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DIAGNOSIS AND TREATMENT OF ACUTE DIZZINESS.

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Abstract

Acute vestibular symptoms, such as dizziness, vertigo and unsteadiness are common symptoms complained by patients referring to the emergency department. The first important challenge for physicians is to distinguish central serious causes of vertigo (for example cerebrovascular events) from peripheral. The current approach focuses on "timing" (duration of symptoms) and triggers, together with a complete neurological and ocular examination, is considered the best evidence for evaluating patients with dizziness. It also helps to prevent misdiagnoses and under-diagnoses, over consumption and wastage of resources, improper in-hospitalization, risk of mortality and co morbidity for patients. The current review focuses on dizziness and the current evaluation algorithms for diagnosis and treatment, such as various disorders that can be considered when performing differential diagnosis.

KEYWORDS: Dizziness, Central, Peripheral, Standing, Hints.

INTRODUCTION

Dizziness is one of the most challenging symptoms and chief complaint, difficult for both patients and physicians to measure, diagnose and treat (Royl et al.,2011). It can be caused by benign but also serious conditions and sometimes it can be difficult to find an underlining mechanism Gurley KL and Edlow JA (2019). It can improve spontaneously, but sometimes it can be responsible for chronic and disabling conditions, even if in a minority of patients, and sometime it can prelude to a life-threatening condition Kerber KA (2009) "Dizziness" refers to various symptoms regarding abnormal perception of the body related to space. Drachman and Hart in 1972 reported four subtypes: vertigo, pre-syncopal lightheadedness, disequilibrium, and other dizziness Drachman DA and Hart CW (1972)

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1) Vertigo: it is commonly reported by patients as sensation of motion, most commonly rotational motion and can be usually considered as a symptom of vestibular dysfunction, even if many causes, even psychological, have been reported Labuguen RH (2006). It can affect all the ages and in older patients it can be considered as one of the most important causes of falls. According to international consensus vertigo can be defined as an unreal sensation of self-motion (referred to the head or total body) or feeling of distorted self-moving when performing normal head movement (Bisdorff et al.,2009).
2) Presyncope: it is commonly reported as "feeling like one was going to pass out, but without actual collapse" (Whitledge et al.,2022). It usually lasts from some seconds to minutes and it can be also associated to various manifestations such as nausea, palpitations, blurry vision. Main causes can be divided into cardiac and non –cardiac. (Pecci et al.,2022)

   International consensus describes presyncope (or near - syncope or sickliness) as the perception of imminent loss of consciousness that, during severe episodes, may be followed by real syncope. If a patient complaint of "lightheadedness," it could be considered as presyncope, faintness or both (Bisdorff et al.,2009).
3) Disequilibrium is a sort of postural instability involving legs and trunk but with head sparing. It can be common in patients with neuromuscular and neurodegenerative disorders (9). Palakurthi B and Burugupally SP (2019)
4) Other dizziness can include a heterogeneous group of sensations, difficult to describe for patients, often long-lasting and associated to psychological and somatic disorders. Limburg (2016)

EPIDEMIOLOGY

Approximately 4% of emergency department (ED) evaluations are related to symptoms of dizziness (Newman et al., 2007) (11). It is most frequent in women and prevalence seems to increase with age (Newman et al., 2008). In can affect 15-35% of the general population at some point of life Kroenke K and Price RK (1993) Dizziness and vertigo can be recurrent; consequently, annual prevalence is higher than incidence, which is estimated at 3% per year in unselected adults (Neuhauser et

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al.,2008), while data o children are scarce, due to methodology differences and the use of not-validated questionnaires (Neuhauser et al.,2008).

Patients affected with dizziness undergo more testing, imaging, in-hospitalizations than general population. Total healthcare-related costs in 2013 was estimated as more than $10 billion, without considering additional indirect costs including falls and their consequences, psychological impact (15). Newman-Toker, D. E. (2016)

ANATOMIC AND PHYSIOLOGIC AL BASIS.

The membranous labyrinth is composed of a group of ducts and chambers that are filled with endolymphatic fluid and placed inside the bony labyrinth; they lie within the petrous part belonging to the temporal bone. The three ducts of the semicircular canals (that sense rotational motion) connect to the utricle, and each one presents at the distal side a single prominent enlargement called ampulla Dickman D (2018). Semicircular canals receptor cells (hair cells) are located in a specialized part of neuroepithelium (the crista) of each ampulla. The receptors in the utricle are oriented in a longitudinal direction, while in the saccule they are oriented vertically along the medial wall; they sense linear motion and are covered by a dense fibrous tissue membrane containing otoliths (calcium carbonate small structures). All these interconnected structures are filled with endolymph Holstein (2021).

As fluids move into semicircular canals sense of motion is generated and perceived. According to different types of head movement various organs of vestibular system: after a linear vertical movement gravity causes heavier otoliths movement and consequent displacement of the hair cells in the utricle; after horizontal movements the same phenomenon happens for the saccule Rabbitt RD (2019). If the motion is angular fluid motion dislocates the cupula that lies within the ampulla at the dilated end portion belonging to the semicircular canals, causing an energy transduction from chemical to electrical end consequent transmission of nerve impulse through vestibular nerve, a branch of the eight cranial nerve that also comprises cochlear nerve, vestibular nuclei in the brainstem, cerebellum, cerebral cortex, oculomotor system, and spinal cord Khan S and Chang R

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(2013). The vestibulo-ocular reflex (VOR) is a reflex arch between vestibular and oculomotor movements, which takes information from the vestibular labyrinth placed in the inner ear to stabilize gaze during head movements (Beraneck et al.,2014). It is considered an important survival trait and it is not directly supervised by cerebellum (that's the reason for which VOR tests such as horizontal head impulse test –HIT- are negative in patients with stroke involving the cerebellum (Newman et al.,2008).

DIAGNOSTIC APPROACH

Considering an ideal setting every patient at department of emergency should be able to explain symptoms a promptly recognize one of the four patterns (vertigo, near-faint, disequilibrium and other dizziness) according to "symptom quality" paradigm previously considered. Indeed, patients are often unable to distinguish among them and, tend to change their "type of dizziness" when questioned again after a short time (Roly et al.,2011).

Some algorithms have been validated in order to help physicians working at the emergency department. In 2015, for example, TiTrATE approach has been proposed. The 'Triage—TITRATE—Test' method, focus on the four acute syndromes (acute and episodic vestibular syndromes, both splitted up into spontaneous and triggered) and doesn't discuss chronic syndromes (Newman et al.,2015).

The "ATTEST" algorithm proposed in 2018, but not validated into ED routine practice, is based on an evidence-based systematic approach. The first three letters composing the acronym ATTEST (Associated symptoms, Timing, and Triggers) refer to past medical history: "What happened?" "When?" "Is the dizziness continuous or intermittent?" "Are there associated symptoms?" "What is the broader context?". Patients without an defined general medical cause usually fall into 1 of 3 categories: the acute vestibular syndrome (AVS: acute onset with persistent, continuous sense of dizziness), triggered episodic vestibular syndrome (t-EVS which can be considered as brief episodes characterized by dizziness caused by various trigger events), or the spontaneous episodic vestibular

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syndrome (s-EVS, consisting of spontaneous episodes of variable duration dizziness without apparently definite trigger events (Edlow et al.,2018).

1. AVS. The spontaneous AVS is generally defined as an acute onset of vertigo persisting during time which can be associated with nausea or vomiting, gait instability, nystagmus, and head motion intolerance lasting days to weeks. The term was initially introduced by Hotson and Baloh (1998). The most common cause is vestibular neuritis (dizziness only) or labyrinthitis (dizziness plus hearing loss or tinnitus), with an estimated annual incidence of 3.5 per 100 000 populations (Tarnutzer et al.,2011). The most frequent dangerous cause is posterior circulation ischemic stroke (probably 5%–10% of all patients with AVS) (Kattah et al.,2009). Vertigo and nystagmus ranked as the most common symptom/sign in patients with posterior circulation stroke in The New England Posterior Circulation Registry (Searls et al.,2012). A small minority are due to multiple sclerosis, cerebellar hemorrhage, thiamine deficiency, and various autoimmune, infectious, or other metabolic conditions (Edlow et al.,2018).
2. s-EVS. It is characterized by recurrent, spontaneous (no triggers elements can be usually found) episodes of dizziness that can vary from seconds to days, the majority lasting minutes to hours (Choi et al.,2017). Spells sometimes occur up to several times a day but are usually less frequent and can be absent for months or even years. However, most of the patients are asymptomatic at the time of clinical assessment, with consequent difficulty for clinicians in making diagnosis, which is necessarily based only on the clinical history (Edlow et al.,2018). Neuroimaging exams can help in finding some cerebrovascular causes (Saber et al.,2018). Méniére disease, vestibular migraine, and psychiatric diagnoses such as anxiety disorders are the most common benign diseases presenting with AVS, while the most common dangerous cause is posterior circulation transient ischemic attack (Saber et al.,2018). Most common causes of s-AVS are neuritis, while stroke accounts for 10-20% of cases (typically in the brain stem or cerebellum, 95% ischemic) (Saber et al.,2018). Uncommon diagnosis are tiamine deficiency and Listeria encephalitis. Examination at bedside performing 3-part bedside ocular motor examination battery (HINTS—Head Impulse, Nystagmus Type, Skew deviation) plus acute hearing loss by finger rub (HINTS

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plus) can be considered as the first and most important instrument helping in differential diagnosis between central and peripheral causes of vertigo. Adding the video head impulse test can help (vHIT) to quantify the vestibular ocular reflex consequently improving effectiveness of the algorithm Nakatsuka M and Molloy EE (2022).

3. t-EVS. Patients affected by clinical condition have brief episodes of dizziness that can last up to a few minutes, depending on the underlying etiology. There is an "obligate", specific trigger that in most of cases causes dizziness (Newman et al.,2015). Common triggers are constituted, for example, by changes in head position or body position (e. g, standing from a seated or lying position) (Newman et al.,2015). Patients with persistent disabling neurovegetative symptoms such as nausea and vomiting may overestimate episode duration. Again, clinicians must distinguish exacerbating features (worsens preexisting baseline dizziness) from triggers events (provokes abrupt dizziness onset not present at baseline) (Saber et al.,2018). The most common etiologies of t-EVS are BPPV, accounting for ≈5% to 10% of acute dizziness cases, and orthostatic hypotension (Saber et al.,2018). Dangerous causes include central (neurologic) mimics of BPPV, such as small strokes, hemorrhages near the fourth ventricle or rotational vertebral artery syndrome and serious causes of orthostatic hypotension. Rotational vertebral artery sign occurs when lateral rotation of the neck leads to occlusion of one or both vertebral arteries due to compression, causing transient symptom such as acute vertigo and nystagmus when the provoking position is maintained Sorensen BF (1978).

Another type of dizziness includes the Traumatic/toxic AVS, due to head injury (such as blunt trauma, blast injuries, whiplash, barotrauma) or other triggers such as toxic exposures, such as aminoglycoside antibiotics or anticonvulsants, carbon monoxide intoxication. Gentamicin, for example, may produce a persistent and the risk of permanent loss of vestibular function with relative hearing spare, and this phenomenon can be diagnosed even after a single antibiotic dose. Common symptoms are unsteadiness and oscillopsia (Newman et al.,2005).

PERIPHERAL DIZZINESS

Méniére's diseases

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Meniere's disease (MD) represents a heterogeneous group of disorders of the inner ear affecting hearing and balance to a varying degree and defined by three main symptoms: episodic vertigo (which can from minutes to hours), tinnitus, and sensorineural hearing loss (involving especially low-medium frequencies) (Oberman et al.,2017). The prevalence of MD is estimated to vary between 3.5 per 100.000 and 513 per 100.000 and seems to occur more often in older (fourth and fifth decade), white and female patients (1·3-times preponderance in compared with men) Harris JP and Alexander TH (2010). It may also be observed in children (3% prevalence) (Choung et al.,2006). The exact etiology is still unclear; endolymphatic fluid conglomeration in the cochlea and the vestibular system seems to be frequent but not specific for MD (Huang S et al.,2020). Family members may also be diagnosed for MD, and it seems to be more frequent in people of Northern European Descents (Manchaiah et al.,2018). The clinical course is often fluctuating with waxing and waning symptoms. It usually starts as unilateral and become bilateral after many years. It can appear alone or in association with autoimmune disorders or migraine (Manchaiah et al.,2018).

The Ménière's Disease Consortium has identified 5 subtypes of MD disease in patients with uni - or bilateral involvement (Manchaiah et al.,2018). In unilateral MD, group 1 (53%) included patients without a clear familial history of this disorder, migraine, or autoimmune associated diseases; type 2 (delayed MD) was found in 8% of cases and characterized by sensory neural hearing loss before the onset of vertigo; familial MD or type 3 (13%) includes cases of MD diagnosed in familial nuclei; MD type 4 (15%) can appear in association with migraine (including both subtypes wth or without aura); MD type 5 (11%) is often diagnosed in association with autoimmune disorders (Frejo et al.,2016).

Barany Society diagnostic criteria for MD include (Escamez et al.,2016):

1.Two or more spontaneous episodes of vertigo, each one of which can last from about 20 minutes to 12 hours

2.Audiometrically documented low- to medium-frequency sensorineural hearing loss in one ear defining and locating to the affected ear on in at least one instance prior, during, or after one of the episodes of vertigo

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3.Fluctuating aural symptoms (fullness, hearing, tinnitus) located in the affected ear

4.Not better accounted for by any other vestibular diagnosis

Diagnosis of probable Ménière disease includes the following criteria:

1.Two or more episodes of dizziness or vertigo, each lasting 20 minutes to 24 hours

2.Fluctuating aural symptoms (fullness, hearing, or tinnitus) in the affected ear

3.The condition is better explained by another vestibular diagnosis

Treatment includes sodium and caffeine restriction diet (which may prevent the release of vasopressin helping to maintain internal ear homeostasis) (Oguz et al.,2021), betahistine (weak histamine H1 agonist and stronger H3 antagonist, even if there is disagreement among scientists regarding their efficacy). Diuretics can be also considered as first line therapy even if a previous Cochrane review reported lack of evidence for MD treatment (Van et al.,2022). Thirlwall AS and Kundu S (2006) Second line treatment includes intratympanic steroids (such as dexamethasone) or gentamicin injections (Hilton et al.,2022). Endolymphatic sac surgery revealed lack of evidence; surgery with vestibular nerve section can be taken into consideration as a therapeutic option in patients who didn't respond to conservative treatments, while labyrinthectomy can be considered when surgical options fails even if it is followed by a complete hearing loss in the surgically treated side (Nevoux et al.,2018).

Vestibular neuronitis

Vestibular neuronitis or vestibular neuritis (VN) is caused by infection (expecially viral) of the vestibular nerve resulting in nerve inflammation. It can present mono or bilaterally (Tarnutzer et al.,2011). It is diagnosed in 6% of patient evaluated at the emergency departments of various Hospitals in the United States (Smith et al.,2021). Herpes virus are the most common viral agents, but also bacterial infection such as Borrelia Burgdorferi can cause VN (Jozefowicz et al.,2019) and incidence of upper respiratory infections preceding neuronitis varies from 23 to 100%, Thompson TL and Amedee R (2009). Superior vestibular nerve is more often involved. Patients usually complain of complaints of abrupt onset of vertigo, lasting up to several days, often associated with neurovegetative symptoms, generally improving slowly (from days to weeks). Symptoms are

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worsened but nod triggered by head movements Furman JM and Cass SP (1999). Diagnosis is mainly clinical (HINTs examination) (Tarnutzer et al.,2011). Neuroimaging exams are usually not useful except when physical evaluation is not suggestive for peripheral vertigo, if they last more than 48 hours and patient presents risk factors for cerebrovascular disorders (Navi et al.,2012). Treatment includes limited use of anti emetics drugs or vestibular suppressants and antivirals seem not to be efficacious for treatment of VN while corticosteroid use is controversial (Muncie et al.,2017).

Labyrinthitis

Labyrinthitis consists of an inflammatory disorder affecting the membranous labyrinth, particularly both the vestibular and cochlear end organs. It may present unilaterally or bilaterally, and similarly to patients with vestibular neuronitis, it can be often preceded by an upper respiratory infection, Thompson TL and Amedee R (2009) (especially due to viral pathogens such as Cytomegalovirus, Ramsay-Hunt Syndrome, but also bacterial and toxin infections, autoimmune disorders such as polyarteritis nodosa and granulomatosis with polyangiitis) Barkwill D and Arona R, (2021). It typically presents in adults aged 30-60 with male to female ratio 1:2. Nausea, vomiting, and disturbing vertigo are the most common symptoms, often accompanied with hearing loss. Nystagmus may also be present with the fast phase moving away from the affected ear, such as instability of gait, positive Romberg sign. Rinner and Weber test may demonstrate sensorineural loss (which can be confirmed by audiometry) while otoscopy can be used to demonstrate the presence of otitis media versus cholesteatoma Barkwill D and Arona R, (2021). Blood exams can be performed at the emergency department and, if a meningitis is suspected, cerebrospinal fluid analysis can be also performed. Magnetic resonance imaging can be useful for diagnosis in in-hospitalized patients (for example for demonstrate acoustic neuroma) Neuhauser HK (2007).

Treatment depends on the etiological agent. Particularly, in case of autoimmune labyrinthitis, corticosteroids should be preferred while antibiotics should be used if due to otitis media. There is still lack of evidence in using antiviral agents for patients with viral etiology Seemungal BM and Bronstein AM (2008).

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Benign Paroxysmal Positional Vertigo (BPPV)

BPPV represents the most frequent episodic vestibular disorder which presents with transient, multidirectional nystagmus with vertigo, due to specific head positions (You et al.,2018). Etiology has been explained with two theories: canalolithiasis and cupulolithiasis. The first one is based on the presence of otolith rests that are free into the canal and, after head movements, lead to symptoms due to an abnormal endolymphatic current that stimulates the cupula; the second on a deposit of otolith attached to the cupula, making it sensitive to linear acceleration Imai T and Inohara H (2022). BPPV is considered the first and most common cause of dizziness worldwide. Estimated lifetime prevalence is about 2.4% (Von et al.,2007) and accounts for 24.1% of all evaluations at the emergency department of patients complaining with dizziness/vertigo (Kim et al.,2020). It is more commonly diagnosed in elderly women (women/men ratio 4:2), with a peak incidence of presentation in the sixties (Liu DH et al.,2017). It may relapse in about 50% of the patients within about 40 months from first episode (Sfakianaki et al.,2021). Even the main cause is unknown many cases may be associated with head traumatism, prolonged lying down positions, or disorders of the inner ear, but also lack of physical activity, vitamin D deficit, metabolic disorders such as diabetes mellitus and hypertension (Fu et al.,2020). Posterior semicircular canal and the right ear seem to be most involved in western countries. A possible anatomic classification differentiates BPPV in horizontal canal BPPV (HC-BPPV), posterior canal BPPV (PC-BPPV), anterior canal BPPV (AC-BPPV), and multiple canal BPPV (MC-BPPV) where PC-BPPV and HC-BPPV are most frequent, while AC-BPPV seems to be rare (Ling X et al.,2020).

The differential diagnosis of BPPV includes brainstem and cerebellar lesions especially next to the fourth ventricle, central positional vertigo due to vestibular migraine (Von et al.,2015).

Even though it tends to resolve spontaneously, canalith repositioning procedure (CRP) is considered the gold standard treatment for BPPV during the attacks with resolution of symptoms in 80% of patients after a single administration Epley JM (1992). Most common maneuvers for PC –VPPB are:

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- Epley manoeuvre is a treatment which should be performed by healthcare professionals involving a series of four movements performed in a precise sequence from sitting to lying, rolling over and again sitting. It works by moving the canal otolythes out of the semicircular canal (Reinink et al.,2014).
- Semont manoeuvre requires many steps: in the first one patient sits in the erect position with the head moved by 45 degrees toward the unaffected ear. Then his head is quickly inclined towards the affected side. After a brief moment, the patient is again rapidly leaned again towards the unaffected side still with head turned by 45 degrees Teixeira LJ and Machado JN (2006).

The Dix-Hallpike maneuver is indicated for patients with hypothesis of paroxysmal vertigo in whom VPPB is suspected. The patient is sitting up, while his head is rotated 45 degrees toward the ear to be tested. The clinician then makes the patient lie down very fast with their head at the end of the bed and extends his neck about 20 degrees below the horizontal line, maintaining the initial rotation of the head (Tahtis et al.,2021). Clinicians aim to evaluate the appearance of torsional and up-beating nystagmus, usually after a brief delay (no more than a minute is generally required). This would indicate a positive test. If the test is negative but VPPB can not be ruled out; in fact, the patient should try to recover for at least one minute, after which he should repeat the same manoeuvre at the other ear (Evren et al.,2017).

DIFFERENTIAL DIAGNOSIS

Long-term study.

A national representative observational study from the National Hospital Ambulatory Medical Care Survey, called (NHAMCS) identified 9472 patients with dizziness in a 13 year-period evaluated in various hospitals. So, called “dangerous” disorders, already predefined (cardiovascular diseases, cerebrovascular accidents, respiratory and general medical conditions) were diagnosed in 15% of cases and significantly resulted more frequent in patients older than 50 years of age. The 10 most frequent diagnoses were auricular and vestibular (32.9%), followed by cardiac (21.1%), respiratory (11.5%), neurologic (11.2%, of which 4% were cerebrovascular events), metabolic dirorders

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(11.0%), injury/poisoning (10.6%), and, in less than 10% of patients, other causes such as psychiatric, digestive, genitourinary, and infectious disorders (Newman et al.,2008). In 49.2% of cases patients received at least one general medical diagnosis, while 40.3% were discharged with only a generic medical diagnosis (no oto-vestibular, neurologic, psychiatric were performed, consequently the precise etiological triggers weren't found) (Newman et al.,2008). The burden for diagnosis and treatment for patients with dizziness was higher than controls, due to longer stay at the ED, more diagnostic test performed, expecially neuroimaging exams, and more often in-hospitalized (Newman et al.,2008).

Dizziness in neurology.

Migraine affects approximately 15% of the whole population. Previous several studies have found an important relationship between dizziness and migraine even if a direct pathological link has never been identified GB, D. (2015). **Vestibular migraine** (VM) is an uncommon sign difficultly recognized when not evaluated by specialist vestibular doctors. Indeed, although it has recently been included in the third edition of the International Classification of Headache Disorders (ICHD3), it has still listed been in the appendix. Vestibular migraine, even if still underdiagnosed, is reported to account for 4–10% of diagnoses in specialized hospital for dizziness and headache treatments (even considering heterogeneous studies with different inclusion criteria) (Neuhauser et at.,2001). Estimated prevalence is about 2.7% in adults and lifetime about 1%. VM seems to have a female preponderance, with a female / male ratio of 1.5-5:1 case. Symptoms onset has been commonly reported between 10 and 50 years of age (median ages between 30s - 40s) (Neuhauser et al.,2006) (74). Vestibular migraine criteria (International Classification of Headache Disorders, 3rd Edition - ICHD-3 and the International Classification of Vestibular Disorders – ICVD) include the following criteria (website link https://ichd-3.org) (75):

A. At least five episodes that must fulfill criteria C and D.

B. A current or past history of migraine without or with aura.

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C. Vestibular symptoms presenting with of moderate or severe intensity, lasting between 5 minutes and 72 hours.

D. At least 50% of episodes should be associated with at least one of the following three features typical of migraine:

1. Referred headache with at least 2 of the following characteristics:

    a) Unilateral pain location

    b) Pulsating quality of pain

    c) Moderate or severe intensity

    d) Worsened by routine physical activity

2. Photophobia and phonophobia

3. Visual aura

E. Not better explained by another ICHD-3 diagnosis or by another vestibular disorder

Suspected vestibular migraine (ICVD) should be consider if the following criteria are fulfilled:

A. At least five episodes characterized by the presence of vestibular symptoms with moderate or severe intensity, lasting from 5 minutes to 72 hours

B. Only one of the criteria B and D for vestibular migraine should be fulfilled (migraine history or migraine typical features reported during the episode)

C. Not better explained by another vestibular or ICHD diagnosis.

Persistent postural perceptual dizziness

Can be considered as a newly - defined chronic functional disorder of the central nervous system, characterized by persistent vertigo and perceived instability, which worsens in the standing position and after prolonged fixation of complex or moving visual stimuli; they are instead alleviated after distraction (Waterston et al.,2021). It can be preceded by an acute episode of dizziness of vestibular,

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neurological or psychiatric origin, and the it is usually diagnosed after resolution of the triggering event (Popkiroy et al.,2018). The most common precipitants can be considered ad central diseases or peripheral vestibular disorders such as BPPV, acute episodes of vestibular migraine (VM), head trauma, panic attacks, generalized anxiety disorders. Incidence and prevalence are still undetermined, but 4% of all patients registered after a first general practitioner evaluation declared to have suffered from persistent symptoms of dizziness with high impact on their quality of life (Nazareth et al.,1999). In UK neurology outpatient clinics, 2% of all secondary referrals received diagnosis of vertigo or faintess, about 50% of which were successively diagnosed with psychological/functional dizziness Stone, J. (2009).

Diagnosis is based on Bárány Society diagnostic criteria (Staab et al.,2017).

(A) One or more symptoms of dizziness, unsteadiness (or non-spinning vertigo) presenting in most part of the days and lasting for at least 3 months. Symptoms last for prolonged periods of time (hours) but severity may be variable. They may be discontinuous throughout the entire day.

(B) Persistent symptoms occur without specific provocative agents, but can be exacerbated by three factors: upright posture, active or passive motion, independently from direction or position, and exposure to dynamic visual stimuli or complex visual patterns.

(C) Persistent postural perceptual dizziness can be triggered by provoking factors potentially responsible for vertigo, unsteadiness, dizziness, or problems with balance, including acute, episodic or chronic vestibular syndromes, other neurological or medical illnesses, and psychological distress. When triggered by an acute or episodic precipitant, symptoms point A can be fulfilled if the precipitant resolves, but may occur intermittently at first, and then consolidate into a persistent course. When triggered by a chronic precipitant factor, symptoms and signs may be soft at the beginning and then gradually worsen.

(D) Symptoms are responsible for significant distress or functional impairment.

(E) Symptoms aren’t better explained by another disease or disorder (Staab et al.,2017).

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Dizziness versus stroke

Blood perfusion of the inner ear, brainstem, and also cerebellum territories arises from the vertebro-basilar system. Therefore, dizziness, vertigo, nausea, vomiting and nystagmus may occur after occlusion or thrombosis involving the vertebrobasilar arteries and their branches Della-Morte D and Rundek T (2012).

Differential diagnosis with stroke in a patient suffering from acute vertigo can be challenging in patients experiencing dizziness symptom at the Emergency Department without other neurologic symptoms or signs. About 10% of strokes can be misdiagnosed at first medical evaluation, and misdiagnosis involves especially younger than 50, women, minorities (Newman et al.,2014). It is crucial to obtain a detailed clinical and medical history and careful description of the all the complained symptoms. A recent observational, retrospective study was performed in 2021 on 2215 consecutive adult patients presenting with dizziness at the Emergency Department between August 2019 and February 2020 (Kim et al.,2021). Multivariate analysis demonstrated that independent risk factors for predicting acute stroke resulted:

1) a previous history of cerebrovascular injury
2) > 65 years years-old age.

They may require a further neuroimaging evaluation at the ED to rule out acute cerebrovascular disorders. Presence of major cardiovascular risk factors should never be underestimated (Kim et al.,2021). Brain computer tomography (CT), usually performed at the emergency department, has a very low sensitivity especially in diagnosis of posterior fossa strokes Hwang et al., (2012). However, it is less expensive giving faster results than magnetic resonance imaging (MRI), consequently it is still considered the first line neuroimaging test at the emergency department for evaluating patients with suspected central dizziness Hwang et al., (2012). MRI, a neuroimaging exam with associated costs and limited access, can miss 15-20% of them, mostly after a short time from onset. Brain MRI is also time-consuming and there is also a rate of false positive diagnoses of posterior fossa strokes within the first 48 hours from the onset of symptoms

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but it is more sensitive than brain CT for diagnosis of acute ischemic changes, cerebellar lesions of different causes, brainstem strokes Sá et al., (200).

Multiple studies demonstrated that the presence of dizziness and vertigo, even as solitary symptoms, constitute the most common premonitory symptoms of vertebro-basilar transient ischemic attacks (TIAs) Paul et al., (2013). When TIAs affect the vascular territory of anterior inferior cerebellar artery, a small branch of basilar artery which supplies blood to the inner ear in most individuals, patients may experience dizziness and hearing symptoms, and differential diagnosis with Ménière disease can be challenging (Pope and Edlow 2012). During anterior inferior cerebellar artery territory TIA unilateral a complaint of sensorineural loss and peripheral nystagmus can be present, with consequent difficult differential diagnosis from peripheral vestibular disorders Chang et al., 2018). Sudden dizziness can be also experienced in more than half of patients with vertebral artery dissection (especially when associated to sudden, severe migraine and neck pain Gottesman et al., (2012).

Dizziness clinical approach in Italian Emergency Department

In 2014 a simple clinical algorithm named STANDING (SponTAneous Nystagmus, Direction, head Impulse test, standiNG) was developed to evalutate patients with vertigo at the emergency department. It was a structured, simple and reliable study protocol developed in order to differentiate central from peripheral acute vertigo, and to evaluate a possible reduction of the neuroimaging burden and hospitalization Vanni et al., (2014).

The first step was based on assessment of Nystagmus using Frenzel's glasses and, in absence of spontaneous, using Mc Clure-Pagnini and Dix -Hallpike positionings. The main limitation of this step is the lack of Frenzel's Glasses in most of the Italian Emergency Departments Vanni et al., (2014).

The second step was based on analysis of direction of spontaneous nystagmus if present and, if unidirectional (third step), to perform head impulse test (HIT). Finally, patients without nystagmus

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were invited to stand and start walking; if impossible without any assistance vertigo was suspected to be central Vanni et al., (2014).

HINTS test

The HINTS (head impulse, nystagmus, test of skew) is a 3-step assessment test that should be performed when evaluating patients suspected to be affected with central vertigo, useful to distinguish brainstem and cerebellar dysfunctions from vestibular neuritis or other peripheral causes. It can be used only when the patient presents symptoms and signs suggestive for persisting, not transient vertigo (Kattah 2018).

HINTS examination is characterized by three main components: head impulse test (HIT), gaze and nystagmus testing, and alternate cover test for detection of skew deviation, A normal HINTS examination with a positive HIT, absence of skew deviation, together with the absence of atypical nystagmus features can be considered equivalent to brain MRI in the first 48 hours execution in patients with suspected diagnosis posterior fossa strokes (Kattah 2018).

CONCLUSIONS

Acute dizziness is a commonly referred symptom, especially at the emergency department. Diagnosis can be challenging and differential diagnosis includes a spectrum of diseases, which can be benign but also severe and deathly. New algorithms recently validated seem to be promising in ensure prompt diagnosis and correct treatment avoid misdiagnosis, excessive resources usage and unnecessary hospitalizations.

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