

A LITERATURE REVIEW STUDY ON VARIOUS TYPES OF VERTIGO

^{*1}Sreenu Thalla, ²Bhukya Moshe Nayak, ²Jakkampudi Nikhitha, ²Datla Bhavya Reddy, ²Nemalikanti Viharika, ³Puttagunta Srinivasa Babu

^{*1}Department of Pharmacology, Vignan Pharmacy College (Autonomous), Vadlamudi, Guntur, Andhra Pradesh.

²Department of Pharmacy Practice, Vignan Pharmacy College (Autonomous), Vadlamudi, Guntur, Andhra Pradesh.

³Department of Pharmaceutics, Vignan Pharmacy College (Autonomous), Vadlamudi, Guntur, Andhra Pradesh.



*Corresponding Author: Sreenu Thalla

Department of Pharmacology, Vignan Pharmacy College (Autonomous), Vadlamudi, Guntur, Andhra Pradesh.

Article Received on 18/10/2024

Article Revised on 07/11/2024

Article Accepted on 27/11/2024

ABSTRACT

Vertigo is a prevalent clinical symptom characterized by the illusion of movement, typically described as a spinning sensation, which can significantly impact an individual's quality of life. It arises from disturbances in the vestibular system, which includes the inner ear and central pathways that process balance and spatial orientation. Vertigo can be classified into two main types: peripheral and central. Peripheral vertigo, often resulting from conditions such as Benign Paroxysmal Positional Vertigo (BPPV), vestibular neuritis, and Meniere's disease, is usually associated with specific triggers and episodes. Central vertigo, on the other hand, is linked to neurological disorders, including strokes and multiple sclerosis, and often presents with more complex symptoms. Diagnosis typically involves a thorough clinical history, physical examination, and specialized tests such as the Dix-Hallpike maneuver or vestibular function tests. Management strategies vary depending on the underlying cause and may include medication, vestibular rehabilitation, and lifestyle modifications. Understanding the multifaceted nature of vertigo is essential for accurate diagnosis and effective treatment, allowing healthcare providers to implement targeted interventions that can alleviate symptoms and improve patient outcomes.

INTRODUCTION

Vertigo is the illusion of motion, usually rotational motion. As patients age, vertigo becomes an increasingly common presenting complaint. The most common causes of this condition are benign paroxysmal positional vertigo, acute vestibular neuronitis or labyrinthitis, Ménière's disease, migraine, and anxiety disorders. Less common causes include vertebrobasilar ischemia and retrocochlear tumors. The distinction between peripheral and central vertigo usually can be made clinically and guides management decisions. Most patients with vertigo do not require extensive diagnostic testing and can be treated in the primary care setting. Benign paroxysmal positional vertigo usually improves with a canalith repositioning procedure. Acute vestibular neuronitis or labyrinthitis improves with initial stabilizing measures and a vestibular suppressant medication, followed by vestibular rehabilitation exercises. Meniere's disease often responds to the combination of a low-salt diet and diuretics. Vertiginous migraine headaches generally improve with dietary changes, a tricyclic antidepressant, and a beta blocker or calcium channel blocker. Vertigo associated with anxiety usually responds to a selective serotonin reuptake inhibitor.^[1] A spinning feeling, nausea, vomiting, dizziness, and loss of balance are common symptoms that can be made worse by head movements or certain visual stimuli. Depending on the

underlying cause, these episodes might last anywhere from a few seconds to several hours. Based on a neurotologic survey of the general population, 1-year prevalence estimates for vertigo were 4.9%, for migrainous vertigo 0.89% and for benign paroxysmal positional vertigo 1.6%. Diagnostic positional manoeuvres and treatments for benign paroxysmal positional vertigo, however, are still not being done by most doctors. The female preponderance among patients with benign paroxysmal positional vertigo and migrainous vertigo may be linked to migraine but is not fully understood. A recently reported prevalence of Meniere's disease of 0.51% is much higher than previous estimates. Follow-up studies have shown benign paroxysmal positional vertigo recurrence rates of 50% at 5 years and a persistence of dizziness related to anxiety in almost a third of patients 1 year after vestibular neuritis.^[2] The majority of vertigo cases are caused by benign paroxysmal positional vertigo, acute vestibular neuronitis, and Meniere's disease; however, family doctors must also take into account migraine, cerebral vascular disease, psychological disorders, perilymphatic fistulas, multiple sclerosis, and intracranial tumors. Finding out if a patient has a central or peripheral cause of vertigo comes next when it has been established that the patient has vertigo.^[3] Making this difference is made easier by being aware of the usual clinical appearances of

the many causes of vertigo. The diagnosis necessitates a thorough clinical evaluation that includes the patient's history and physical examination. Imaging studies, like as CT or MRI scans, may be necessary to rule out more serious issues, even if some treatments, such the Dix-Hallpike maneuver, can help identify a cause.

METHODOLOGY

At the study location, clinical evaluations, patient interviews, and diagnostic testing will be used to collect data. Medical histories, symptom evaluations, and pertinent vestibular function testing will all be part of this.

RESULTS AND DISCUSSIONS

Brian Sheng Yeo *et al.*, (2024), Dizziness is a debilitating symptom experienced by 20%–30% in the population, especially those with vertigo. Among the types of vertigo, people with Benign Paroxysmal Positional Vertigo (BPPV) display high levels of disability and suffer from lower quality of life. BPPV is a condition where patients have episodes of vertigo with sudden changes in head position, because otoconia particles have been displaced from the otolithic membrane in the inner ear. Well-known symptoms of BPPV include impaired balance, tiredness, slower walking speed, greater number of falls, and motion intolerance. However, an issue that remains unaddressed is the association of anxiety and depression with this condition. Abrupt episodes of dizziness caused by BPPV may lead to patients feeling anxious because of its paroxysmal nature.^[4]

Daniel B. Hilton. *et al.*, (2024) Vertigo is defined as a sensation or feeling of motion, especially spinning, when there is no actual movement of the patient or their surroundings. Migraine-associated vertigo occurs when vertigo is the main symptom of the patient's migraine presentation. This type of migraine is now more uniformly referred to as vestibular migraine (VM). Older terms for this condition include migraine-associated vertigo, migraine-related vestibulopathy, and migrainous vertigo. In VM, patients often experience a sensation described as a "to-and-fro" motion, which can complicate the diagnosis process. Simultaneous headaches do not always accompany these vestibular symptoms. Consequently, a detailed patient history and comprehensive multispecialty evaluation are pivotal for an accurate diagnosis.^[5]

Frank A Orlando. *et al.*, (2024), Vertigo, an unexpected feeling of self-motion, is no longer characterized simply by symptom quality but by using triggers and timing. Evaluating vertigo by triggers and timing not only distinguishes serious central causes from benign peripheral causes, but also narrows the differential diagnosis by further classifying vertigo as spontaneous episodic vestibular syndrome, triggered episodic vestibular syndrome, or acute vestibular syndrome. A targeted physical examination can then be used to further

delineate the cause within each of these three vestibular categories. Neuroimaging and vestibular testing are not routinely recommended. In the management of vertigo, vestibular hypofunction can be treated with vestibular rehabilitation, which can be self-administered or directed by a physical therapist. Pharmacotherapy sometimes is indicated for vertigo based on triggers, timing, and the specific condition, but it is not always beneficial and is used more often for symptom reduction than as a cure. Transtympanic corticosteroid or gentamicin injections are recommended for patients who do not benefit from nonablative therapy. Surgical ablative therapy is reserved for patients who have not benefited from less definitive therapy and have unusable hearing.^[6]

Claire E. J. Cerian. *et al.*, (2024) Vestibular migraine is an underdiagnosed disorder. It may present with a wide range of symptoms, but only a few are represented in the diagnostic criteria. Familiarity with the other non-vertiginous symptoms may help clinicians recognize this diagnosis more often, especially when vertigo is not the patient's main concern. As many of these symptoms may present in migraine more generally as well, knowledge of the broad range of possible presentations should improve patient care. Many patients who could benefit from migraine therapy will be missed if only the most common migraine symptoms are assessed.^[7]

Andreas Zwergala and Marianne Dieterich. *et al.*, (2023) said that patients presenting with acute vertigo and dizziness account for approximately 4% of all emergency department visits and 20% of neurological consultations. Most cases are due to benign conditions, with benign paroxysmal positional vertigo (BPPV), orthostatic hypotension, acute unilateral vestibulopathy, vestibular migraine, and Ménière's disease being the most common. To prevent misdiagnosis of critical conditions like cerebrovascular events, it is essential for emergency departments to follow a standardized assessment protocol for patients with acute vertigo and dizziness.^[8]

Hyo-Jung Kim. *et al.*, (2023) Benign paroxysmal positional vertigo (BPPV) is a common condition characterized by sudden episodes of vertigo triggered by changes in head position relative to gravity. The condition arises from the migration of degenerated otoconia into the semicircular canals, making them abnormally sensitive to head movements. BPPV is the leading cause of dizziness and vertigo worldwide, with a lifetime prevalence of 2.4%, a 1-year prevalence of 1.6%, and a 1-year incidence of 0.6%. It accounts for 24.1% of all hospital visits related to dizziness and vertigo. BPPV most frequently affects elderly women, peaking in incidence during their sixties, with a women-to-men ratio of 2.4:1. Although considered benign, BPPV has significant socio-economic implications. Advancements in remote diagnostic devices for BPPV are showing promise, offering potential breakthroughs in detection. While physical therapy is a well-established treatment, emerging evidence suggests that vitamin D

supplementation may benefit a subgroup of patients with low serum vitamin D levels.^[9]

Jeremy Chee. *et al.*, (2023) Being an AI tool, lacks the ability to process certain nuances in clinical decision making, in both identifying atypical dizziness, as well as in recommending further examination steps to elucidate a clearer diagnosis. We believe that AI will continue to forge ahead in the medical field. Merging the immense knowledge base of AI programming with the nuances of clinical assessment and knowledge integration will surely enhance patient care in the years to come. The model accurately provided differentials for both vestibular and non-vestibular causes of dizziness, with the correct diagnosis presented first in six of the cases, with important limitations. Eight hypothetical scenarios were presented to ChatGPT, which included varying clinical pictures and types of prompts. The responses given by ChatGPT were evaluated for coherence, clarity, consistency, accuracy, appropriateness, and recognition of limitations. ChatGPT provided coherent and logical responses.^[10]

Pauwels. *et al.*, (2023) Benign paroxysmal positional vertigo (BPPV) is the most commonly reported vestibular disorder. The age of onset of BPPV is most often between 50 and 70 years, and affects more women than men (2.4:1). BPPV is caused by dislodged otoconia from the utricular macula in the inner ear. When otoconia migrate into one of the semicircular canals or attach to the cupula of the ampullae, deflection of the cupula occurs. As a result, BPPV causes positional nystagmus and short repeated episodes of rotational vertigo induced by head position changes in the plane of the semicircular canals. People with BPPV (pw BPPV) can experience symptoms of vertigo, imbalance, and nausea. Moreover, due to its higher prevalence in women and its association with osteoporosis, pw BPPV have a 1.14-fold elevated risk of fractures from falls compared with those without BPPV. BPPV is diagnosed when nystagmus is provoked during positional tests, such as Dix-Hallpike and supine roll, depending on the involved canal. It can be cured using noninvasive treatment approaches called particle repositioning maneuvers (PRM), such as the Epley maneuver, Sémont maneuver, or barbeque roll maneuver. With PRM, the therapist aims to relocate the dislodged otoconia by performing consecutive movements in the plane of the affected semicircular canal to relieve the symptoms of BPPV.^[11]

Katharina Feil. *et al.*, (2023) Vertigo and dizziness comprise a multisensory and multidisciplinary syndrome of different etiologies. The term "cerebellar vertigo and dizziness" comprises a heterogeneous group of disorders with clinical signs of cerebellar dysfunction and is caused by vestibulo-cerebellar, vestibulo-spinal or cerebellar systems. About 10 % of patients in an outpatient clinic for vertigo and balance disorders suffer from cerebellar vertigo and dizziness. According to the

course of the symptoms, one can consider 3 types: permanent complaints, recurrent episodes of vertigo and balance disorders, or an acute onset of complaints. The most common diagnoses in patients with cerebellar vertigo and dizziness were as follows: degenerative disease, hereditary forms and acquired forms. In a subgroup of patients with cerebellar vertigo, central cerebellar oculomotor dysfunction is indeed the only clinical correlate of the described symptoms. 81 % of patients with cerebellar vertigo suffer from permanent, persistent vertigo and dizziness, 31 % from vertigo attacks, and 21 % from both. Typical clinical cerebellar signs, including gait and limb ataxia or dysarthria, were found less frequently. Key to diagnosis is a focused history as well as a thorough clinical examination with particular attention to oculomotor function. Regarding oculomotor examination, the most common findings were saccadic smooth pursuit, gaze-evoked nystagmus, provocation nystagmus, rebound nystagmus, central fixation nystagmus, most commonly downbeat nystagmus, and disturbances of saccades. Thus, oculomotor examination is very sensitive in diagnosing cerebellar vertigo and dizziness, but not specific in distinguishing different etiologies. Laboratory examinations using posturography and a standardized gait analysis can support the diagnosis, but also help to estimate the risk of falls and to quantify the course and possible symptomatic treatment effects. Patients with cerebellar vertigo and dizziness should receive multimodal treatment.^[12]

Jonathan A. Edlow. *et al.*, (2023) summarizes the systematic assessment of the dizzy patient who presents with peripheral vertigo. It demonstrates the steps and tests necessary using the Triage- Timing-Trigger-Test (Triage + TiTraTe) method to accurately diagnose the underlying most probable cause while ruling out life-threatening causes. A systematic approach to the management of vertigo is more accurate than subcategorizing patients based on the question, "What do you mean by dizzy?". Use the Dix-Hallpike to diagnose posterior canal-triggered episodic vertigo then treat with an Epley or Semont maneuver. Use HINTS 1 hearing loss to diagnose acute vestibular neuritis. Reserve MRI and central nervous system workup for groups that neither have benign paroxysmal positional vertigo nor acute vestibular neuritis based on Triage, Timing, Triggers, and Targeted Exam 1 Tests (Triage 1 TiTraTe 1 Tests). Never perform computed tomography for dizziness unless there is a possible risk of intracranial bleeding, such as patients on anticoagulation or trauma, although posterior fossa hemorrhages usually present with headache and changes in mental status.^[13]

Sofia Waissbluth. *et al.*, (2023) The initial description of Lindsay-Hemenway syndrome was positional vertigo followed by an acute unilateral peripheral vestibulopathy. A suggested aetiology was vascular. There is conflicting information about the relationship between cardiovascular risk factors and benign

paroxysmal positional vertigo caused by acute unilateral peripheral vestibulopathy. The purpose of the study was to compare patients with idiopathic benign paroxysmal positional vertigo and those with benign paroxysmal positional vertigo secondary to acute unilateral peripheral vestibulopathy in terms of the prevalence of cardiovascular risk factors, as well as differences in the affected semicircular canals, past history of benign paroxysmal positional vertigo, and response to repositioning manoeuvres.^[14]

Takao Imai. *et, al*, (2023), Benign paroxysmal positional vertigo (BPPV) is the most common cause of vertigo and is characterized by positional nystagmus. BPPV can be treated using the canalith repositioning procedure (CRP), which is more effective than a sham maneuver, medication alone, or no treatment. The Epley maneuver (EM) is a type of CRP effective for treating benign paroxysmal positional vertigo of the posterior canal (pc-BPPV). However, the efficacy of the EM is comparable to that of other CRPs, such as the Semont and Gans maneuvers. The treatment of BPPV using the EM, Semont maneuver, or Gans maneuver has immediate effects. For instance, following the EM, the characteristic positional nystagmus can no longer be observed, as assessed using the Dix–Hallpike (DH) test. By contrast, sham maneuvers, medication alone, and no treatment do not show such effects, thus demonstrating the superiority of CRP maneuvers for treating BPPV. The repeated performance of the DH test for assessing positional nystagmus in patients with pc-BPPV gives rise to BPPV fatigue, where the positional nystagmus and dizziness/vertigo decrease with each repetition.^[15]

Virginia Fancello. *et, al*, (2023), The age-related deterioration of vestibular function seems to be linked to a decreased number of vestibular hair cells and neurons, although alterations affecting the central pathways are also reported. Despite this evidence, a cross-sectional analysis of the US National Health Care Survey, focusing on clinical pathways for balance disorders in older adults surprisingly revealed that an ENT/vestibular consultation has been performed in only 16.8% of elderly subjects with vertigo, even though audio-vestibular complications account for at least 21.5% of the cases. Due to the presence of many possible vertigo etiologies, a systematic and structured approach is always valuable and crucial in the identification of the underlying pathologies and the choice of the best treatment and rehabilitation program. Moreover, very often the course of vertigo becomes chronic or recurrent and the subsequent psychological issues (fear about vertigo onset), comorbidities and concomitant symptoms, can affect the patient's ability to manage these aspects in daily life.^[16]

Vishal Paresh Shah. *et, al*, (2023) Dizziness and vertigo are common symptoms in patients presenting to the emergency department (ED) accounting for 3.3% to 4% of ED visits. Emergency clinicians must distinguish the

majority of patients who will have a benign and self-limiting etiology of symptoms from the serious causes that can have short- and long-term consequences. Dizziness has a heterogeneous presentation and workup, with significant ED resource use, prolonged length of stay, and increasing imaging costs overtime. Low-sensitivity neuroimaging such as noncontrast CT is extensively used, and this represents an opportunity to reduce health care costs. In fact, existing evidence suggests that physical examination maneuvers are more sensitive than MRI early after symptom onset in certain subset of dizzy patients such as those with the acute vestibular syndrome (AVS). A good history and physical examination are tools clinicians should use to risk stratify and narrow the differential diagnosis of these patients. The classic teaching focused on the character of dizziness (i.e., “What do you mean by dizzy?”) is associated with misdiagnosis.^[17]

Gurberg J. *et, al*, (2023) Benign paroxysmal vertigo of childhood (or recurrent vertigo of childhood) is the most common cause of vertigo in young children. It is considered a pediatric migraine variant or precursor disorder, and children with the condition have an increased likelihood of developing migraine later in life than the general population. Episodes are typically associated with room-spinning vertigo in conjunction with other migrainous symptoms (e.g. pallor, nausea, etc.), but it is rarely associated with headaches. Episodes typically only last for a few minutes and occur with a frequency of days to weeks without interictal symptoms or exam/test abnormalities. Treatment is rarely necessary, but migraine therapy may be beneficial in cases where episodes are particularly severe, frequent, and/or prolonged. An appreciation of the typical presentation and characteristics of this common condition is essential to any provider responsible for the care of children with migraine disorders and/or dizziness. This chapter will review the current literature on this condition, including its proposed pathophysiology, clinical presentation, and management. This chapter also includes a brief introduction to pediatric vestibular disorders, including relevant anatomy, physiology, embryology/development, history-taking, physical examination, testing, and a review of other common causes of pediatric dizziness/vertigo.^[18]

Yao K. *et, al*, (2023) As a prevalent vertigo disease in the clinic, isolated transient vertigo can present as a vertigo episode without focal signs and always free of symptoms on presentation. Previous studies showed a part of isolated transient vertigo events had a high risk of stroke during follow-up. However, how to discern posterior circulation ischemia become a great challenge for clinicians, especially in emergency, neurology, and ENT departments. Routine besides, hematological, and imaging examinations are often difficult provide a clear etiological diagnosis. Hence, this article reviews current knowledge about the epidemiology, risk factors, offending lesions, and clinical manifestation of transient

ischemic attack (TIA) presenting as isolated transient vertigo. In addition, we summarize several advances in besides examinations, serum biomarkers, and imaging technologies to better identify stroke events. Finally, the current situation of therapy was briefly retrospected. Here we present a critical clinical puzzle that needs to be solved in the future. Of note, there is a still lack of high-quality studies in this field. The article reviews the keys to the diagnosis of isolated transient vertigo due to TIA and provides us with more methods to screen for high-risk stroke populations.^[19]

Benjamin Nham. *et al.*, (2022) In AVS, we employed “Quantitative-HINTS plus” (Head-Impulse, Nystagmus and Test-of-Skew quantified by vHIT and VOG, audiometry) to identify vestibular-neuritis (VN) and stroke (41.2 and 31.1%). vHIT gain ≤ 0.72 , catch-up saccade amplitude $> 1.4^\circ$, saccade-frequency $> 154\%$, and unidirectional horizontal-nystagmus, separated stroke from VN with 93.1% sensitivity and 88.5% specificity. In ESV, 66.2 and 14% were diagnosed with vestibular migraine and Meniere’s Disease by using history and audiometry. Horizontal-nystagmus velocity was lower in migraine $0.4 \pm 1.6^\circ/\text{s}$ than Meniere’s $5.7 \pm 5.5^\circ/\text{s}$ ($p < 0.01$). In EPV, benign positional vertigo (BPV) was identified in 82.3% using VOG. Paroxysmal positional-nystagmus lasting < 60 s separated BPV from non-BPV with 90% sensitivity and 100% specificity.^[20]

Benton R Hunter. *et al.*, (2022) Vertigo is the sensation of movement (typically rotatory) and is frequently associated with nausea or imbalance. It effects up to 20% of adults, with a higher incidence in women and older individuals. Curative treatment can sometimes be tailored to the specific underlying cause, but medications are frequently used to suppress vertigo symptoms. Repositioning techniques are the preferred treatment for benign positional paroxysmal vertigo (BPPV). However, medications are also frequently prescribed, perhaps because many patients experience ongoing symptoms despite treatment with repositioning maneuvers. Antihistamines and benzodiazepines are frequently prescribed as “vestibular suppressants” for vertigo. Although treatment based on acute vertigo etiology is recommended, a specific cause is not always immediately identified. Symptom control for acute vertigo with vestibular suppressants may be indicated with or without a definitive diagnosis, and the efficacy of these medications remains unclear. In this systematic review and meta-analysis, we assessed the relative efficacy of benzodiazepines and antihistamines when compared with each other, other active comparators, placebo, or no intervention in the treatment of acute vertigo from any underlying cause.^[21]

Shayna R Cole. *et al.*, (2022) Benign paroxysmal positional vertigo (BPPV), caused by wayward crystals (“rocks”) in the semicircular canals of the inner ear, is the most common cause of brief symptoms of vertigo secondary to head and body movements. Diagnosing and

treating it are simple to do in the medical office. This article reviews the differential diagnosis for patients presenting with dizziness and vertigo, the pathophysiology of BPPV, how to diagnose it using maneuvers to elicit symptoms and nystagmus, how to interpret the nystagmus pattern to determine where the rocks are, and how to treat it using different maneuvers to reposition (“roll”) the rocks back where they belong.^[22]

George Korres. *et al.*, (2022) The spectrum of neurologic syndromes known to be caused by COVID-19 encompasses encephalitis, meningitis, demyelination and Guillain–Barre Syndrome. amongst other. Direct viral invasion of the brain leading to clinical encephalitis was confirmed by the presence of SARS-CoV-2 in the cerebrospinal fluid (CSF) of patients with COVID-19 through genome sequencing. 6The inner ear is considered a privileged immunological site due to the absence of lymphatic drainage as well as to the presence of an effective hemato-labyrinthine barrier. The hemato-labyrinthine barrier in the stria vascularis is a highly specialized network that controls ion exchanges between the blood and the interstitial space in the cochlea (and, presumably, also the vestibule), necessary to maintain the ionic gradient and the endocochlear potential for the active processes of mechanical-electrical transduction of the inner and outer hair cells. Local immunity is regulated by the endolymphatic sac, the main antigen-processing site, and its destruction causes a reduction of the immune response in the inner ear.^[23]

JingYu Chen. *et al.*, (2022) Meniere’s disease (MD) represents one of the vertigo disorders characterized by triad symptoms (recurrent vertigo, fluctuating hearing loss, tinnitus or ear fullness). The diagnosis of MD relies on the accurate and detailed taking of medical history, and the differentiation between MD and vestibular migraine (VM) is of critical importance from the perspective of the treatment efficacy. VM is a highly prevalent vertigo condition and its typical symptoms (headache, vestibular symptoms, cochlear symptoms) mimic those of MD. Furthermore, the misdiagnosis in MD and VM could lead to VM patients mistakenly receiving the traumatic treatment protocol designed for MD, and sustaining unnecessary damage to the inner ear. Fortunately, thanks to the advances in examination technologies, the barriers to their differentiation are being gradually removed. These advances enhance the diagnostic accuracy of vertigo diseases, especially VM and MD. This review focused on the differentiation of VM and MD, with an attempt to synthesize existing data on the relevant battery of differentiation diagnosis (covering core symptoms, auxiliary tests [audiometry, vestibular tests, endolymphatic hydrops tests]) and longitudinal follow-up. Since the two illnesses are overlapped in all aspects, no single test is sufficiently specific on its own, however, patterns containing all or at least some features boost specificity.^[24]

Jonathan A Edlow. *et, al*, (2022) Acute dizziness or vertigo is a frequent presentation in emergency departments (EDs), making up 2.1% to 3.6% of visits annually. The yearly cost of ED visits in the US is estimated to be around \$10 billion, much of which is connected to imaging. Compared to patients with other primary complaints, these patients have higher resource utilisation and longer ED stays. While the percentage of studies that are diagnostically valuable is declining, the use of neuroimaging in the emergency department (ED), particularly noncontrast computed tomography of the head (CT), is increasing with time.^[25]

JS Kim. *et, al*, (2022) Vertigo/dizziness is one of the most common symptoms of posterior circulation stroke [Its onset is typically acute and may be prolonged (≥ 24 hours, acute prolonged vertigo/dizziness) or transient (<24 hours, transient vertigo/dizziness). Transient vertigo/dizziness may recur in episodes (recurrent spontaneous vertigo/dizziness). An isolated positional vestibular syndrome (or recurrent positional vertigo/dizziness) due to vascular vertigo/dizziness is rare. Vertigo/dizziness in cerebrovascular disorders is usually accompanied by other neurological symptoms and signs]. Recent advances in clinical neuro-otology/neuro-ophthalmology and neuroimaging have led to a consensus that strokes involving the brainstem or cerebellum can also present with isolated vertigo/dizziness or imbalance. Patients with vascular vertigo/dizziness typically present with acute vestibular syndrome (AVS), which refers to the acute onset of vertigo or dizziness with nausea or vomiting, head-motion intolerance, and unsteadiness. Depending on the presentation, vascular vertigo/dizziness can be divided into acute prolonged vascular vertigo/dizziness and transient vascular vertigo/dizziness. Acute prolonged vascular vertigo/dizziness refers to symptoms lasting 24 hours or more. Finally, transient vertigo/dizziness is also one of the most common manifestations of vertebrobasilar ischemia and is occasionally isolated.^[26]

Konstanze Dunker. *et, al*, (2022) Recurrent Vertigo of Childhood” (RVC) has recently replaced the term “Benign Paroxysmal Vertigo of Childhood” and was defined as recurrent spells of vertigo without evidence of a vestibular migraine of childhood (VMC). RVC and VMC are considered the most frequent causes of vertigo and dizziness in children below 18 years of age. Diagnosis might be challenging since clinical features of RVC and VMC may overlap. RVC, as recently defined by the Bárány Society, is characterized by at least three episodes with vestibular symptoms of moderate or severe intensity, lasting between 1 min and 72 h without a current or past history of migraine with or without aura and associated migraine features in over 50% of episodes in children and adolescents below 18 years of age. The syndrome was first described in 1964 by Basser with an onset at the age of four. It was labelled “Benign Paroxysmal Vertigo of Childhood” due to the spontaneous cessation of attacks between ages 8–10

without persistent vestibular or neurological deficits. Among “dizzy” children and adolescents, RCV is diagnosed in about 18–23% of cases and constitutes the second most frequent diagnosis in patients under the age of 18. Notably, the proportion of children with RCV has been shown to be especially high] in children under the age of seven (71–87.5%) and between seven and 12 years (30%). Symptom remission typically occurs between 3 months to 8 years after onset, but may persist longer in some children/adolescents or may be followed by the diagnosis of migraine The underlying pathophysiology of RVC is still unknown, but a possible link with migraine has been suggested due to a high reported prevalence of migraine in children suffering from RVC.^[27]

Augusto Pietro Casani. *et, al*, (2021), The terms ‘dizziness’ and ‘vertigo’ are commonly used to indicate a variety of symptoms regarding disorders of spatial orientation and motion perception; older patients tend to report less rotatory vertigo and more non-specific dizziness and unsteadiness than younger patients presenting with the same conditions, for this reason, a detailed patient history is key for diagnosis. Normal balance is the result of the interaction between the inputs derived by the peripheral vestibular system (semicircular canals and otolith organs), which are integrated in the vestibular nuclei with proprioceptive and visual information. As a result of the integration of these three different perceptive inputs, the central nervous system (CNS) generates a series of reflexes that guarantee proper balance. A wide range of neurotransmitters underlie this highly complex neural activity, among which glutamate, acetylcholine, and glycine play a relevant role and are further modulated by histamine, adrenaline, and noradrenaline.^[28]

Camille Gerlier and Maëlle Hoarau. *et, al*, (2021) In emergency departments (EDs), vertigo, unsteadiness, and imbalance are often reported problems. There are various restrictions on our investigation. First, the examiner& interpretation of the STANDING assessment may have been skewed due to the sequence in which the tests were administered: HINTS first, followed by STANDING. By guaranteeing the examiner& independence from care administration, we were able to reduce this prejudice. It was not possible for us to evaluate interobserver reliability by having two separate examiners administer each clinical test. As far as we are aware, only the STANDING validation research assessed this metric in an emergency department. On 129 patients, it demonstrated strong overall reliability ($\kappa = 0.83$). Additionally, we did not evaluate each person & diagnostic accuracy or baseline knowledge after training. Nonetheless, our study offered a fascinating perspective on how trained EPs perceive eye-movement evaluations.^[29]

Di Mauro. *et, al*, (2021) Adverse effects observed in Italy after administration of these vaccines, are recorded in the

COVID-19 Vaccine Surveillance Report drawn up by the Italian Medicines Agency (AIFA). As of August 2021, 91,360 reports of adverse events following vaccination have been entered in the National Pharmacovigilance Network, out of 76,509,846 vaccine doses (119/100,000 administered doses). Approximately 86.1% of adverse effects reports entered refer to non-serious events, and 13.8% to serious adverse events. The efforts of the scientific community to prevent coronavirus disease 2019 (COVID-19) associated mortality and morbidity have resulted in multiple vaccines worldwide available and approved for use. Severe acute respiratory syndrome coronavirus spike (S) glycoprotein is the main target for current vaccines, since antibodies directed against SARSCoV-2 spike can block the fusion between the virus and host cell membrane, inhibiting the infection. Adverse effects observed in Italy after administration of these vaccines, are recorded in the COVID-19 Vaccine Surveillance Report drawn up by the Italian Medicines Agency (AIFA) (4). As of August 2021, 91,360 reports of adverse events following vaccination have been entered in the National Pharmacovigilance Network, out of 76,509,846 vaccine doses (119/100,000 administered doses). Approximately 86.1% of adverse effects reports entered refer to non-serious events, and 13.8% to serious adverse events.^[30]

Jinbao Chen. *et, al*, (2021) Benign paroxysmal positional vertigo is one of the most common vestibular diseases, especially in the elderly. Although the treatment of BPPV is relatively successful, many patients suffer recurrence after treatment. Therefore, identifying potential risk factors for BPPV recurrence may help improve treatment outcome and patient prognosis. However, some related risk factors for BPPV recurrence are relatively controversial and poorly studied. This meta-analysis aims to identify potential risk factors associated with BPPV recurrence, thereby reducing the recurrence rate of BPPV and improving the prognosis of patients. This meta-analysis indicated that female gender, hypertension, diabetes mellitus, hyperlipidemia, osteoporosis, and vitamin D deficiency were risk factors for BPPV recurrence. However, the effects of other potential risk factors including advanced age, migraine, head trauma, and Menière's disease on BPPV recurrence need further investigations.^[31]

João Lemos and Michael Strupp. *et, al*, (2021) Clinically, atypical forms of its peripheral counterpart, benign paroxysmal positional vertigo (BPPV), such as a downwardly and torsionally beating nystagmus as in anterior canal BPPV or a linear horizontal nystagmus as in horizontal canal BPPV, are often indicative of central positional nystagmus (CPN). Pathophysiologically, brainstem and/or cerebellar dysfunction is the aetiology of CPN. More understanding of the many clinical manifestations and the underlying pathomechanisms has been made possible by recent studies. Up to 12% of people with positional nystagmus may have CPN.^[32]

Michael Strupp. *et, al*, (2021) The function of the peripheral vestibular system can be quantified using the video head impulse test (vHIT) for the high frequency of the angular vestibulo-ocular reflex (aVOR), caloric testing for the low frequency of the aVOR of the semicircular canals, and vestibular evoked myogenic potentials (VEMP) for the otolith organs. These laboratory tests are used worldwide in clinical practice and in research. For instance, 360+ articles listed on PubMed have been published with the vHIT and 1500+ with the VEMP. In particular, while working on the classification of vestibular disorders, such as bilateral vestibulopathy or acute unilateral vestibulopathy (UVP) ("vestibular neuritis"), we realized that there seems to be a wide range of what are assumed to be "normal" and "pathologic" values for the outcome parameters of these laboratory tests in terms of absolute values and side differences. This also became apparent during elaboration of the current practice guidelines for cervical VEMP (cVEMP) and ocular VEMP (oVEMP). Important methodological issues are the variety in devices, variety in test conditions and test execution, different stimulation and recording techniques, various ways of analyzing and interpreting the data, and the fact that "normative values" derive from various sources.^[33]

Sun-Uk Lee. *et, al*, (2021) Pure or predominant downbeat nystagmus is generally considered a central sign, mostly caused by lesions involving the vestibulocerebellum. Asymmetry of the vertical vestibulo-ocular reflex (VOR) favoring upward eye motion is one of the proposed mechanisms of downbeat nystagmus, which may occur in peripheral as well as central vestibular lesions. In peripheral vestibular lesions, however, relative hypofunction of both posterior semicircular canals (PCs) or hyperfunction of both anterior semicircular canals (ACs) are required to generate pure downbeat nystagmus, which explains the rarity of this nystagmus in peripheral vestibulopathy. Alternately, disinhibition and resultant hyperfunction of the upward VOR pathways have been presumed to explain downbeat nystagmus in vestibulocerebellar lesion. Other proposed mechanisms for downbeat nystagmus include impaired neural integrator function for vertical eye movements, asymmetric vertical smooth pursuit or otolithic dysfunction.^[34]

Virginia Fancello. *et, al*, (2021) Vertigo or dizziness are relatively infrequent in paediatric patients, but specific data on the prevalence of this condition is limited and influenced by various factors, including the age of the examined group. A retrospective review of 561,151 patients performed by O'Reilly *et al* identified a 0.4% prevalence of balance impairment related to otologic and neuro-otologic diagnoses, while the prevalence of dizziness and imbalance in the paediatric population has been estimated to be about 5.6% in the United States. However, a survey performed among school-children revealed that 15% of them have experienced disequilibrium at least once. These heterogeneous

prevalence data reflect the difficulties of an exhaustive assessment. Children are not “little” adults, and although they can be affected by the same diseases as adults, their clinical manifestations can be very different, especially since they are often incapable of expressing their complaints or describing their symptoms. The vestibular system (and the neural pathway in particular) is not fully developed until the early teen years, and paediatric patients also have a high ability of adaptation and compensation due to higher neural plasticity. Vestibular dysfunction can be present in childhood with various and sometimes unspecific symptoms, such as visual disturbance, migraine, unbalance or learning disability. A significant association with sensorineural hearing loss, syncope, and headaches was noticed. Due to the presence of many possible aetiologies, a systematic and structured approach, often involving Paediatricians, Neurologists and Otorhinolaryngologists, is always valuable and crucial to avoid misdiagnosis.^[35]

Fan Huang. *et al.*, (2020) Cervical Vertigo (CV) might be considered to be a disorder of the cervical spine after excluding other causes. The main symptoms of CV are dizziness, nausea, vomiting, neck pain, and fainting when turning the head or laterally bending the neck to a certain position. A survey by Hannaford *et al.* found that approximately 21% of 15788 participants in Scotland suffered from dizziness. Research has indicated that vertigo is likely to be associated with advanced degenerative changes of the cervical spine, so cervical spondylosis with vertigo is more common among elderly individuals. The pathological basis of CV is the narrowness of and insufficient blood supply from the vertebral artery. Current evidence indicates that Tuina is effective and safe for the management of CV. Nevertheless, the level from the GRADE system is low due to the low quality of the included RCTs. More high-quality, large-sample, and multicenter studies are expected to confirm the effectiveness of Tuina in treating CV. Furthermore, it is recommended that the biomechanical characteristics of CV treated by Tuina should be systematically studied in RCTs and that internationally recognized guidelines for CV should be established in the future.^[36]

G. ALTISSIMI. *et al.*, (2020) Ototoxicity is an undesirable effect of some drugs that induce reversible and irreversible damage of the inner ear structures, including the cochlea and the vestibule, causing temporary or permanent hearing loss, tinnitus and/or balance alterations. Cochlear damage manifests through sensorineural hearing loss and tinnitus. Tinnitus can be associated to hearing loss or appear in the absence of clinically evident hearing alterations; tinnitus may also be a consequence of central drug-induced alterations. Vestibular injury may cause balance disorders, such as instability, difficulty in maintaining straight posture, unsteadiness, loss of balance and dizziness. Ototoxic effects depend on duration of therapy, route of administration, infusion rate, dosage, individual

sensitivity, genetic predisposition and altered renal and hepatic functions. Drug classes most associated with ototoxicity include antibiotics, such as aminoglycosides, glycopeptides and macrolides, platinum-based antitumor drugs, loop diuretics, such as furosemide, antimalarial drugs, such as quinine and chloroquine, nonsteroidal anti-inflammatory drugs (NSAIDs) and acetylsalicylic acid. General practitioners, otolaryngology, neurology and audiology specialists should be aware of possible audio-vestibular side effects of drugs, such as hearing loss, tinnitus, dizziness and vertigo, a practical tool to rapidly identify potential audio-vestibular side effects of drugs as reported by the pharmaceutical companies and/or health agencies.^[37]

Hyun Ah Kim. *et al.*, (2020) Isolated dizziness and vertigo due to vascular mechanisms are frequently misdiagnosed as peripheral vestibulopathy or vestibular migraine. For diagnosis of strokes presenting with an acute prolonged (24 hours) vestibular syndrome, findings on clinical examination, such as HINTS (negative head impulse tests, detection of direction changing gaze-evoked nystagmus, and presence of skew deviation), are more sensitive than findings on neuroimaging. Since HINTS alone cannot securely detect anterior inferior cerebellar artery strokes, additional attention should be paid to the patients with unexplained hearing loss in addition to acute prolonged vestibulopathy. For diagnosis of transient (< 24 hours) spontaneous vestibular syndrome due to vascular mechanisms, the presence of associated craniocervical pain and focal neurological symptoms/signs is the clue. Even without these symptoms or signs, however, vascular imaging combined with perfusion- and diffusion-weighted MRI should be performed in patients with multiple vascular risk factors or a high ABCD2 score (age, blood pressure, clinical features, duration of symptom, and presence of diabetes).^[38]

Kemar E. Green. *et al.*, (2020) Patients with acute vestibular disorders are often a diagnostic challenge for neurologists – especially when the evaluation must be conducted remotely. The clinical dilemma remains: Does the patient have a benign peripheral inner ear problem or a worrisome central vestibular disorder, such as a stroke? The use of a focused history and the virtual HINTS (Head Impulse test, Nystagmus evaluation, and Test of Skew) examination are key steps towards correctly diagnosing and triaging the acute vertiginous patient. When looking for signs of vestibulo-ocular dysfunction, there are important technological and practical considerations for an effective clinical interpretation.^[39]

Laura Power. *et al.*, (2020) This study offers insight into the ‘real world’ of BPPV management. Hitherto, similar studies have been performed in tertiary referral centres where access limitations have precluded the data collection of acute BPPV assessment and management. Based on our data, we recommend when if the patient history is suggestive of BPPV, repeated positional testing

within the same session be conducted to confirm or refute the diagnosis of BPPV. Repeated testing and treatment within the same session is a safe and more efficient approach to treatment, with a low risk of canal conversion. In PC BPPV, vertigo and nystagmus during the EM are not indicative of treatment success. Performing the DHP and SRT (as relevant) remain the only indicators of treatment outcome. We strongly recommend, if patients do not respond promptly to CRP, further investigation is mandatory to exclude cerebellar or brainstem structural pathology.^[40]

Nouama Bouanani. *et al*, (2020) Hodgkin's lymphoma is associated with multiple paraneoplastic neurological syndromes of which cerebellar degeneration is the most characterized one. Association with vertigo is exceptional and sometimes it can be the only presenting feature of an underlying Hodgkin's lymphoma posing a diagnostic challenge. Many paraneoplastic neurological syndromes have been described in association to Hodgkin's lymphoma but peripheral vestibular syndrome is a very rare presentation. Seronegativity for paraneoplastic antibodies should not delay diagnosis and treatment of paraneoplastic neurological syndromes. Indeed, the cornerstone of treatment is adequate management of the underlying malignancy.^[41]

Qi Pan. *et al*, (2020) Recurrent vertigo is one of the most common complaints in neurologic clinics, affecting 89% of patients with vestibular vertigo, and it always leads to medical consultations. In 1979, Slater first described benign recurrent vertigo (BRV) in adult patients who presented with recurrent vertigo that lasted from several minutes to hours without neurologic or any auditory symptoms. Several terms have also been used for this condition: benign paroxysmal vertigo (BPV), recurrent vestibulopathy (RV), migrainous vertigo, and migraine-associated vertigo, considering that there is no approved medication for BRV, a few open-label studies have suggested that preventive drugs for migraine, such as flunarizine, might be effective.²⁰ Thus, these patients with high frequency (more than once a month) or severe vertiginous episodes received flunarizine (5 mg per day) as preventive medication for at least 3 months, and the remaining patients-initiated lifestyle adaptations due to the low frequency and benign nature of the vertigo attacks. Benign recurrent vertigo presented as the sudden onset of recurrent vertigo attacks that lasted for less than 72 hours and occurred predominantly in middle-aged women. The outcomes of patients with BRV were benign, and the frequency of vertigo was significantly reduced. Few cases developed into vestibular migraine, but none developed into Meniere's disease. We suggest that more preclinical and clinical studies should be carried out to explore the pathological mechanism of BRV.^[42]

Seo-Young Choi. *et al*, (2020) Benign paroxysmal positional vertigo (BPPV) is characterized by brief spinning sensations, which are generally induced by a

change in head position with respect to gravity. Because the free-floating or cupula-attached otolith debris induce abnormal lymph flow within the semicircular canals (SCCs), the sense of rotation is induced depending on the head position. According to the fundamental pathophysiology based on abnormal endolymph flow due to the free-floating debris, the positional nystagmus in canalolithiasis type of BPPV should be stopped when the head kept at the final position during positioning maneuvers, since the otolith debris would be at standstill. However, spontaneous reversal of positional nystagmus (SRPN), which is defined as spontaneous reversal of initial geotropic nystagmus without any head movement in horizontal canal (HC) has been occasionally reported. Since this study was based on the data from tertiary referral centers, the results from this study may not be applied to the community hospitals or the ambulatory care units. Our study included the small sample size of HC-BPPV with SRPN and consequent underpowered analysis, particularly for the various measures of positional nystagmus and treatment outcome. We eliminated patients with bilateral SRPN in HC-BPPV from the analysis because it was not clear which side more contributed to adaptation process. A selection bias is also possible because we analyzed positional nystagmus only in patients with clear tracing. PC-BPPV stimulate ipsilateral superior oblique muscle of which primary action is cyclotorsion, and torsional component of positional nystagmus may be wellcorrelated with the degree of excitation. However, due to poor recording with artifact in torsional tracing in the majority of patients with PC-BPPV, we could analyze vertical component of positional nystagmus only.^[43]

Verena Regauer...*et al.*, (2020) Vertigo, dizziness and balance disorders (VDB) are the most relevant factors influencing the burden of disability among older adults. and are associated with immobility, limitations in activities of daily living (ADL) and decreased participation. VDB are frequent complaints of older people with a reported prevalence up to 50% and the prevalence tends to increase with age. Complaints of VDB are distinct risk factors for falls, and even the fear of falling may lead to activity restriction and disability. Especially in older individuals, a unique underlying cause of VDB is difficult to determine because of multifactorial potential underlying pathomechanisms in the vestibular, visual and proprioceptive systems. Vestibular rehabilitation in any variation seems to be effective in treating older adults with VDB. The same applied to VR in addition to CRMs. Overall, quality of evidence is rather low, especially in regard to bias. Many physical therapy intervention studies focus on surrogate markers, such as specific postural or muscle functions than on patient relevant outcomes that reflect mobility and participation. In addition, there is a lack of transparent reporting of PT interventions as complex interventions what makes it hard to implement findings into day-to-day care. High-quality randomized trials need to be carried out in future to inform clinical decision

making for the highly vulnerable group of older patients with VDB.^[44]

Vishal Mandge. *et al.*, (2020) Acute isolated vertigo was considered to be of peripheral vestibular origin, thus suggesting a relatively benign etiology. However, the literature presented over the past decade gives persuasive evidence that acute isolated vertigo can be the sole manifestation of ischemic strokes occurring in the territory of the vertebrobasilar arteries, also called posterior circulation strokes.¹⁻⁹ Posterior circulation strokes account for 20.25% of all cerebral ischemic strokes. Estimates are that about 20% of the posterior circulation strokes present with isolated vertigo without focal neurological signs. Moreover, recent studies estimate that about one-sixth to one-third of these strokes are missed in the Emergency Department (ED) and are misclassified as being of peripheral vestibular origin, resulting in several thousand missed posterior circulation strokes in the United States annually. Vertigo can be the sole manifestation of vertebrobasilar stroke, which is often missed in the ED. In our patient population, sensitivity and specificity to detect central vertigo were 100% and 66.4% respectively, in patients with either constant vertigo symptoms or no change in symptoms with head movement or unsteady gait (VAIN: Vertigo-Ataxia, Incessant, or Non-positional). This can serve as a simple and effective tool for paramedics and triage nurses in the ED. to confirm these findings and to develop a triage algorithm for detection of central vertigo in ED might lead to earlier detection and better outcomes in patients with vertebrobasilar strokes.^[45]

Andreas Zwergal. *et al.*, (2019) Dizziness and vertigo are frequent symptoms in the general population. The most common causes are peripheral or central vestibular or ocular motor disorders, functional disorders, or rarely nonvestibular disorders. Central etiologies of dizziness or vertigo mostly originate from dysfunction of brainstem-cerebellar vestibular, ocular motor, or sensorimotor circuits. Specifically, cerebellar dizziness and vertigo is a general term for a group of disorders which all share signs of cerebellar dysfunction on clinical examination of ocular motor, vestibular, or postural systems. The time course of presentations is heterogeneous and can be classified into three types: (1) persistent presentations (e.g., in degenerative cerebellar disorders); (2) recurrent episodes of dizziness and vertigo (e.g., in vestibular migraine, episodic ataxias); or (3) acute onset of dizziness or vertigo (e.g., in stroke or inflammation). The most frequent recurrent vestibular syndrome, vestibular migraine, can also clinically manifest as a cerebellar phenotype. In acute dizziness and vertigo presentations, cerebellar lesions account for about two-thirds of central lesions, or approximately 2.5 to 6.5% of all acute cases. In this article, we will describe the most common etiologies, clinical signs, and symptoms of patients with chronic, recurrent, and acute cerebellar dizziness and vertigo, together with helpful diagnostic tests to support

the diagnosis and therapeutic strategies in affected patients.^[46]

Bernardo Cacho-Diaz. *et al.*, (2019) Brain metastasis (BM) can occur in up to 30% of cancer patients. The main causes of BM in adults are lung, breast, and colon cancer, along with melanoma. Headache, changes in vision (blurred vision, visual field defects, or diplopia), localized weakness, seizures, and cognitive dysfunction are the most common symptoms reported at the time of BM diagnosis. On the other hand, vertigo, which is a common symptom in everyday clinical practice, is rarely reported as a primary symptom associated with BM. It has been reported that 20–30% of the population experience vertigo. however, BM causing vertigo in patients with cancer has been reported only in case reports and few case series. Therefore, in this study, we aimed to analyze whether the presence of vertigo in patients with systemic cancer represents a clinical marker for the presence of BM. In patients with cancer who experience vertigo, the presence of headache, ataxia, seizures, visual symptoms, focal motor or sensitive complaint, speech impairment or altered mental status should be considered as red flags.^[47]

Eva Kovacs. *et al.*, (2019) Vertigo and dizziness, belonging to the most frequent symptoms with an estimated lifetime prevalence of 17– 30%, cover diseases and conditions of various origin . In a narrower sense, vertigo refers to peripheral or central vestibular diseases with a lifetime prevalence of up to 10% and a yearly incidence of 1.4%. The most prevalent types of peripheral vestibular vertigo are benign paroxysmal positional vertigo (BPPV), Meniere's disease (MD), vestibular neuritis and bilateral vestibulopathy; vestibular migraine is one of the most common examples of central vestibular vertigo. Arguably, vertigo and dizziness are among the main drivers for health care utilization from primary care through specialist care to tertiary level hospitals therefore may have a high impact on direct costs in industrialized countries. The increasing prevalence of vertigo in older population further contributes to this burden of health care. Thus, the financial burden may widely deviate in different countries even by similar prevalence of vertigo and similar frequency of health care utilisation. This limits the value of these data regarding the economic burden of vertigo. Future studies of new or established diagnostic devices and therapies for vestibular disease should include cost-effectiveness considerations. Population-based studies that focus on health care utilization should include simple assessments of vestibular function to get more reliable estimates of burden of disease and associated costs on the level of the general population. Clinical and population-based registries that include patients with vestibular disease, should invest more effort in the exact characterization of disease and consider collecting long-term patient-reported outcomes, absence from work and other types of societal burden. Primary data collection should increasingly include

assessment of health care utilization e.g. by linking their diagnoses and outcomes to routine data from health insurances.^[48]

Hyo-Jung Kim. *et, al*, (2019) Benign paroxysmal positional vertigo (BPPV) is the most common cause of vertigo. Appropriate canalith repositioning procedure (CRP) results in immediate resolution of BPPV in $\approx 80\%$ of patients after single application, and the success rate increases up to 92% with repetition of the procedure. CRP may be attempted by the patients themselves if instructed appropriately. Indeed, addition of self-applied CRPs at home was more effective than the CRP performed by the clinician alone. However, the appropriate CRP should be selected according to the affected canal and subtype (canalolithiatic vs cupulolithiatic) of BPPV. BPPV recurs frequently, with an annual recurrence rate of 15% to 18%. If the same subtype and involved canal of BPPV as the previous attack could be expected during recurrence, self-administration of CRP may be instructed at the clinic and can be attempted by the patients themselves when BPPV recurs. Unfortunately, however, the type and involved canal of BPPV do not depend on those of the previous attack when it recurs. This variability limits our ability to simply recommend repetitive treatment with the same maneuvers that worked previously. A few studies have explored the utility of questionnaires in confirming BPPV and determining the subtypes. However, those studies applied the questionnaire only to the patients with suspected BPPV and thus limited adoption of the questionnaire in screening BPPV and determining the subtypes BPPV in patients with dizziness. The purpose of this study was to develop a questionnaire feasible for self-diagnosis of BPPV by the patients themselves that would allow self-administration of an appropriate CRP, especially when BPPV recurs.^[49]

Kenji Numata. *et, al*, (2019) Acute vertigo is a common and challenging problem encountered in the departments of otolaryngology, emergency medicine (EM), and internal medicine (IM). More than one-third of Americans visit a health care provider for dizziness during their life-time. Vertigo is one of the most common complaints in the emergency department (ED) and is responsible for 2.5% of ED visits. The psychological impact of vertigo can significantly affect an individual's lifestyle. Patients with vertigo have had to quit, change, or modify their job because of their symptoms. Appropriate treatment is important to lead the patients to complete recovery. prospectively collected and analyzed data from the Multicenter Effort to investigate Management of vertigo In Acute Care (MEMAI). The MEMAI study is a multicenter scenariobased survey developed to investigate the variation in acute vertigo care between different specialties. questionnaire, the patients with posterior canal BPPV, vestibular neuritis, and Meniere disease complained of nausea. Although metoclopramide is anti-emetic and not an anti-vertigo medication, non-

otolaryngologists preferred prescribing metoclopramide in the case of posterior canal BPPV. This might have also been caused by differences in the daily bedside practice. In the ED, ruling out cerebellar bleeding as a cause of vertigo is a high priority task. Non-otolaryngologists tend to control the symptoms of the patients prior to CT in an acute manner. here were significant differences in acute vertigo diagnosis and treatment practices between non-otolaryngologists and otolaryngologists from a vignette-based research. These differences might be caused due to variations in the guideline of each specialty.^[50]

Mary Lauren Pfeiffer. *et, al*, (2019) Dizziness is a common presenting symptom among patients in many settings, but half of patients with dizziness present to primary care clinics. It is a nonspecific term used to describe a subjective sensation that patients may find difficult to fully explain. Dizziness involves a sense of compromised spatial orientation. Studies have confirmed that dizziness occurs in about 15% to 20% of adults nationwide every year. The prevalence of dizziness increases with age and is higher in women than men. Various broad concepts have been used in the literature to describe and classify dizziness. These categories include vertigo, disequilibrium, presyncope or syncope, lightheadedness, and nonspecific dizziness. Dizziness is a challenging complaint to evaluate; however, a systematic approach can help narrow the vast list of differential diagnoses. The history and physical examination have particular value in sorting out dizziness and differentiating vertigo. Awareness of common causes, characteristics, and red flags is important. The primary care NP can manage many cases of dizziness, but some serious cases require referral for additional workup or treatment. When the dizziness persists, the diagnosis remains unclear, or standard therapies do not produce expected results, other members of the healthcare team can assist primary care NPs in expanding the workup or advancing the treatment regimen so that optimal outcomes are facilitated for each patient.^[51]

Rodney Omron (2019) Dizziness is a common chief complaint resulting in about 4% of all emergency department (ED) visits. Defining dizziness by the subcategories of vertigo and lightheadedness offers no benefit in diagnosing the underlying disease. Instead asking questions about associated factors (triage), timing, and triggers and then completing focused physical examination tests based on the responses have been shown to be more accurate than performing advanced imaging such as computed tomography (CT) or MRI in making the correct diagnosis and ruling out life-threatening causes.^[52]

Ryohei Oya. *et, al*, (2019) Benign paroxysmal positional vertigo (BPPV) is the most common cause of peripheral vertigo. BPPV is characterized by brief attacks of vertigo provoked by head movement. This phenomenon is

suggested to originate from the otolithic organs, in which otoconia are dislocated from the utricle and move into the lumen of the semicircular canals. Vestibular evoked myogenic potential (VEMP) is an electromyographic response to loud auditory stimulation. There are two methods of measuring VEMP, cervical VEMP (cVEMP) and ocular VEMP (oVEMP). The difference between these two methods is the muscles used to record the myogenic potential. The sternocleidomastoid muscle (SCM) is used in cVEMP, and the extraocular muscles including inferior rectus and inferior oblique are used in oVEMP. It has been suggested that cVEMP is generated from a sacculocollic reflex that starts in the saccule and proceeds through the inferior branch of the vestibular nerve and oVEMP is generated from utricle and carried along the otolith-ocular crossed pathway. VEMPs reflect the otolith function of patients. The articles that were enrolled in the present study include various characteristics such as patients' profile, type of BPPV, and VEMP threshold. In particular, the cVEMP threshold is slightly different in each article. The cVEMP threshold employed in each article is within an acceptable range regarding the appropriate threshold that was previously proposed. However, these differences may affect the results; therefore, we have applied a random effect model for the meta-analysis.^[53]

Timothy Hain. *et al.*, (2019) The clinical association of migraine and vertigo or dizziness has been given many names in the literature, including migraine associated vertigo (MAV), vestibular migraine, migrainous vertigo, migraine-related vestibulopathy, basilar artery migraine, and others. 17% of the female population and 6% of males has severe migraine headaches. As about onethird of persons with migraine experience dizziness, one would expect that the prevalence of migraine combined with vertigo or dizziness is about 3% of the population. "Vestibular migraine" is the most recent nomenclature for the combination of migraine and vertigo. Our own clinical experience suggests that 20–30% of patients with chronic migraines who also have MAV and are treated with onabotulinum toxin A experience improvement in the vertiginous component of their symptoms. Given the otherwise refractory nature of these patients' symptoms, onabotulinum toxin A probably deserves formal and systematic study as a treatment for MAV. With respect to medical management, most patients with MAV are able to bring symptoms under a reasonable degree of control, meaning that the frequency will be significantly reduced, and breakthrough symptoms diminished with migraine abortive therapies.^[54]

Francesca Yoshie Russo. *et al.*, (2018) Autoimmune mechanisms seem to be the origin of many disorders of the inner ear, according to an etiopathogenesis that is not yet completely delineated. The main feature of these conditions is the presence of an abnormal immune response, in either absence or presence of systemic autoimmune disease, directed against delicate components of the inner ear. Immune response can

determine a functional or anatomical alteration with an inflammatory reaction often devastating for hearing and balance. According to their clinical presentation, we can classify these disorders as isolated or in association with systemic autoimmune disease. The main isolated immune-mediated vestibular disorders in which vertigo plays a central role are autoimmune inner ear disease (AIED), delayed endolymphatic hydrops (DEH), Ménière's disease (MD), and bilateral vestibulopathy (BV). T cells releasing cytokines, tumor necrosis factor (TNF), and interferon gamma, are suggestive that AIED has features of both autoimmune disease and autoinflammatory disease. Currently, the diagnosis of AIED is based on clinical presentation and response to the administration of corticosteroids. A multidisciplinary approach in these patients is of paramount importance. When approaching patients with a clinical diagnosis of autoimmune disorders, vertigo is often underestimated or considered a manifestation of central nervous system involvement; however, in many cases, the cause may be directly connected to a damage of the inner ear and early targeted therapy could prevent peripheral irreversible damages if promptly initiated. In other cases, vertigo may underlie or be the presenting symptom of an undiagnosed autoimmune disorder, whose identification could lead to significant reduction of diagnostic delay between onset of symptoms and clinical diagnosis. Even if a specific therapy for these clinical forms is not exactly delineated according to universally accepted schemes, these patients respond well to corticosteroid therapy, and in more complex cases, therapies with immunosuppressive drugs have proven to be effective.^[55]

Jędrzej Fedorowicz. *et al.*, (2018) According to the assessment, the problem of vertigo affects 20-30% of adults in reproductive age and 8-18% of children, of whom 7-10% of adults report recurrent vertigo. There are many methods of balance system examination which are often on the border of laryngology and neurology. It is important to, if possible, diagnose the patients in a multi-profile hospital which gives a possibility to quickly conduct multidisciplinary consultations and additional examinations. The aim of diagnostic proceedings is to define the probable causes and characteristic features for the given type of vertigo, and next to establish and initiate appropriate treatment, according to the current standards. Methods of examination of the balance system are used not only for diagnosing symptoms, but also for prophylaxis and case-law. One of the methods of examining the balance system is multisensory posturography, also called an objective Romberg's test. It allows for the evaluation of postural and vestibulospinal reflex disorders, and the whole balance system is involved in its conduction. There are two diagnostic methods: static and dynamic posturography, conducted on the one- or two-platform devices. In case of tests on a stable surface, both with eyes open and closed, patients with vertigo of mixed origin managed slightly better. The results of the test on a foam surface turned out to be more favorable in patients with vertigo

of central origin. Based on the conducted research, that ability to maintain balance in patients with central and mixed vertigo is on average threefold lower than in population of people not reporting episodes of vertigo.^[56]

Jeong-Yoon Choi. *et, al*, (2018) Central vestibular dysfunction is one of the leading causes of vertigo and is mostly because of strokes, intracranial tumors, metabolic conditions, and paroxysmal or degenerative disorders. Vestibular migraine may be also considered of a central origin. Central vertigo especially requires early diagnosis and proper treatments, given its potentially serious diseases and grave prognosis. In addition, detailed evaluation of central vertigo can enhance our understanding on how the central vestibular system functions to guarantee our daily activities. Central vertigomay have a diverse clinical spectrum depending on underlying diseases. For proper diagnosis and treatment of central vertigo, an approach integrating detailed history taking, careful examination, and appropriate neuroimaging is essential. Recognizing the characteristic findings from dysfunction of each central vestibular structure would enhance our understanding of the central vestibular function and lead to better management of central vertigo.^[57]

Jorge C Kattah (2018) The AVS is the result of an acute unilateral peripheral or central vestibular lesion that causes a sudden asymmetry of the normal vestibular nuclei neuronal firing rate. Patients with an AVS experience vertigo, nausea and vomiting and head movement intolerance. By and large, the sudden onset of an AVS is associated with severe anxiety, largely due to the continuous and frequently intense illusion of rotation and the associated vasovagal response. The examiner looks for static (head still) and dynamic (head moving) ocular motor findings, related to alterations of the angular vestibulo-ocular reflex (VOR): nystagmus and head impulse test (HIT) gain; alterations of the vestibulo-spinal reflex: postural unsteadiness and gait imbalance are additional findings. The purpose of this chapter is to discuss the use of 'HINTS' on the diagnosis, triage and management of patients with AVS. v The head is rapidly turned 90° to either side while supine, this manoeuvre excites the horizontal semicircular and inhibits the contralateral canal. Nystagmus elicited by changing the direction of gaze horizontal or vertical. Of note the nystagmus fast phase does not have to match the Gaze direction, for example a right-beat nystagmus may be present in upgaze. It beats in direction opposite to the GEN and lasts usually 20–30 s. Clinicians use the h-HIT extensively since its inception in both unilateral and bilateral vestibulopathy. The normal response to a rapid, passive eye movement as a subject fixates on a central target is an equal and opposite eye movement of the same magnitude (Gain: ratio of head velocity/eye velocity is 1.0 The potential diagnostic impact of vHIT by objectively analysing HINTS52 60 which has been described as an ECG of the eyes60 will enable in future years development of updated management guidelines

which combine improved diagnostic accuracy and patient safety with effective, low-cost management.^[58]

K. Devaraja (2018) The etiopathology of vertigo among children differs from that in adults. Not only that 'vertigo in children' has peculiarly different differential diagnoses but also, the affected children respond relatively well to the treatment, and they recover quicker than the adults. However, pediatricians, physicians, otorhinolaryngologists and neurologists often find it difficult to establish the appropriate diagnosis in these cases. The inability of the affected children to explain the characteristics of the experienced symptoms may preclude the diagnosis making, especially in very young children. Vertigo in children could be due to various causes. In the majority of the cases, an appropriate diagnosis can be established by taking a detailed history and careful clinical examination. The BPV is common in younger children whereas the VM is responsible for giddiness in a majority of older children. Both have an association with a migraine headache and usually would demonstrate normal hearing thresholds on testing. When there is a hearing loss along with vertigo, one should look for otitis media or MD, less commonly for Cogan's syndrome or infratentorial tumors. SVD, OH, Motion sickness, vHI, VP, BPPV and refractory errors are some of the rare causes of giddiness in children, typical characteristics of each condition would make their diagnosis easy. Medical professionals who deal with pediatric cases of giddiness should be aware of these differential diagnoses to be able to make the accurate diagnosis and manage these children appropriately.^[59]

MagdalenaJózefowicz-Korczyńska. *et, al*, (2018) Traumatic brain injury (TBI) is increasingly becoming more commonplace, with one of the most common subtypes being mild traumatic brain injury (MTBI). Although patients with severe TBI are more likely to seek medical attention at the outpatient ward, many patients with MTBI report to general practitioners or primary healthcare units at varying times after injury, or fail to report it at all. The diagnostic criteria for MTBI used by the American Congress of Rehabilitation Medicine comprise loss of consciousness, the presence of headaches, dizziness or changes in mental status, feeling dazed, disorientated or confused, and experiencing persistent post-traumatic amnesia, as well as cognitive and/or behavioral/emotional symptoms following the injury. Benign paroxysmal positional vertigo (BPPV) is a disorder of the inner ear characterized by sudden episodes of severe rotatory vertigo triggered by rapid changes in head position relative to gravity. The provoked situations are lying down, tipping the head up or down, sitting up from a supine position, particularly after awaking in the morning, or turning over in bed. In addition, a reaction can be elicited by the patient looking upward. Despite the fact that the occurrence of BPPV in patients with MTBI is not frequent, BPPV should be diagnosed and

treated successfully without any medication, no surgery and no special equipment.^[60]

Sun-Uk Lee. *et, al*, (2018) Headshaking in the horizontal plane at 2 to 3 Hz for ≈ 10 to 20 seconds may induce nystagmus in central and peripheral vestibular lesions. In unilateral or asymmetric peripheral vestibular dysfunction, this headshaking nystagmus (HSN) beats toward the sound ear or toward the ear with lesser dysfunction. It is explained by the Ewald second law, which states that excitatory inputs are more effective in inducing vestibular responses than inhibitory ones. According to this explanation, the interaural difference in the vestibular activity is accumulated in the central velocity-storage mechanism (VSM) during horizontal headshaking, and the stored difference is discharged as a nystagmus after headshaking. However, a genetic link between BRV and MD and/or VM has been raised by familial studies. One-fourth of the relatives of the patients with MD experience spontaneous episodes of vertigo without auditory symptoms.⁶ Indeed, BRV was once considered a vestibular form of MD. However, the presence of vestibular MD has been questioned because only one-fourth of the patients with BRV later developed the characteristic patterns of hearing loss observed in MD. In addition, in contrast to BRV, MD has a female preponderance and an earlier age at onset. Otherwise, BRV may be understood as a migraine equivalent because patients with BRV usually have migrainous headaches.^[61]

Ronald Sahyouni. *et, al*, (2017) Each year, 19 new patients per 1 million develop vestibular schwannoma (VS), and in total, VS constitutes 6% of all intracranial neoplasms. Currently, observation, microsurgical resection, or stereotactic radiosurgery (SRS) are the primary treatment modalities for VS patients. Given that most VSs do not grow and that surgical intervention carries many risks, some patients are better served with SRS or observation. VS patients commonly present with hearing loss (39–95%), tinnitus (45–75%), and dizziness (49–66%). Additionally, the presence of mild vertigo symptoms is not uncommon, with 10 to 19% of VS patients presenting with vertigo as a primary symptom. The underlying mechanism is attributed to the VS growing into the internal auditory canal and impinging on the eighth nerve, cerebellum, and/or pons. Furthermore, the VS can cause secondary hydrocephalus and vestibular changes, which can result in vertiginous episodes. Although vertigo may initially be attributed to the VS, underlying comorbid conditions should be thoroughly evaluated before attributing the vertigo to the VS. All VS patients presenting with vertigo should undergo a standard vertigo history and examination.^[62]

Vincent A van Vugt. *et, al*, (2017) Chronic vertigo is a challenging problem. Currently patients are generally treated in general practice with betahistine (off-label use), while stronger evidence exists for the effectiveness of vestibular rehabilitation. Vertigo is the most common

type of dizziness. Each year around 1 in 20 people in the general population experiences vertigo. Around 80% of these people affected by vertigo find that it severely impairs their daily functioning. Since the symptoms of vertigo prevent many people from working, as well as resulting in an increase in the risk of falling and a high use of healthcare services. Most cases of vertigo are caused by peripheral vestibular disorders such as vestibular neuronitis, benign paroxysmal positional vertigo, vestibular migraine, and Ménière's disease. Initial treatment varies, depending on the most likely vestibular disorder. Evaluate the effect of treatment to ascertain whether the patient has developed chronic vertigo. Chronic vertigo is present if symptoms persist for more than a month. There is no place for betahistine or any other anti-vertigo drugs in the treatment of chronic vertigo: stop all anti-vertigo drugs that the patient is using for acute vertigo and offer vestibular rehabilitation to all patients with chronic vertigo. Evaluate the effect of treatment to ascertain whether the patient has developed chronic vertigo. Chronic vertigo is present if symptoms persist for more than a month. There is no place for betahistine or any other anti-vertigo drugs in the treatment of chronic vertigo: stop all anti-vertigo drugs that the patient is using for acute vertigo and offer vestibular rehabilitation to all patients with chronic vertigo.^[63]

Sindhu Dommaraju. *et, al*, (2016) suggests presentation in general practice and constitutes approximately 54% of cases of dizziness. Classically, vertigo presents as a sensation of movement of the environment around the patient. Often patients describe a 'spinning' sensation of either their body or their surroundings. This sensation can be confused with dizziness, which is a non-specific term, so an adequate history is required to differentiate this symptom. Dizziness can be classified into four groups: vertigo (spinning sensation), disequilibrium (feeling of imbalance), light-headedness, presyncope (sensation of feeling faint). Vertigo can be classified as central or peripheral on the basis of vestibular symptom pathology. Balance is controlled by the cerebellum, which receives input from the vestibular nuclei in the brain stem. This in turn receives input from the visual pathway, proprioception and inner ear. The vestibular apparatus of the inner ear consists of three semicircular canals, and two otolith organs called the utricle and the saccule. The utricle and saccule contain hair cells embedded in calcium carbonate crystals. These cells control vertical and non-rotational movements. Receptors in the semicircular canals respond to the position of the head. When the head tilts, receptors on the ipsilateral ear are stimulated and receptors in the contralateral ear are inhibited. These send impulses to the brain stem and cerebellum to control balance.^[64] Any disruption of this pathway can lead to vertigo.

A.P. Casani. *et, al*, (2015) Vertigo is relatively rare in childhood, in contrast to adults; an erroneous perception of movement can be due, in the child as in the adult, to

an anomaly in the normal function of the three major sensory systems that supply this information: the visual system, vestibular system, and somatosensory system. The main epidemiological studies demonstrate a prevalence of dizziness during childhood from 0.45 to 15%; this wide range is obviously related to differences in study design, method of data collection, and inclusion and exclusion criteria. At the same time, a remarkable disparity between children and adults regarding different pathologies is noticeable underlined: in example, benign paroxysmal positional vertigo (BPPV) is the most frequent cause of vertigo in adults, but is not common in children. These aspects explain why the prevalence of different pathologies appears to change dramatically as the child's age increases (i.e. somatoform disorder and vestibular migraine are more common in adolescence than in younger children). A recent review analysed studies (724 subjects) confirming that benign paroxysmal vertigo (BPV) (15.68%), vestibular migraine (VM) (27.82%), vestibular neuritis (VN) (9.81%) and psychogenic disorders (8.28%) are the most frequent causes of vertigo, while Menière's Disease (MD), BPPV and orthostatic hypotension are rare in childhood.^[65]

Jennifer Wiperman. *et, al*, (2014) Dizziness is a common and challenging condition seen in the primary care office. More than one-third of Americans see a health care provider for dizziness during their lifetime. Although most dizziness is due to benign causes, life-threatening causes, such as a stroke or intracranial mass, also need to be excluded. Because "dizziness" is a vague term that can include a wide array of medical disorders, it is important to use a stepwise approach to differentiate between causes. First, clinicians should distinguish between the four common types of dizziness: presyncope, disequilibrium, psychogenic dizziness, and vertigo. Patients should be asked to specifically describe their dizziness in their own words. Vertigo is a false sense of motion of either the environment or self. Often, patients describe a feeling of the room spinning or tilting. Benign paroxysmal peripheral vertigo (BPPV), vestibular neuritis, vestibular migraine, and Meniere's disease are the four most common causes of vertigo in ambulatory settings, and a thorough history and physical examination alone can lead to the diagnosis in most cases.^[66]

Michael Strupp. *et, al*, (2013) Vertigo is not a single disease entity but the cardinal symptom of different diseases of varying etiology; these may arise from the inner ear, brainstem, or cerebellum or may be of psychic origin. Internistic causes are unlikely in pure rotatory vertigo and are usually overrated; postural vertigo may result from orthostatic dysregulation or from adverse effects of medications such as antihypertensive or anticonvulsive drugs. Around 30% of people will suffer from rotatory or postural vertigo at some point in their lives, and vertigo is also a very frequent symptom in emergency patients. This review is therefore aimed at physicians from a range of specialties from primary care

to internal medicine, neurology, otorhinolaryngology, and psychiatry. Despite the great clinical importance of vertigo, patients exhibiting this cardinal symptom often receive insufficient or inappropriate care. This is true for both diagnosis (long delay from presentation to correct diagnosis with too many, mostly unnecessary technical examinations) and treatment (administration of too many, mostly ineffective, often purely symptomatic medications). An ongoing study of our own and a study from Switzerland corroborate this assessment.^[67]

David Della- Morte. *et, al*, (2012) Dizziness is a general, non- specific term to indicate a sense of disorientation. Vertigo is a subtype of dizziness and refers to an erroneous perception of self- or object- motion or an unpleasant distortion of static gravitational orientation that is a result of a mismatch between vestibular, visual, and somatosensory systems. Vertigo is among the most common complaints in medicine, affecting approximately 20–30% of the general population. Stroke accounts for 3–7% among all causes of vertigo. The blood perfusion to the inner ear, brainstem, and cerebellum arise from the vertebrobasilar system. Vertigo, nausea, and vomiting, along with nystagmus, represent symptoms of stroke in posterior fossa due to arterial occlusion or rupture of the vertebrobasilar system. However, the spectrum of signs and symptoms as a manifestation of stroke associated with dizziness and vertigo may be variable depending on the affected vascular territories. Stroke or transient ischemic attack should be seriously considered in patients presenting with acute vertigo in the emergency room. Differential diagnosis between vascular vertigo and other causes of vertigo can result in misclassification due to the overlapping of symptoms. Careful medical history, physical examination, neuroimaging and ear, nose, and throat studies may help to distinguish vascular vertigo from other causes.^[68]

Mehmet Karatas (2011) Vertigo, as a common complaint in medicine, is an illusory sensation of movement, and occurs in asymmetric involvement of the vestibular system by various causes. Vertigo of vascular origin is usually limited to migraine, TIAs of the vertebrobasilar system, and ischemic or hemorrhagic stroke. Vascular causes lead to various central or peripheral vestibular syndromes with vertigo. Migraine is the most frequent vascular disorder causing vertigo in all age groups. Migrainous vertigo, which is vertigo directly caused by migraine, occurs in up to 25% of patients with migraine, especially in migraine with aura. Cerebrovascular disorders are estimated to account for 3% to 7% of patients with vertigo. As circulation to the inner ear arises from the vertebrobasilar system, usually from the AICA, vertigo because of vascular origin can be of peripheral and/or central involvement of vestibular system. Vestibular paroxysmia has been diagnosed in 1.8% to 4% of cases in various neurotology clinics. Vestibular paroxysmia, which is attributed to neurovascular cross compression of the eighth cranial

nerve, leads to brief attacks of vertigo, tinnitus, and vestibular and auditory deficits. MRI (constructive interference in a steady-state sequence) may show the eighth nerve compression from vessels in the posterior fossa. Vasculitic disorders are rare in the general population, but vertigo may be seen in almost up to 50% of patients with different vasculitic syndromes.^[69]

Susan Holmes. *et al.*, (2011) Vertigo, a significant and distressing clinical problem, clearly affects significant numbers of people and has wide-ranging implications for those affected, particularly when the condition is chronic. It is a true burden associated with significant morbidity deserving the attention of healthcare professionals and, given its prevalence, its health care costs and societal impact are significant (Bhattacharyya *et al.* 2008). Yet, as 'dizziness' means different things to different people and has diverse causes, vertigo is often difficult to evaluate; nurses have important roles in the diagnosis, assessment and care of affected patients. Interventions to help patients cope with vertigo have been outlined. The most important thing may, however, be that patients recognise that support is available even although they may have to learn to live with vertigo. Care must be selected on an individual basis taking individual symptoms and problems into account; maintaining physical status, psychosocial interaction and quality of life are the primary goals.^[70]

Roberto Bovo. *et al.*, (2010) Autoimmune diseases are common and often devastating. The main feature of this disorder is the development and persistence of inflammatory processes in the apparent absence of pathogens, leading to destruction of the target tissues. Most likely, they are promoted by an underlying genetic predisposition which allows autoimmune disease expression following immunoregulatory defects in immune response to unknown environmental pathogens. According to the clinical features, autoimmune vertigo disorders can be classified into two main groups: isolated immune-mediated inner ear disorders and inner ear disorders associated with autoimmune systemic manifestations.^[71]

Hannelore K. Neuhauser. *et al.*, (2009) Epidemiologic data on vertigo and on specific vestibular syndromes are used for evidence-based clinical decision making, and are therefore valuable for clinicians and not only for public health experts. Furthermore, the investigation of vestibular disorders in the larger context of populations can contribute to a better understanding of causative factors, unravel unbiased information on outcome and prognosis, and point toward problems in the delivery of care. The Hearing and Equilibrium Committee of the American Academy of Otolaryngology-Head and Neck Surgery has defined vertigo as "the sensation of motion when no motion is occurring relative to earth's gravity." Although patients and many physicians tend to use the terms vertigo and dizziness interchangeably, dizziness experts seek to differentiate vertigo—as a symptom that

arises from the vestibular system—from nonvestibular dizziness, which can comprise a sensation of light-headedness, giddiness, unsteadiness, drowsiness, or impending faint. In this article, we use the term vertigo as a vestibular symptom. As measures of disease frequency in the population we use incidence (proportion of newly developed—incident—disease over a specific period) and prevalence (proportion of an existing disease at one time point, point prevalence, or during a given period, period prevalence, e.g., one-year prevalence). Lifetime prevalence denotes the cumulative lifetime frequency of a disease to the present time, i.e., the proportion of people who have had the event at any time in the past.^[72]

Mehmet Karatas (2008) Dizziness and vertigo are among the most common complaints in medicine, affecting approximately 20% to 30% of persons in the general population. Dizziness is a general term for a sense of disequilibrium. Vertigo is a subtype of dizziness, defined as an illusion of movement caused by asymmetric involvement of vestibular system. Central vestibular lesions affecting the pons, the medulla, or the cerebellum cause vertigo, nausea, vomiting, severe ataxia, multidirectional nystagmus (which is not suppressed by optic fixation), and other neurologic signs. Epidemiologic studies indicate that central causes are responsible for almost one-fourth of the dizziness experienced by patients. The most common central causes of dizziness and vertigo are cerebrovascular disorders related to vertebrobasilar circulation, migraine, multiple sclerosis, tumors of posterior fossa, neurodegenerative disorders, some drugs, and psychiatric disorders. The other types of dizziness are dysequilibrium without vertigo, presyncope, and psychophysiologic dizziness, which is often associated with anxiety, depression, and panic disorder.^[73]

REFERENCES

1. Swartz R, Longwell P. Treatment of vertigo. *Am Fam Physician*, 2005 Mar 15; 71(6): 1115-22. PMID: 15791890. <https://pubmed.ncbi.nlm.nih.gov/15791890/>.
2. Neuhauser HK. Epidemiology of vertigo. *Curr Opin Neurol*, 2007 Feb; 20(1): 40-6. <https://doi.org/10.1097/wco.0b013e328013f432> . PMID: 17215687.
3. Labuguen RH. Initial evaluation of vertigo. *Am Fam Physician*, 2006 Jan 15; 73(2): 244-51. Erratum in: *Am Fam Physician*, 2006 May 15; 73(10): 1704. PMID: 16445269.
4. Yeo BSY, Toh EMS, Lim NE, Lee RS, Ho RCM, Tam WWS, Ngo RYS. Association of Benign Paroxysmal Positional Vertigo with Depression and Anxiety-A Systematic Review and Meta-Analysis. *Laryngoscope*, 2024 Feb; 134(2): 526-534. <https://doi.org/10.1002/lary.30957> PMID: 37560919.
5. Hilton DB, Lui F, Shermetaro C. Migraine-Associated Vertigo, 2024 Feb 12. In: StatPearls [Internet]. Treasure Island (FL): StatPearls

- Publishing, 2024 Jan. PMID: 29939636. <http://www.ncbi.nlm.nih.gov/books/nbk507859/>
6. Orlando FA, Malaty J, Williams MP, Tudeen M. Otolaryngology: Vertigo. *FP Essent*, 2024 Jul; 542: 14-22. PMID: 39018126. <https://pubmed.ncbi.nlm.nih.gov/39018126/>.
 7. Ceriani CEJ. Beyond Vertigo: Vestibular, Aural, and Perceptual Symptoms in Vestibular Migraine. *Curr Pain Headache Rep*; 2024 Jul; 28(7): 633-639. <https://doi.org/10.1007/s11916-024-01245-3> Epub; 2024 May 23; PMID: 38780828; PMCID: PMC11271338.
 8. Zwergal A, Mantokoudis G, Heg D, Kerkeni H, Diener S, Kalla R, Korda A, Candraia C, Welge-Lüssen A, Tarnutzer AA. What is the current status of care by neuro-otology specialists in Switzerland-A national survey. *Front Neurol*, 2023 Dec 7; 14: 1322330. doi: <https://doi.org/10.3389/fneur.2023.1322330>. PMID: 38130837; PMCID: PMC10733682.
 9. Kim HJ, Kim JS, Choi KD, Choi SY, Lee SH, Jung I, Park JH. Effect of Self-treatment of Recurrent Benign Paroxysmal Positional Vertigo: A Randomized Clinical Trial. *JAMA Neurol*, 2023 Mar 1; 80(3): 244-250. <https://doi.org/10.1001/jamaneurol.2022.4944> PMID: 36648931; PMCID: PMC10011937.
 10. Chee J, Kwa ED, Goh X. "Vertigo, likely peripheral": the dizzying rise of ChatGPT. *Eur Arch Otorhinolaryngol*, 2023 Oct; 280(10): 4687-4689. doi: <https://doi.org/10.1007/s00405-023-08135-1>. Epub; 2023 Jul 26; PMID: 37493845.
 11. Pauwels S, Casters L, Lemkens N, Lemmens W, Meijer K, Meyns P, van de Berg R, Spildooren J. Gait and Falls in Benign Paroxysmal Positional Vertigo: A Systematic Review and Meta-analysis. *J Neurol Phys Ther*, 2023 Jul 1; 47(3): 127-138. doi: <https://doi.org/10.1097/npt.0000000000000438>. Epub; 2023 Mar 7; PMID: 36897200; PMCID: PMC10521788.
 12. Feil K, Rattay TW, Adeyemi AK, Goldschagg N, Strupp ML. Zerebellärer Schwindel, was steckt dahinter? [What's behind cerebellar dizziness? - News on diagnosis and therapy]. *Laryngorhinootologie*, 2024 May; 103(5): 337-343. German. doi: 10.1055/a-2192-7278. Epub; 2023 Nov 21. Erratum in: *Laryngorhinootologie*, 2024 May; 103(5): e1. doi: <https://doi.org/10.1055/a-2192-7278> . PMID: 37989215.
 13. Edlow JA, Carpenter C, Akhter M, Khoujah D, Marcolini E, Meurer WJ, Morrill D, Naples JG, Ohle R, Omron R, Sharif S, Siket M, Upadhye S, E Silva LOJ, Sundberg E, Tartt K, Vanni S, Newman-Toker DE, Bellolio F. Guidelines for reasonable and appropriate care in the emergency department 3 (GRACE-3): Acute dizziness and vertigo in the emergency department. *Acad Emerg Med*; 2023 May; 30(5): 442-486. doi: <https://doi.org/10.1111/acem.14728>. PMID: 37166022.
 14. Waissbluth S, Becker J, Sepúlveda V, Iribarren J, García-Huidobro F. Benign Paroxysmal Positional Vertigo Secondary to Acute Unilateral Peripheral Vestibulopathy: Evaluation of Cardiovascular Risk Factors. *J Int Adv Otol*, 2023 Jan; 19(1): 28-32. <https://doi.org/10.5152/iao.2023.22703> PMID: 36718033; PMCID: PMC9984917.
 15. Imai T, Uno A, Yamato A, Takimoto Y, Sato G, Matsuda K, Takeda N, Nishiike S, Kawashima K, Iga T, Ueno Y, Ohta Y, Sato T, Kamakura T, Shingai-Higashi K, Mikami S, Kimura N, Nakajima T, Tanaka A, Inohara H. Comparison of the efficacy of the Epley maneuver and repeated Dix-Hallpike tests for eliminating positional nystagmus: A multicenter randomized study. *Front Neurol*, 2023 Feb 27; 14: 1095041. <https://doi.org/10.3389/fneur.2023.1095041> PMID: 36923489; PMCID: PMC10008883.
 16. Fancello V, Hatzopoulos S, Santopietro G, Fancello G, Palma S, Skarżyński PH, Bianchini C, Ciorba A. Vertigo in the Elderly: A Systematic Literature Review. *J Clin Med*; 2023 Mar 11; 12(6): 2182. doi: <https://doi.org/10.3390/jcm12062182>. PMID: 36983184; PMCID: PMC10058392.
 17. Shah VP, Oliveira J E Silva L, Farah W, Seisa M, Kara Balla A, Christensen A, Farah M, Hasan B, Bellolio F, Murad MH. Diagnostic accuracy of neuroimaging in emergency department patients with acute vertigo or dizziness: A systematic review and meta-analysis for the guidelines for reasonable and appropriate care in the emergency department. *Acad Emerg Med*; 2023 May; 30(5): 517-530. doi: <https://doi.org/10.1111/acem.14561>. Epub; 2022 Aug 17; PMID: 35876220.
 18. Gurberg J, Tomczak KK, Brodsky JR. Benign paroxysmal vertigo of childhood. *Handb Clin Neurol*, 2023; 198: 229-240. doi: <https://doi.org/10.1016/b978-0-12-823356-6.00004-4> . PMID: 38043965.
 19. Yao K, Zu HB. Isolated transient vertigo due to TIA: challenge for diagnosis and therapy. *J Neurol*, 2023 Feb; 270(2): 769-779. doi: <https://doi.org/10.1007/s00415-022-11443-x> . Epub; 2022 Nov 12. PMID: 36371598.
 20. Nham B, Wang C, Reid N, Calic Z, Kwok BYC, Black DA, Bradshaw A, Halmagyi G, Welgampola MS. Modern vestibular tests can accurately separate stroke and vestibular neuritis. *J Neurol*, 2023 Apr; 270(4): 2031-2041. doi: <https://doi.org/10.1007/s00415-022-11473-5> . Epub; 2022 Dec 24; PMID: 36566345.
 21. Hunter BR, Wang AZ, Bucca AW, Musey PI Jr, Strachan CC, Roupf SK, Propst SL, Croft A, Menard LM, Kirschner JM. Efficacy of Benzodiazepines or Antihistamines for Patients With Acute Vertigo: A Systematic Review and Meta-analysis. *JAMA Neurol*, 2022 Sep 1; 79(9): 846-855. <https://doi.org/10.1001/jamaneurol.2022.1858>. PMID: 35849408; PMCID: PMC9295021.

22. Cole SR, Honaker JA. Benign paroxysmal positional vertigo: Effective diagnosis and treatment. *Cleve Clin J Med*; 2022 Nov 1; 89(11): 653-662. <https://doi.org/10.3949/ccjm.89a.21057>. PMID: 36319052.
23. Korres G, Kitsos DK, Kaski D, Tsogka A, Giannopoulos S, Giannopapas V, Sideris G, Tyrellis G, Voumvourakis K. The Prevalence of Dizziness and Vertigo in COVID-19 Patients: A Systematic Review. *Brain Sci*; 2022 Jul 20; 12(7): 948. doi: <https://doi.org/10.3390/brainsci12070948>. PMID: 35884754; PMCID: PMC9313303.
24. Chen JY, Guo ZQ, Wang J, Liu D, Tian E, Guo JQ, Kong WJ, Zhang SL. Vestibular migraine or Meniere's disease: a diagnostic dilemma. *J Neurol*, 2023 Apr; 270(4): 1955-1968. <https://doi.org/10.1007/s00415-022-11532-x>. Epub; 2022 Dec 23; PMID: 36562849; PMCID: PMC10025214.
25. Edlow JA, Carpenter C, Akhter M, Khoujah D, Marcolini E, Meurer WJ, Morrill D, Naples JG, Ohle R, Omron R, Sharif S, Siket M, Upadhye S, E Silva LOJ, Sundberg E, Tartt K, Vanni S, Newman-Toker DE, Bellolio F. Guidelines for reasonable and appropriate care in the emergency department 3 (GRACE-3): Acute dizziness and vertigo in the emergency department. *Acad Emerg Med*; 2023 May; 30(5): 442-486. <https://doi.org/10.1111/acem.14728> PMID: 37166022.
26. Kim JS, Newman-Toker DE, Kerber KA, Jahn K, Bertholon P, Waterston J, Lee H, Bisdorff A, Strupp M. Vascular vertigo and dizziness: Diagnostic criteria. *J Vestib Res*; 2022; 32(3): 205-222. <https://doi.org/10.3233/ves-210169>. PMID: 35367974; PMCID: PMC9249306.
27. Dunker K, Schnabel L, Grill E, Filippopoulos FM, Huppert D. Recurrent Vertigo of Childhood: Clinical features and prognosis. *Front Neurol*, 2022 Sep 28; 13: 1022395. doi: <https://doi.org/10.3389/fneur.2022.1022395>. PMID: 36247755; PMCID: PMC9554238.
28. Casani AP, Gufoni M, Capobianco S. Current Insights into Treating Vertigo in Older Adults. *Drugs Aging*, 2021 Aug; 38(8): 655-670. doi: <https://doi.org/10.1007/s40266-021-00877-z> Epub; 2021 Jun 23; PMID: 34159566; PMCID: PMC8342368.
29. Gerlier C, Hoarau M, Fels A, Vitaux H, Mousset C, Farhat W, Firmin M, Pouyet V, Paoli A, Chatellier G, Ganansia O. Differentiating central from peripheral causes of acute vertigo in an emergency setting with the HINTS, STANDING, and ABCD2 tests: A diagnostic cohort study. *Acad Emerg Med*; 2021 Dec; 28(12): 1368-1378. doi: <https://doi.org/10.1111/acem.14337>. Epub; 2021 Jul 20; PMID: 34245635.
30. Di Mauro P, La Mantia I, Cocuzza S, Sciancalepore PI, Rasà D, Maniaci A, Ferlito S, Tundo I, Anzivino R. Acute Vertigo After COVID-19 Vaccination: Case Series and Literature Review. *Front Med (Lausanne)*, 2022 Jan 6; 8: 790931. doi: <https://doi.org/10.3389/fmed.2021.790931>. PMID: 35071270; PMCID: PMC8770332.
31. Chen J, Zhang S, Cui K, Liu C. Risk factors for benign paroxysmal positional vertigo recurrence: a systematic review and meta-analysis. *J Neurol*, 2021 Nov; 268(11): 4117-4127. doi: <https://doi.org/10.1007/s00415-020-10175-0>. Epub; 2020 Aug 24; PMID: 32839838.
32. Lemos J, Strupp M. Central positional nystagmus: an update. *J Neurol*, 2022 Apr; 269(4): 1851-1860. doi: <https://doi.org/10.1007/s00415-021-10852-8>. Epub; 2021 Oct 20; PMID: 34669008.
33. Strupp M, Grimberg J, Teufel J, Laurell G, Kingma H, Grill E. Worldwide survey on laboratory testing of vestibular function. *Neurol Clin Pract*; 2020 Oct; 10(5): 379-387. <https://doi.org/10.1212/CPJ.0000000000000744> PMID: 33299665; PMCID: PMC7717631.
34. Lee SU, Na S, Yu S, Lee TK, Lee ES. Mouth-Opening-Induced Vertigo and Downbeat Nystagmus. *J Clin Neurol*, 2021 Oct; 17(4): 607-609. doi: 10.3988/jcn.2021.17.4.607. Erratum in: *J Clin Neurol*, 2022 Mar; 18(2): 256. <https://doi.org/10.3988/jcn.2021.17.4.607> PMID: 34595878; PMCID: PMC8490893.
35. Fancello V, Palma S, Monzani D, Pelucchi S, Genovese E, Ciorba A. Vertigo and Dizziness in Children: An Update. *Children (Basel)*, 2021 Nov 8; 8(11): 1025. <https://doi.org/10.3390/children8111025>. PMID: 34828738; PMCID: PMC8623325.
36. Huang F, Zhao S, Dai L, Feng Z, Wu Z, Chen J, Guo R, Tian Q, Fan Z, Wu S. Tuina for cervical vertigo: A systematic review and meta-analysis of randomized controlled trials. *Complement Ther Clin Pract*; 2020 May; 39: 101115. <https://doi.org/10.1016/j.ctcp.2020.101115> Epub; 2020 Feb 3; PMID: 32379654.
37. Altissimi G, Colizza A, Cianfrone G, de Vincentiis M, Greco A, Taurone S, Musacchio A, Ciofalo A, Turchetta R, Angeletti D, Ralli M. Drugs inducing hearing loss, tinnitus, dizziness and vertigo: an updated guide. *Eur Rev Med Pharmacol Sci*; 2020 Aug; 24(15): 7946-7952. https://doi.org/10.26355/eurrev_202008_22477 PMID: 32767320.
38. Kim HA, Lee H, Kim JS. Vertigo Due to Vascular Mechanisms. *Semin Neurol*; 2020 Feb; 40(1): 67-75. <https://doi.org/10.1055/s-0039-3402737> Epub; 2020 Jan 14; PMID: 31935768.
39. Green KE, Pogson JM, Otero-Millan J, Gold DR, Tevzadze N, Saber Tehrani AS, Zee DS, Newman-Toker DE, Kheradmand A. Opinion and Special Articles: Remote Evaluation of Acute Vertigo: Strategies and Technological Considerations. *Neurology*, 2021 Jan 5; 96(1): 34-38. doi: 10.1212/WNL.0000000000010980. Epub; 2020 Oct 1. Erratum in: *Neurology*, 31; 97(9): 459.

- <https://doi.org/10.1212/wnl.00000000000010980>
PMID: 33004609; PMCID: PMC7884977.
40. Power L, Murray K, Szmulewicz DJ. Characteristics of assessment and treatment in Benign Paroxysmal Positional Vertigo (BPPV). *J Vestib Res*; 2020; 30(1): 55-62. <https://doi.org/10.3233/ves-190687> PMID: 31839619; PMCID: PMC9249279.
 41. Bouanani N, Aasfara J, Hajjij A, Ouhabi H. Hodgkin's lymphoma presenting with an unusual horizontal Nystagmus and vertigo. *Tunis Med*; 2020 Nov; 98(11): 869-872. <https://pubmed.ncbi.nlm.nih.gov/33479986/> PMID: 33479986.
 42. Pan Q, Zhang Y, Zhang S, Wang W, Jiang H, Fan Y, Zhou J. Clinical features and outcomes of benign recurrent vertigo: A longitudinal study. *Acta Neurol Scand*; 2020 May; 141(5): 374-379. <https://doi.org/10.1111/ane.13214> Epub; 2020 Jan 21; PMID: 31883379.
 43. Choi SY, Lee MJ, Oh EH, Choi JH, Choi KD. Short-Term Central Adaptation in Benign Paroxysmal Positional Vertigo. *Front Neurol*; 2020 Apr 21; 11: 260. <https://doi.org/10.3389/fneur.2020.00260> PMID: 32373046; PMCID: PMC7186433.
 44. Regauer V, Seckler E, Müller M, Bauer P. Physical therapy interventions for older people with vertigo, dizziness and balance disorders addressing mobility and participation: a systematic review. *BMC Geriatr*; 2020 Nov 23; 20(1): 494. <https://doi.org/10.1186/s12877-020-01899-9> PMID: 33228601; PMCID: PMC7684969.
 45. Mandge V, Palaiodimos L, Lai Q, Papanastasiou CA, Wang Y, Santos D, Grau L, Kodali A, Ocava L, Gutwein AH. Predictors of vertigo in the emergency department: The preved study. *J Stroke Cerebrovasc Dis*; 2020 Sep; 29(9): 105043. <https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.105043> Epub; 2020 Jun 25; PMID: 32807455.
 46. Zwergal A, Feil K, Schniepp R, Strupp M. Cerebellar Dizziness and Vertigo: Etiologies, Diagnostic Assessment, and Treatment. *Semin Neurol*; 2020 Feb; 40(1): 87-96. <https://doi.org/10.1055/s-0039-3400315> Epub; 2019 Dec 30; PMID: 31887755.
 47. Cacho-Díaz B, Salmerón-Moreno K, Mendoza-Olivas LG, Reynoso-Noverón N, Gómez-Amador JL. Vertigo in patients with cancer: Red flag symptoms. *J Clin Neurosci*; 2019 Nov; 69: 175-178. <https://doi.org/10.1016/j.jocn.2019.07.071> Epub; 2019 Aug 10; PMID: 31409547.
 48. Kovacs E, Wang X, Grill E. Economic burden of vertigo: a systematic review. *Health Econ Rev*; 2019 Dec 27; 9(1): 37. <https://doi.org/10.1186/s13561-019-0258-2> PMID: 31883042; PMCID: PMC6933936.
 49. Kim HJ, Song JM, Zhong L, Yang X, Kim JS. Questionnaire-based diagnosis of benign paroxysmal positional vertigo. *Neurology*; 2020 Mar 3; 94(9): e942-e949. <https://doi.org/10.1212/wnl.00000000000008876> Epub; 2019 Dec 30; PMID: 31888973.
 50. Numata K, Shiga T, Omura K, Umibe A, Hiraoka E, Yamanaka S, Azuma H, Yamada Y, Kobayashi D. Comparison of acute vertigo diagnosis and treatment practices between otolaryngologists and non-otolaryngologists: A multicenter scenario-based survey. *PLoS One*; 2019 Mar 7; 14(3): e0213196. <https://doi.org/10.1371/journal.pone.0213196> PMID: 30845218; PMCID: PMC6405109.
 51. Pfeiffer ML, Anthamatten A, Glassford M. Assessment and treatment of dizziness and vertigo. *Nurse Pract*; 2019 Oct; 44(10): 29-36. <https://doi.org/10.1097/01.npr.0000579744.73514.4> b PMID: 31568028.
 52. Omron R. Peripheral Vertigo. *Emerg Med Clin North Am*; 2019 Feb; 37(1): 11-28. <https://doi.org/10.1016/j.emc.2018.09.004> PMID: 30454774.
 53. Oya R, Imai T, Takenaka Y, Sato T, Oshima K, Ohta Y, Inohara H. Clinical significance of cervical and ocular vestibular evoked myogenic potentials in benign paroxysmal positional vertigo: a meta-analysis. *Eur Arch Otorhinolaryngol*; 2019 Dec; 276(12): 3257-3265. <https://doi.org/10.1007/s00405-019-05674-4> Epub; 2019 Oct 11; PMID: 31605189.
 54. Hain T, Cherchi M. Migraine Associated Vertigo. *Adv Otorhinolaryngol*; 2019; 82: 119-126. <https://doi.org/10.1159/000490280> Epub; 2019 Jan 15; PMID: 30947176.
 55. Russo FY, Ralli M, De Seta D, Mancini P, Lambiase A, Artico M, de Vincentiis M, Greco A. Autoimmune vertigo: an update on vestibular disorders associated with autoimmune mechanisms. *Immunol Res*; 2018 Dec; 66(6): 675-685. <https://doi.org/10.1007/s12026-018-9023-6> PMID: 30270399.
 56. Fedorowicz J, Bielińska M, Olszewski J. Posturography studies in patients with central and mixed vertigo Summary. *Otolaryngol Pol*; 2018 May 16; 72(3): 19-25. <https://doi.org/10.5604/01.3001.0011.7256> PMID: 29989559.
 57. Choi JY, Lee SH, Kim JS. Central vertigo. *Curr Opin Neurol*; 2018 Feb; 31(1): 81-89. <https://doi.org/10.1097/wco.0000000000000511> PMID: 29084063.
 58. Kattah JC. Use of HINTS in the acute vestibular syndrome. An Overview. *Stroke Vasc Neurol*; 2018 Jun 23; 3(4): 190-196. <https://doi.org/10.1136/svn-2018-000160> PMID: 30637123; PMCID: PMC6312070.
 59. Devaraja K. Vertigo in children; a narrative review of the various causes and their management. *Int J Pediatr Otorhinolaryngol*; 2018 Aug; 111: 32-38. <https://doi.org/10.1016/j.ijporl.2018.05.028> Epub; 2018 May 24; PMID: 29958611.
 60. Józefowicz-Korczyńska M, Pajor A, Skóra W. Benign paroxysmal positional vertigo in patients

- after mild traumatic brain injury. *Adv Clin Exp Med*; 2018 Oct; 27(10): 1355-1359. <https://doi.org/10.17219/acem/69708> PMID: 30058780.
62. Lee SU, Choi JY, Kim HJ, Kim JS. Recurrent spontaneous vertigo with interictal headshaking nystagmus. *Neurology*, 2018 Jun 12; 90(24): e2135-e2145. <https://doi.org/10.1212/wnl.0000000000005689> Epub; 2018 May 23; PMID: 29792303.
 63. Sahyouni R, Moshtaghi O, Haidar YM, Mahboubi H, Moshtaghi A, Lin HW, Djalilian HR. Vertigo in Vestibular Schwannoma Patients Due to Other Pathologies. *Otol Neurotol*, 2017 Dec; 38(10): e457-e459. <https://doi.org/10.1097/mao.0000000000001567> PMID: 28891872; PMCID: PMC6082136.
 64. Van Vugt VA, van der Horst HE, Payne RA, Maarsingh OR. Chronic vertigo: treat with exercise, not drugs. *BMJ*; 2017 Aug 23; 358: 3727. <https://doi.org/10.1136/bmj.j3727> PMID: 28835412.
 65. Dommaraju S, Perera E. An approach to vertigo in general practice. *Aust Fam Physician*, 2016 Apr; 45(4): 190-4. PMID: 27052132. <https://pubmed.ncbi.nlm.nih.gov/27052132/>.
 66. Casani AP, Dallan I, Navari E, Sellari Franceschini S, Cerchiai N. Vertigo in childhood: proposal for a diagnostic algorithm based upon clinical experience. *Acta Otorhinolaryngol Ital*; 2015 Jun; 35(3): 180-5. PMID: 26246662; PMCID: PMC4510932. <https://pubmed.ncbi.nlm.nih.gov/26246662/>.
 67. Wipperman J. Dizziness and vertigo. *Prim Care*, 2014 Mar; 41(1): 115-31. <https://doi.org/10.1016/j.pop.2013.10.004> PMID: 24439886.
 68. Strupp M, Dieterich M, Brandt T. The treatment and natural course of peripheral and central vertigo. *Dtsch Arztebl Int*; 2013 Jul; 110(29-30): 505-15; quiz 515-6. <https://doi.org/10.3238/arztebl.2013.0505> Epub; 2013 Jul 22; PMID: 24000301; PMCID: PMC3752584.
 69. Della-Morte D, Rundek T. Dizziness and vertigo. *Front Neurol Neuro sci*; 2012; 30: 22-5. <https://doi.org/10.1159/000333379> Epub; 2012 Feb 14; PMID: 22377855.
 70. Karatas M. Vascular vertigo: epidemiology and clinical syndromes. *Neurologist*, 2011 Jan; 17(1): 1-10. <https://doi.org/10.1097/nrl.0b013e3181f09742> PMID: 21192184.
 71. Holmes S, Padgham ND. A review of the burden of vertigo. *J Clin Nurs*, 2011 Oct; 20(19-20): 2690-701. <https://doi.org/10.1111/j.1365-2702.2010.03585.x> Epub; 2011 Apr 20; PMID: 21507089.
 72. Bovo R, Ciorba A, Martini A. Vertigo and autoimmunity. *Eur Arch Otorhinolaryngol*, 2010 Jan; 267(1): 13-9. <https://doi.org/10.1007/s00405-009-1122-5> Epub; 2009 Oct 16; PMID: 19834724.
 73. Neuhauser HK, Lempert T. Vertigo: epidemiologic aspects. *Semin Neurol*, 2009 Nov; 29(5): 473-81. <https://doi.org/10.1055/s-0029-1241043> Epub; 2009 Oct 15; PMID: 19834858.
 74. Karatas M. Central vertigo and dizziness: epidemiology, differential diagnosis, and common causes. *Neurologist*, 2008 Nov; 14(6): 355-64. <https://doi.org/10.1097/nrl.0b013e31817533a3> PMID: 19008741.