Central and peripheral vertigo: Neurological and otorhinolaryngological approaches

https://doi.org/10.56238/sevened2024.012-056

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ABSTRACT

Vertigo is a common symptom in several clinical conditions, and may have a central or peripheral origin. The differential diagnosis between these forms is crucial to guide appropriate treatment and prevent complications. This study aims to analyze the neurological and otorhinolaryngological approaches to central and peripheral vertigo, highlighting diagnostic methods, therapeutic approaches, and pathophysiological differences. A descriptive and qualitative literature review was carried out, using electronic databases and selection of articles relevant to the theme. Specific diagnostic methods, such as the Dix-Hallpike maneuver and magnetic resonance imaging, are essential to differentiate between central and peripheral vertigo. Therapeutic approaches include repositioning maneuvers, vestibular rehabilitation, and pharmacological therapy. Pathophysiological differences between the forms of vertigo influence the clinical management and prognosis

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of patients. Understanding the differences between central and peripheral vertigo is crucial for accurate diagnosis and effective treatment. Complementary therapeutic approaches, such as acupuncture and craniosacral therapy, may offer additional benefits to patients. A multidisciplinary and patient-centered approach is essential to ensure satisfactory outcomes and improve the quality of life of individuals affected by vertigo.

Keywords: Vertigo, Differential Diagnosis, Therapy, Pathophysiology, Multidisciplinary Treatment.

INTRODUCTION

Vertigo is a clinical symptom frequently reported by patients in medical emergencies, characterized by the illusory sensation of movement, usually rotation, which may be accompanied by imbalance, nausea, and vomiting (1). The differentiation between central and peripheral vertigo is essential for proper diagnosis and treatment, since the causes and therapeutic approaches vary considerably between these two types of vertigo (3).

Peripheral vertigo originates from dysfunctions in the inner ear and vestibular nerves, while central vertigo results from changes in the central nervous system, specifically in the brain regions responsible for controlling balance (2). The most common causes of peripheral vertigo include Benign Paroxysmal Positional Vertigo (BPPV), Meniere's Disease and Vestibular Neuritis (9). Central vertigo, on the other hand, can be caused by conditions such as stroke, multiple sclerosis and brain tumors (10).

BPPV is the most common cause of peripheral vertigo, characterized by brief episodes of vertigo triggered by changes in head position. This condition is caused by the displacement of otoliths in the semicircular canals of the inner ear, leading to anomalous stimulation of the vestibular system (1). The diagnosis of BPPV is often clinical, based on the patient's history and the performance of specific maneuvers, such as the Dix-Hallpike maneuver, which triggers the characteristic symptoms (3).

Ménière's disease is another common cause of peripheral vertigo, characterized by recurrent episodes of severe vertigo, accompanied by hearing loss, tinnitus, and a feeling of pressure in the ear (4). The pathophysiology of Ménière's disease involves an increase in endolymphatic fluid pressure in the inner ear, leading to dysfunction of the vestibular and auditory systems (5). The diagnosis is clinical and is based on the presence of characteristic symptoms, and it is important to exclude other causes of vertigo (6).

Vestibular neuritis is an inflammation of the vestibular nerve, usually of viral origin, which leads to intense vertigo, of sudden onset, without hearing impairment (11). The diagnosis is clinical, based on the exclusion of other causes of vertigo, and can be confirmed through imaging tests, such as magnetic resonance imaging, which may show signs of inflammation in the vestibular nerve (10).

On the other hand, central vertigo is often associated with more serious conditions such as stroke, multiple sclerosis, and brain tumors. Stroke can cause central vertigo when it affects the areas of the brain responsible for balance, such as the brainstem and cerebellum (2). Patients with central vertigo often have other neurological signs, such as changes in speech, muscle weakness, and loss of coordination (12).

Multiple sclerosis is a chronic inflammatory disease of the central nervous system that can cause central vertigo due to demyelination of the nerve pathways that control balance (5). Symptoms

of vertigo in multiple sclerosis can be intermittent and vary in intensity depending on the location and extent of the demyelinating lesions (11).

Brain tumors can also cause central vertigo, especially when located in the cerebellum or brain stem. These tumors can compress structures critical for balance and coordination, leading to symptoms of vertigo, along with other neurological signs (1). Diagnosing brain tumors often requires advanced imaging tests, such as MRI, to identify the location and extent of the tumor (6).

The diagnostic approach to vertigo should be systematic and comprehensive, including a detailed history, complete physical and neurological examination, and, when necessary, complementary tests (1). The history should include questions about the duration, frequency, intensity, and triggering factors of vertigo, as well as the presence of associated symptoms, such as hearing loss, tinnitus, nausea, and vomiting (2). Physical examination should include assessment of balance, coordination, and vestibular function, using specific tests such as the Dix-Hallpike maneuver for BPPV and the head impulse test for vestibular neuritis (12).

Imaging tests, such as computed tomography (CT) and magnetic resonance imaging (MRI), are often needed to exclude central causes of vertigo, such as stroke and brain tumors (11). In addition, audiometric tests may be useful to assess hearing function in patients with suspected peripheral vertigo associated with inner ear diseases (1).

The therapeutic approach to vertigo varies depending on the underlying cause. In the case of BPPV, canalicular repositioning maneuvers, such as the Epley maneuver, are effective in relieving symptoms (1). For Ménière's disease, treatment may include dietary changes, medications to reduce endolymphatic fluid pressure, and, in severe cases, surgical procedures (4).

Vestibular neuritis can be treated with medications to relieve symptoms and, in some cases, with vestibular rehabilitation to help regain balance (11). For central vertigo, treatment should be directed at the underlying cause, such as the use of anticoagulants for stroke, immunomodulatory drugs for multiple sclerosis, and surgery for brain tumors (12).

Thus, vertigo, whether of central or peripheral origin, represents a significant diagnostic and therapeutic challenge. Proper differentiation between these two types of vertigo and identification of the underlying cause are critical for the effective management of patients and for improving quality of life (3).

The objective of this research is to analyze and synthesize the neurological and otorhinolaryngological approaches to central and peripheral vertigo, identifying the main diagnostic and therapeutic methods used. In addition, it seeks to understand the pathophysiological differences between the two types of vertigo and to highlight the importance of a multidisciplinary approach in the management of patients.

METHODOLOGY

This research is a descriptive and qualitative literature review, as described by Gonçalves J.R. (2019)(13). Scientific articles, dissertations, theses, and books published between 2019 and 2024, in Portuguese and English, that addressed aspects of central and peripheral vertigo were included. The electronic databases consulted included PubMed, Scielo, LILACS and Google Scholar, using keywords such as "central vertigo", "peripheral vertigo", "neurological approaches" and "otorhinolaryngological approaches".

Data were collected by reading and analyzing the titles and abstracts of the identified studies. The articles that met the inclusion criteria were thoroughly read to extract the pertinent information. The qualitative analysis involved the identification of patterns, themes and categories that emerged from the data, using the content analysis technique to categorize and interpret the findings in order to answer the research question.

As this is a literature review, no research ethics committee approvals were required. Every care was taken to ensure integrity and ethics in the conduct and reporting of the research, respecting copyright and properly citing all sources used.

RESULTS AND DISCUSSION

DIAGNOSTIC METHODS IN CENTRAL AND PERIPHERAL VERTIGO

The differentiation between central and peripheral vertigo is essential for the proper management of patients. Peripheral vertigo usually involves dysfunctions in the inner ear and vestibular nerves, while central vertigo is related to changes in the central nervous system, specifically in the brain regions responsible for balance control (1,2). Accurate diagnostic methods are essential to correctly identify the cause of vertigo.

The Dix-Hallpike maneuver is a widely used clinical test to diagnose Benign Paroxysmal Positional Vertigo (BPPV), the most common cause of peripheral vertigo. This test causes the otoliths to be displaced in the semicircular canals of the inner ear, triggering characteristic vertigo and nystagmus (3). Studies indicate that the Dix-Hallpike maneuver has high sensitivity and specificity, making it an effective tool in the diagnosis of BPPV (3).

For central vertigo, magnetic resonance imaging (MRI) is a crucial imaging test. MRI allows detailed visualization of brain structures, identifying ischemic lesions, tumors, or demyelination, which are common in conditions such as stroke and multiple sclerosis (4). Computed tomography (CT) can also be used, especially in emergency situations, due to its speed and accessibility, although it has lower resolution for lesions of the brainstem and cerebellum (5).

In addition to imaging, audiometric tests are useful to assess hearing function in patients with suspected peripheral vertigo associated with inner ear diseases. Pure tone audiometry and impedance

metry are often used to identify hearing loss and changes in ossicular chain mobility and Eustachian tube function (6).

Laboratory tests can also help in the differential diagnosis. Blood tests to check glucose, electrolyte and thyroid function levels can reveal underlying conditions that contribute to vertigo symptoms (7). Cerebrospinal fluid analysis may be necessary in suspected cases of infections or inflammatory diseases of the central nervous system (8).

Therefore, the combination of clinical, imaging, and laboratory tests is essential for a comprehensive evaluation of patients with vertigo. Appropriate use of these diagnostic tools can significantly improve diagnostic accuracy and treatment efficacy (1,2).

THERAPEUTIC APPROACHES AND MULTIDISCIPLINARY INTERVENTIONS

The treatment of vertigo varies according to its origin, and a multidisciplinary approach involving neurologists, otorhinolaryngologists and other health professionals is essential. Benign Paroxysmal Positional Vertigo (BPPV), for example, responds well to canalicular repositioning maneuvers, such as the Epley maneuver, which helps to dislodge the otoliths outside the semicircular canals, relieving symptoms (1).

Ménière's disease, characterized by recurrent episodes of vertigo, hearing loss, tinnitus, and a feeling of pressure in the ear, requires a more complex approach. Dietary changes, such as reducing salt intake, can help manage symptoms (2). Diuretic medications and betahistine are also commonly used to reduce endolymphatic fluid pressure (3). In severe cases, surgical procedures, such as endolymphatic sac decompression, may be necessary (4).

Vestibular neuritis, usually caused by a viral infection, is initially treated with medications to relieve symptoms of vertigo and nausea, such as antihistamines and benzodiazepines (5). Vestibular rehabilitation, which involves specific exercises to improve balance and coordination, is a crucial part of long-term treatment (6).

For central vertigo, treatment should focus on the underlying condition. In the case of stroke, the use of anticoagulants and thrombolytic agents may be necessary to prevent further damage (7). Multiple sclerosis can be treated with immunomodulatory medications, such as interferons and glatiramer acetate, which help reduce the frequency and severity of flare-ups (8). Brain tumors may require surgery, radiation therapy, or chemotherapy, depending on their location and type (9).

The importance of a multidisciplinary approach cannot be underestimated. Collaboration between neurologists, otolaryngologists, physical therapists, and speech pathologists is essential for the development of effective and personalized treatment plans. For example, the inclusion of speech therapy in the management of Ménière's Syndrome has shown significant benefits in the auditory and vestibular rehabilitation of patients (10).

In addition, aquatic physical therapy has been shown to be an effective vestibular rehabilitation option, providing a safe and controlled environment for performing balance and coordination exercises (11). Studies show that patients undergoing aquatic physical therapy programs have a significant improvement in vertigo symptoms and quality of life (11).

The treatment of vertigo requires an integrated approach that combines different specialties and therapies to meet the specific needs of each patient. Multidisciplinary collaboration is crucial to ensure effective management and improve clinical outcomes (1,2).

PATHOPHYSIOLOGICAL DIFFERENCES AND CLINICAL IMPLICATIONS

The pathophysiological differences between central and peripheral vertigo are critical for the proper diagnosis and treatment of these conditions. In peripheral vertigo, symptoms are often attributed to dysfunctions in the inner ear and vestibular nerves, resulting in an illusory sense of movement. BPPV, for example, is caused by the presence of displaced otoliths in the semicircular canals of the inner ear, leading to anomalous stimulation of the vestibular system in certain positions of the head (1). On the other hand, central vertigo results from changes in the central nervous system, including brain regions responsible for processing and integrating vestibular information.

The clinical implications of these pathophysiological differences are significant and directly influence the clinical management of patients. For example, while peripheral vertigo often responds well to vestibular repositioning and rehabilitation maneuvers, central vertigo may require more specific and targeted therapeutic approaches to treat the underlying cause. In cases of central vertigo related to neurological conditions, such as stroke or multiple sclerosis, treatment may include pharmacological therapies to control symptoms and reduce the risk of recurrence (2). Additionally, central vertigo may be associated with more serious complications, such as impaired balance and mobility, and requires careful monitoring and intervention to prevent further complications.

Understanding the pathophysiological differences between central and peripheral vertigo also has important implications for patient prognosis. In general, peripheral vertigo tends to have a more favorable prognosis, with a high rate of spontaneous resolution or significant improvement in symptoms over time. On the other hand, central vertigo can be more challenging to treat and may be associated with an increased risk of long-term complications, such as deficits in balance and vestibular function (3). Therefore, careful evaluation and a multidisciplinary approach are essential to ensure proper management and ongoing follow-up of patients with central vertigo.

In addition to the pathophysiological differences, it is important to consider the distinct clinical manifestations associated with central and peripheral vertigo. In peripheral vertigo, patients often experience symptoms such as nausea, vomiting, and sweating during vertigo episodes, along with characteristic nystagmus and postural imbalance (4). On the other hand, central vertigo may be

associated with additional neurological symptoms, such as muscle weakness, speech changes, and visual disturbances, which may provide important clues about the underlying cause of vertigo (5). The identification and characterization of these symptoms are crucial to guide the differential diagnosis and determine the most appropriate therapeutic approach for each patient.

The pathophysiological differences between central and peripheral vertigo have important clinical implications for the diagnosis, treatment, and prognosis of patients. A comprehensive understanding of these differences is essential to ensure proper management and ongoing follow-up of patients with vertigo, highlighting the importance of a multidisciplinary and individualized approach to each case.

TECHNOLOGICAL ADVANCES AND FUTURE PERSPECTIVES IN THE EVALUATION AND TREATMENT OF VERTIGO

Technological advances play an increasingly significant role in the assessment and treatment of vertigo, offering new tools and approaches for better understanding and management of this complex clinical condition. A rapidly expanding area is the application of remote sensing and monitoring technologies for objective assessment of vertigo symptoms and vestibular function. Handheld devices, such as accelerometers and gyroscopes, can be utilized to record and analyze head and body movements in real time, providing valuable data on the severity and frequency of vertigo episodes, as well as abnormal movement patterns that may indicate vestibular dysfunction (1).

In addition, virtual reality (VR) and augmented reality (AR) are increasingly being explored as vestibular rehabilitation tools, offering immersive and interactive virtual environments for training and therapeutic exercises. These technologies allow them to simulate challenging and varied situations, such as walking on uneven surfaces or performing specific balance tasks, providing a more engaging and personalized training experience for patients (2). Additionally, VR and AR can be utilized as assessment tools, allowing healthcare professionals to quantify vestibular performance and monitor progress over time.

Another significant advance in the assessment of vertigo is functional neuroimaging, which allows direct visualization of brain regions involved in the processing and integration of vestibular information. Techniques such as functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) can provide insights into neuronal activity during the occurrence of vertigo episodes and help identify abnormal patterns of neural connectivity associated with vestibular disorders (3). This information may be useful to guide the differential diagnosis and develop more targeted and effective therapeutic strategies for patients with vertigo.

Future perspectives in the evaluation and treatment of vertigo include the development of gene and pharmacological therapies aimed at correcting specific dysfunctions in the vestibular

system. Advances in understanding the molecular mechanisms underlying vestibular disorders, such as Ménière's disease and vestibular migraine, are opening up new opportunities for the development of personalized and targeted treatments aimed at restoring normal vestibular function and relieving vertigo symptoms (4). In addition, innovative approaches, such as non-invasive brain stimulation and gene therapy, are being explored as potential strategies to modulate neural activity and restore vestibular homeostasis in patients with vertigo refractory to conventional treatments.

Technological advances are transforming the way we assess and treat vertigo, offering new tools and approaches for better understanding and management of this complex clinical condition. The integration of remote sensing technologies, virtual reality, functional neuroimaging, and targeted therapies promises to significantly improve the diagnosis and treatment of vertigo, providing a more accurate, effective, and personalized approach for patients with this condition.

COMPLEMENTARY AND ALTERNATIVE THERAPEUTIC APPROACHES IN VERTIGO

In addition to conventional therapeutic approaches, several complementary and alternative modalities have been explored in the management of vertigo, offering additional options for patients seeking symptom relief. One of these modalities is acupuncture, an ancient practice of traditional Chinese medicine that involves inserting needles into specific points on the body to restore energy balance and promote healing. Clinical studies have shown that acupuncture can be effective in relieving vertigo and other vestibular disorders, helping to reduce the frequency and severity of vertigo episodes and improving patients' quality of life (1). Proposed mechanisms include the regulation of neural activity and the modulation of the inflammatory response in the vestibular system.

Another complementary therapeutic approach is craniosacral therapy, a gentle form of manual manipulation that aims to improve cerebrospinal fluid flow and restore balance and harmony in the body. Craniosacral therapy has been used in the treatment of a variety of neurological disorders, including vertigo, and can help relieve symptoms and promote overall well-being for patients. Preliminary studies suggest that craniosacral therapy may have beneficial effects in reducing the intensity and frequency of vertigo episodes, although more research is needed to confirm its efficacy and mechanisms of action (2).

In addition, lifestyle-based approaches, such as diet and exercise, play an important role in the management of vertigo, helping to reduce risk factors and promote the overall health of the vestibular system. A balanced diet, rich in essential nutrients like magnesium, vitamin D, and omega-3s, can help reduce inflammation and improve vestibular function, while regular practice of balance and coordination exercises can strengthen muscles and improve postural stability, thereby reducing the risk of falls and vertigo-related injuries (3).

In addition to therapeutic approaches, psychosocial and supportive interventions can play an important role in managing vertigo by helping patients cope with the emotional and psychological aspects of the condition. Cognitive behavioral therapy (CBT), for example, can help patients identify and modify negative thought patterns and maladaptive behaviors related to vertigo, thereby reducing the anxiety and stress associated with the condition. In addition, support groups and educational programs can provide a social support network and useful information about coping strategies and resources available to cope with vertigo on a day-to-day basis (4).

Complementary and alternative therapeutic approaches offer additional options in the management of vertigo by providing a holistic and integrative approach to the treatment of this complex condition. Integrating these modalities into clinical care can help improve patient outcomes and promote a more personalized, patient-centered approach to vertigo management.

CONCLUSION

Understanding the complementary and alternative therapeutic approaches in vertigo provides a more comprehensive insight into the treatment options available. These modalities offer a holistic approach to the management of vertigo, considering not only the physical but also the emotional and psychosocial aspects of the condition. Integrating these approaches into clinical care can provide additional benefits to patients by improving their quality of life and promoting a more complete recovery.

By exploring therapeutic options beyond conventional approaches, healthcare providers can offer patients a wider range of choices for vertigo management. However, it is important to note that these complementary and alternative approaches are not a substitute for standard treatments, but can be used as part of an integrated care strategy. In addition, more research is needed to evaluate the efficacy and safety of these modalities in different clinical settings and patient populations.

Ultimately, individualization of vertigo treatment is essential, taking into account the needs and preferences of each patient. By taking a patient-centered approach, healthcare providers can collaborate with patients to develop personalized treatment plans that take into account not only the medical aspects of the condition but also its emotional, social, and psychological dimensions. This integrative, patient-centered approach has the potential to significantly improve patient outcomes and promote a more comprehensive and compassionate approach to vertigo management.

In summary, by recognizing and exploring complementary and alternative therapeutic approaches in vertigo, healthcare providers can provide patients with additional options for treating the condition. These modalities, when integrated into a multidisciplinary and patient-centered approach, have the potential to improve quality of life and promote a more complete and sustainable recovery for patients suffering from vertigo.

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