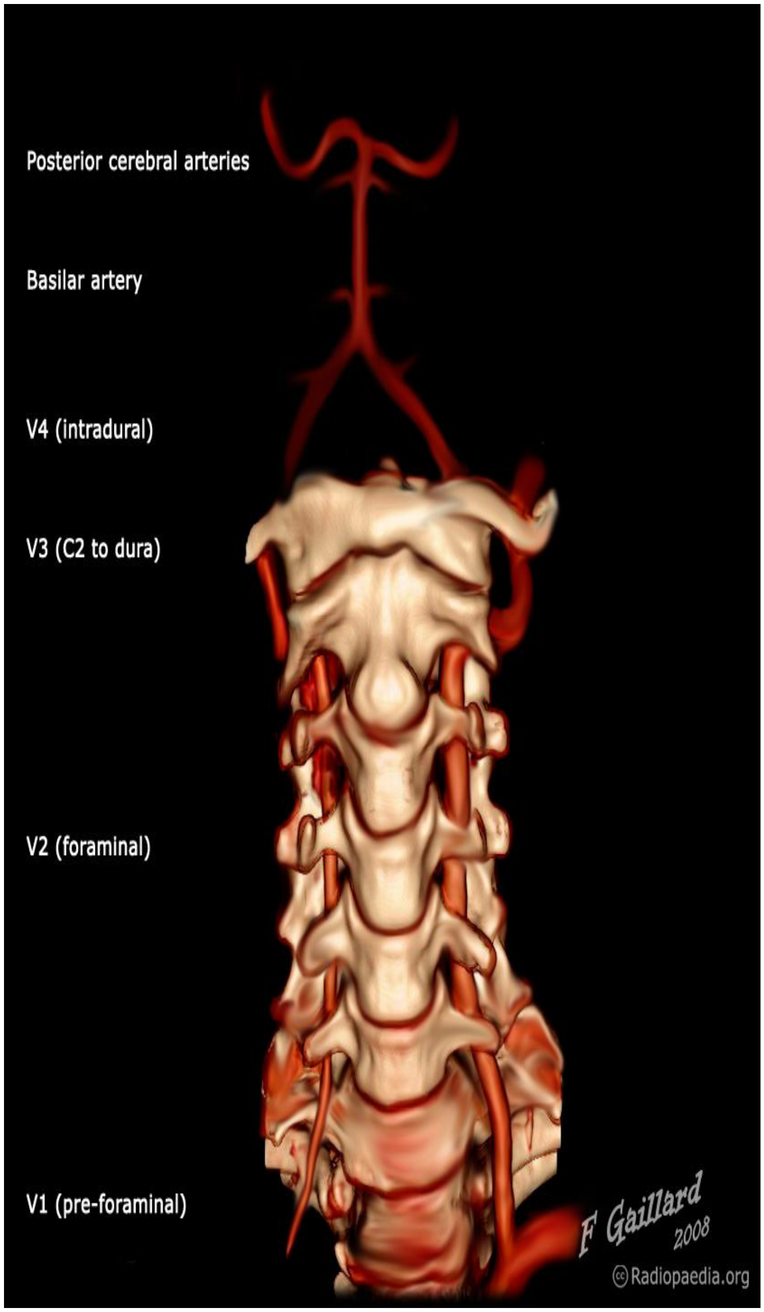

Figure (3): Cervical segments (3D) show arteries of the neck**.** The vertebral arteries arise from the subclavian arteries and join to form the basilar artery (Chen, et al. 2006).

Branches of the vertebral arteries:

The branches of the vertebral arteries may be divided into two sets, those given off in the neck and those within the cranium. Cervical branches are spinal and muscular. Cranial branches are meningeal, medullary, posterior spinal, anterior spinal and posterior inferior cerebellar (figure 4).

Spinal Branches enter the vertebral canal through the inter-vertebral foramina to supply the medulla spinalis and its membranes.

Muscular branches are given off to the deep muscles of the neck where the vertebral arteries curve around the articular process of the atlas. They anastomose with the occipital, the ascending and with deep cervical arteries.

The meningeal springs from the vertebral arteries opposite the foramen magnum and supplies the falx cerebelli.

The posterior spinal artery arises from the vertebral arteries at the side of the medulla oblongata, passing backward then descends on this structure, lying in front of the posterior roots of the spinal nerves.

The anterior spinal artery is a small branch which arises near the termination of the vertebral arteries, descending in front of the medulla oblongata, unites with its fellow of the opposite side at the level of the foramen magnum.

The posterior inferior cerebellar artery (PICA) is the largest branch of the vertebral arteries it divides into two branches. The medial branch is continued backward to the notch between the two hemispheres of the cerebellum.

The lateral one supplies the under surface of the cerebellum as far as its lateral border, where it anastomose with the anterior inferior cerebellar (AICA) and the superior cerebellar (SCA) branches of the basilar artery. Branches from this artery supply the choroid plexus of the fourth ventricle (Chen, et al. 2006).

The medullary arteries are several minute vessels which spring from the vertebral arteries and its branches and are distributed to the medulla oblongata.

The basilar artery, so named from their position at the base of the skull, is a single trunk formed by the junction of the two vertebral arteries. It extends from the lower to the upper border of the pons, lying in its median groove under cover of the arachnoid to end by dividing into the two posterior cerebral arteries.

Its branches, on either side, are the following: pontine, internal auditory, anterior inferior cerebellar, superior cerebellar and posterior cerebral arteries.

The pontine branches are a number of small vessels which come off at right angles from either side of the basilar artery and supply the pons and adjacent parts of the brain (Chen, et al. 2006).

The internal auditory artery is a long slender branch, arises from near the middle of the artery. It accompanies the acoustic nerve through the internal acoustic meatus and is distributed to the internal ear.

The anterior inferior cerebellar artery (AICA) passes backward to be distributed to the anterior part of the under surface of the cerebellum, anatomizing with the posterior inferior cerebellar branch of the vertebral.

The superior cerebellar artery (SCA) arises near the termination of the basilar artery. It passes lateralward immediately below the oculomotor nerve separating it from the posterior cerebral artery. It winds around the cerebral peduncle close to the trochlear nerve.

The posterior cerebral artery is larger than the preceding, from which it is separated near its origin by the oculomotor nerve. Passing lateralward parallel to the superior cerebellar artery and receiving the posterior communicating from the internal carotid. It winds around the cerebral peduncle and reaches the tentorial surface of the occipital lobe of the cerebrum where it breaks up into branches for the supply of the temporal and occipital lobes (Chen, et al. 2006) (figure 4).