

The positive correlation between migraine and vertigo: a review

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Many studies have focused on understanding the correlation between migraine and vertigo. It has resulted in the emergence of several theoretical perspectives on these two conditions, attempting to explain the connection between them. This paper explores a wide range of research publications on migraine and vertigo in order to present a comprehensive perspective on the correlation. Distinctive analysis of each theory facilitates a clear understanding of each in connection with migraine and vertigo; these theoretical perspectives include (a) sensory exaggerations, (b) low blood pressure, (c) ear disorders, and (d) vascular complications (i.e. stroke, neurotransmitter changes, and cerebellar disturbances). There is an established link between Meniere's disease, migraine, and vertigo. Through an analysis of results from various studies, the paper explores the relationship between Meniere's disease and migraine. A better understanding of migraine and vertigo is also vital in identifying the conditions, diagnosis, and selection of appropriate treatment options.

Keywords:

Meniere's disease, migraine, sensory exaggeration, vertigo

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Introduction

Migraine is a prevalent condition affecting a significant portion of the population [1]. It is a headache causing a pulsing sensation or intense throbbing in one area of the head. Dizziness is also known as vertigo; this is a symptom or feeling that the surrounding environment is moving or spinning. One-third of patients reporting episodes of migraine complain of dizziness/vertigo. It depicts the relationship between migraine and vertigo [2]. As a result, this raises the issue that these two factors might be correlated. Migraine is a common condition caused by a variety of factors; these factors result in a normal body response in the form of migraine [3]. A person with migraine may experience symptoms such as loss of balance, lightheadedness, and nausea [4]. Many researchers provide explanations on how migraine causes vertigo. There is a wide range of theories providing logical explanations on the correlation between the two factors; these theories are discussed in this paper. An understanding of the correlation helps in distinguishing vertigo caused by migraine from that caused by other conditions.

Sensory exaggerations

Migraine is often characterized by the occurrence of various sensory amplifications. It occurs through the eyes, ears, and joints. Phonophobia and photophobia are sensitivity to sound and light, respectively [5]. The amplifications may also be in the form of smell sensitivity, allodynia (pain from normally painless

stimuli) [6], motion sensitivity [7], sensitivity to weather and season changes, and medication sensitivity [2]. Whenever a migraine occurs, sensory amplification increases and worsens the migraine through positive feedback [8]; this occurs when a migraine causes vertigo and the vertigo's effects worsen the migraine. Whenever a migraine occurs, sensory amplification increases and worsens the migraine through positive feedback [8], this is evident when a migraine causes vertigo and the effects of vertigo in turn worsen migraine intensity. It is evident in MRI scans taken from those experiencing chronic migraine that distinctively large cortical and other related areas of the brain are involved in related sensory processes, related to brainstem circuit sensitivity [9]. Increases in the sensitivity of these evaluated regions have been evaluated as significantly contributory to the perceptual pain experience perceived by individuals suffering from recurrent migraines.

In migraine, all senses can be acute; this makes a migraine patient more likely to suffer from motion sickness [10]. It occurs because of the overloading of the sensory input due to the presence of two or more conflicting sensory streams. Vertigo and sensory

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amplification are among the symptoms of migraine exhibited by patients. Some of the sensory-related complications include double vision, tinnitus [11], decreased hearing, and simultaneous bilateral visual symptoms in both eyes [12].

Ear disorders

Many migraines are also associated with ear complications that are also related to the occurrence of vertigo [13]. The analysis of ear disorders contributing towards the correlation between migraine and vertigo focuses on Meniere's disease and benign paroxysmal positional vertigo (BPPV) [14]. Meniere's disease is a disorder of the inner ear causing spontaneous vertigo episodes, tinnitus, and fluctuating hearing loss. An estimated 50% of people with Meniere's disease exhibit symptoms similar to those of migraine. Thus, instead of using migraine-associated vertigo to determine the presence of migraine, other alternatives are used. For instance, low-tone hearing loss is a characteristic of migraine rather than Meniere's disease; this helps in creating a distinction on whether the vertigo is caused by Meniere's disease or by migraine.

Pathophysiologically, BPPV occurs because of the detachment of otoconia from the otolithic membrane in the utricle; they collect in one of the semicircular canals. When the head is motionless, gravity uses the otoconia to settle and clump. When the head moves, the otoconia moves, stimulating the cupula to send false signals to the brain causing vertigo [15,16]. BPPV and its connection to migraine can also help explain the connection between migraine and vertigo [17]. It has been noted that almost 50% of people with BPPV before the age of 50 meet the criteria for migraine based on the exhibited symptoms. The inner ear consists of canals filled with fluids [18]. The canals are responsible for balance, as they are oriented at different angles. When the head moves, the canals communicate to the brain how far, fast, and in what direction the head moved. Interruption of the process may result in vertigo. Thus, any inner ear problems such as BPPV may result in dizziness and migraine [10].

BPPV is associated with the occurrence of vestibular migraine. It is a moderate or severe headache, usually unilateral, with throbbing pain. It may last from a few hours to a few days. Vestibular Disorders Association [15,16] indicates that 40% of migraine patients have vestibular syndrome involving balance disruption. The vertigo may occur before, during, or after a migraine. Though migraine is often associated with paroxysmal vertigo of childhood or benign recurrent vertigo of adulthood [7], there are cases when migraine patients

present true BPPV; the BPPV may occur even after the migraine stops. It occurs because of a combination of vascular events and alteration of neural activity [19]. The changes interfere with utricle and/or the superior portion of the vestibular artery.

Vascular including stroke

Migraines can produce focal neurological symptoms and other structural lesions [20]. For instance, the occurrence of vascular malformations produces similar symptoms; this highlights the need for paraclinical investigations in patients with headaches and focal neurological symptoms [21]. It will provide additional evidence on the correlation between migraine and vertigo in reference to vascular malformations.

Thus, there are migraines related to vascular disorders. Migraine associated with acute ischemic cerebrovascular disease is often neglected by physicians [21]. The occurrence of migraine alongside transient ischemic attacks or strokes varies between 15 and 65% according to previous studies [21]. Migraines often occur in patients with posterior circulation ischemia, in ~10% of patients before the ischemic attack or hemorrhage. It is characterized by continuous throbbing and moderate intensity [21]. Migraine occurrence at the onset of an ischemic stroke does not help distinguish between atherothrombotic from embolic stroke [22].

In nontraumatic and traumatic intracranial hemorrhage, migraines are helpful diagnostic elements. Intracerebral hemorrhages cause migraine in 36–66% of cases [22]. It is also common in patients with head trauma who recover consciousness but then show a deterioration in their condition. Migraine is an indicator of the late development of an acute epidural or subdural hematoma [22]. It may also be characterized by neck stiffness [22].

Third, the occurrence of a migraine may also be due to a subarachnoid hemorrhage, with an abrupt onset [20]. It is severe and incapacitating. Pain is felt immediately or intensified to a maximum of 60 min for ruptured aneurysm and 12 h for an arteriovenous malformation [20]. It has characteristics associated with vertigo, such as vomiting and stiff neck [22]. The migraine may also be due to unruptured vascular malformation [20]. Other causes include arthritis, carotid or vertebral artery pain, and cerebral venous thrombosis [20].

Vascular conditions such as ischemic stroke contribute toward the development of acute vestibular syndrome

[23]. The syndrome is characterized by the occurrence of vertigo symptoms such as unsteadiness, presyncope, nausea, vomiting, intolerance to head motion, unsteady gait, and nystagmus [23]. There are also auditory symptoms associated with the occurrence of migraine, including temporary hearing loss and tinnitus [19]. It occurs because of the ischemic disturbance of the inner ear, which often occurs in association with frank infarction of the posterior circulation in the territory (supplied by the anterior inferior cerebellar artery).

Neurotransmitter changes

Patients suffering from migraine often experience irregularities in neurotransmitters. Patients cope with migraine through the use of medications manipulating serotonin – for instance, with the use of antidepressants [8]. Use of such medication often results in vertigo as a common side effect. Serotonin is a neurotransmitter regulating pain; thus a reduction in its level causes pain in the form of migraine. The pain worsens if the levels reduce during the migraine. According to Kaslow [24], low serotonin levels are associated with migraine. Serotonin is an amine neurotransmitter existing in the intestinal wall, platelets, blood vessels, and the central nervous system. It influences body conditions such as sleep, memory, appetite, learning, mood, temperature regulation, behavior, muscle contraction, cardiovascular function, endocrine regulation, platelet homeostasis, depression, motility of the gastrointestinal tract, and carcinoid tumor secretion [5].

It works alongside other neurotransmitters including norepinephrine, acetylcholine, and dopamine [25]. Before a migraine occurs, the serotonin level rises, and during a migraine the serotonin level falls. Serotonin receptors including type 1, 2, 3, and 1D are associated with the occurrence of migraine; this is because triptan medications for migraines work directly on the receptors.

The direct association between serotonin level and migraine depicts its role in migraine-associated vertigo [25] and influences the selection of medications for migraine patients. Medications that manipulate serotonin such as triptans help in the reduction of motion sickness in migraine patients [2]. As per the results of a double-blind, randomized and controlled trial of orally administered triptans, 100 mg of sumatriptan is the most common oral dose [26]. Rizatriptan (10 mg) and eletriptan (80 mg) work faster than sumatriptan, which was effective in 59% of patients. A reduction in pain is evident within 2 h of administration [26].

Cerebellar disturbances

The cerebellum contributes toward the maintenance of balance in the body. Cerebellar or brainstem disturbance is evident in the role of migraine in the alteration of metabolism in the cerebellum [5]. A reduction in cerebral blood flow plays a significant role in migraine development. It is crucial to note that migraine patients often exhibit unsteadiness associated with cerebellar changes [7]. In cases of severe migraine, they can develop profound ataxia. Many cases of migraine exhibit cerebellar findings; nystagmus is also noted in individuals with migraine [7]. According to Reinhard *et al.* [27], silent ischemic brain lesions frequently occur in migraine with aura; they are most often located in the cerebellar border zones. Such patients exhibit disturbances in the cerebral autoregulation [5].

Patients with episodic ataxia tend to suffer from migraine and some progressive cerebellar degenerative disorders [28]. Vertigo is also associated with cerebellar disturbances. One of the causes of dizziness involves the central or cerebral cortex, cerebellum, or brainstem [28]. It shows that changes in the cerebellar metabolism or circulation influence the occurrence of migraine-related dizziness [2].

Low blood pressure

Patients with migraine tend to have low blood pressure and often faint; women of child-bearing age are at a higher risk of fainting [3]. Vertigo is also directly associated with low blood pressure, as dizziness makes a person lose consciousness. Symptoms like nausea, clamminess, and pale skin are accompanied by a feeling of dizziness [29]. Such dizziness results from a drop in blood pressure or inadequate output of blood from the heart [29].

A drop in blood pressure is also known as orthostatic hypotension [29]. It is characterized by a dramatic decrease in systolic blood pressure, which results in lightheadedness. It often occurs after sitting up or standing up too quickly. Inadequate output of blood from the heart is also a major factor in the occurrence of low blood pressure. Various heart diseases may interfere with and cause the flow of blood from the heart to decrease [29]. Such diseases include cardiomyopathies, arrhythmias, or a decrease in blood volume [30]. Normal blood pressure is defined as 120/80 mmHg; measures below that may exhibit cases of hypotension. Due to decreased blood pressure perfusion potentially limiting oxygen content delivered to the brain, affected individuals can potentially develop migraine-associated orthostasis, dizziness,

and syncope (fainting). Therefore, the treatment of hypotension can prevent migraine-related symptoms [31].

Meniere's disease, migraine, and vertigo-associated migraine

Meniere's disease is a condition described in 1861 by Prosper Meniere. It is a disorder of the inner ear causing episodes of vertigo, a feeling of fullness or pressure in the ear, ringing in the ear (tinnitus), and fluctuating hearing loss [17]. It affects the entire labyrinth, including both the semicircular canals and the cochlea [8].

Vertigo is caused by the progressive distension of the membranous labyrinth known as endolymphatic hydropsy [10]. As a result, there is injury to the vestibular system, causing vertigo [10]. The association of Meniere's disease with vertigo-associated migraine also emerges in its etiology. One of the causes of Meniere's disease is vascular; these vascular factors are major contributors to the occurrence of migraine and vertigo associated with it; there is also an association between Meniere's disease and migraine through similarities in the symptoms of both conditions [32]. There are studies linking Meniere's disease to blood vessel vasoconstriction, which is similar to those causing migraine headaches. The resultant low blood pressure causes symptoms similar to those of vertigo-associated migraine [33].

Subsequently, some patients with Meniere's disease tend to suffer from migraine [7]. It increases chances of confusion between migraine-related vertigo and Meniere's disease during diagnosis [7]. The symptoms of migraine-related vertigo and Meniere's disease are closely similar and may be confused. For instance, some of the neurological symptoms of migraine-related vertigo include ear pain (otalgia), ear fullness, ringing in the ear, migratory scalp pain, nausea, vomiting, heightened light sensitivity, difficulty talking, visual changes, facial numbness, and mental confusion [19]. Some of these characteristics are also found in Meniere's disease, such as nausea, vomiting, ringing in the ear, vertigo, and ear fullness [34].

The link is also evident in the treatment options for both conditions. In Meniere's disease, the dietary changes, medications, and surgical procedures are aimed at suppressing the conditions that cause vertigo. Surgical destruction of the inner ear structure also occurs through damage of nerve endings from administration of drugs, destroying their sensitivity [35]. In the treatment of

migraines, the options focus on the reduction and prevention of vertigo spells and neurological symptoms resulting in acute migraine. It occurs through the blockage of the neurogenic inflammation produced by antidromic electrical stimulation of the trigeminal afferents, vasoconstriction, and action on the serotonergic receptors [34].

The symptoms of Meniere's disease and migraine and the link between the two conditions are areas of interest. According to Minor [36], the two conditions may coexist because of the poor understanding of the pathophysiologic characteristics of Meniere's disease and migraine; it is hard to determine which one is the cause of episodic vertigo [19]. Further research and accumulation of knowledge of both conditions may reveal that they emerge from a related cause. Both conditions also have a variable clinical course, which makes the assessment of treatment outcome a difficult task [17]. However, if one medical management approach fails, an alternative should be considered. Because of the close relationship between migraine and Meniere's disease, the diagnosis of the cause of vertigo, and selection of an efficient approach to treatment, remains a clinical challenge. It is crucial to note that future longitudinal analyses of treatment outcomes, and studies on the pathophysiologic characteristics and genetic links of migraine and Meniere's disease, will help in enhancing the treatment options [36].

Conclusion

The correlation between migraine and vertigo is complex and relates to a variety of theories including (a) sensory exaggerations, (b) low blood pressure, (c) ear disorders, and (d) vascular complications (i.e. stroke, neurotransmitter changes, and cerebellar disturbances). The paper explores arguments that have developed from a variety of studies supporting the view that vertigo and migraine have a link [1]. The prevalence of migraine is also enhanced in some of the well-defined vestibular disorders such as BPPV and Meniere's disease. An analysis of the link between migraine and Meniere's disease also provides a basis for the distinction between vertigo caused by Meniere's disease and that by migraine. It validates the results of studies that show a connection between migraine and other vertigo-related disorders like Meniere's disease; this allows understanding from a wider perspective according to Brandt [7]. Studies on the various theoretical approaches toward understanding the correlation between vertigo and migraine present various explanations supported by empirical evidence from experiments and studies. The information can be

used in a scientific manner to enhance the clinical diagnosis and management of disorders leading to vertigo and migraine. It occurs through an increase in knowledge on the pathogenesis of both vertigo and migraine [6].

Conflicts of interest

There are no conflicts of interest.

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