

Balance Disorders: A Review of Patients at a Specialized Vestibular Clinic

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ABSTRACT

INTRODUCTION: With recent advancements in vestibular assessments, new ancillary tests can assist clinicians to better understand the underlying cause of a balance problem. The recently established specialized vestibular clinic in Sultan Ahmad Shah Medical Centre @IIUM is equipped with these tests. This study aimed to determine the prevalence of the different diagnoses of balance disorders in a specialized vestibular clinic in Kuantan, Malaysia. **MATERIALS AND METHODS:** This is a retrospective review of 121 walk-in patients over an 18-month period at a specialized Vestibular Clinic in Sultan Ahmad Shah Medical Centre @IIUM. The variables analysed in this review include the age, gender, ethnicity, diagnoses, and total number of visits before the diagnoses were achieved. **RESULTS:** Meticulous history taking, focused otorhinolaryngological examination and detailed vestibular assessment through the specialized vestibular clinic helped us in reaching a conclusive diagnosis. The most common cause of balance disorders in our review was Benign Paroxysmal Positional Vertigo (BPPV), constituting 41.3% of the cases. Among the canals, the posterior canal is the most affected (70%) and it is usually treated with the Epley manoeuvre. Other common diagnoses include Vestibular Migraine, Meniere's Disease and Vestibular Neuritis. **CONCLUSION:** Vestibular clinics play a vital role in helping to pinpoint the accurate diagnosis of patients with balance disorders.

Keywords

Balance disorders, Vertigo, Dizziness, Vestibular Clinic

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INTRODUCTION

Balance disorders constitute a group of diseases which is made up of many differential diagnoses. These diagnoses may be caused by pathologies affecting multiple systems within the body, including the peripheral vestibular, cardiovascular, and central nervous systems. Due to the wide range of systems involved, patients with symptoms of balance disorders may present to a different number of clinical specialties, including primary healthcare physicians, emergency departments, neurology/internal medicine departments, physiotherapy clinics or otorhinolaryngology/neuro-otology clinics.¹ The involvement of several different systems may pose a challenge in accurately diagnosing and treating patients with balance disorders. Due to the challenge in its diagnosis and the significant burden it imposes on both

patients and the healthcare system, specialized vestibular clinics have been established. These clinics aim to be a one-stop assessment and diagnostic centre to ensure accurate diagnosis of patient's balance disorders.

Much data had been studied to determine the differential diagnoses of balance disorders. According to Kim et al's (2020) study in a centre in South Korea, BPPV (24.1%) was the most common cause of dizziness or vertigo, followed by persistent postural perceptual dizziness (PPPD) (20.8%), vascular disorders (12.9%), vestibular migraine (10.2%), Meniere's disease (7.2%), and vestibular neuritis (5.4%).² Closer to our region, in Thailand, Isaradisaiikul et al (2010) noted that the most common diagnoses are BPPV (52.5%), Meniere's disease (14.6%),

and sudden sensorineural hearing loss (2.9%).³ It is generally agreed that BPPV is the most common diagnosis encountered, while the subsequent diagnoses may differ based on the region. In the South Korean study, the mean age at diagnosis is 50 to 60 years of age, and the prevalence of psychogenic or PPPD is also among the younger population (less than 65 years old); making it the second most common diagnosis. Meanwhile, otosyphilis as the cause of sudden sensorineural hearing loss is more prevalent in the Thai population, thus making it the third most common diagnosis.

In Malaysia, a retrospective review of 100 walk-in patients at a specialized neurotology clinic in dizziness at a tertiary referral centre by Philip et al (2009) found that the most common cause of dizziness was BPPV (31%), followed by recurrent vestibulopathy, idiopathic causes, Meniere's disease and central causes.⁴ Abdul Wahat et al (2013) conducted a prevalence study on vestibular disorders in another tertiary centre in Malaysia and discovered that BPPV is the most prevalent diagnosis, followed by Meniere's disease and vestibular neuritis.⁵

It is interesting to note that there are significant differences in the diagnoses for patients presenting with dizziness or vertigo, depending on the specialty making the diagnosis. A systematic review by Parker et al (2018) showed that, among the ENT proportions, the most common diagnostic categories were BPPV, Psychogenic and Meniere's disease, while the Emergency proportions were dominated by Other, Cardiac, and Neurological diagnostic categories.

Prior to the establishment of the dedicated vestibular clinic, an exploratory study on balance disorders was conducted at the Ear, Nose and Throat Clinic by Wan Aslynn, Mohd Sakeri & Arshad (2016). This retrospective study revealed that out of the 92 medical records examined, 14% of cases (n=13) attended by ENT doctors were described as balance disorders. Four cases were identified as BPPV, one case of Meniere's disease and the rest (n=9) were nonspecific balance problems.⁶ The Otorhinolaryngology Department of Sultan Ahmad Shah Medical Centre @IIUM has set up a Vestibular Clinic, aiming to address the need of a specialized assessment

centre for patients with dizziness or vertigo. The clinic sessions are run by otorhinolaryngologists, audiologists and rehabilitation specialists equipped with an array of vestibular diagnostic tools. Referrals of patients are accepted from various primary care clinics, emergency departments, specialty clinics and otorhinolaryngology departments throughout the state of Pahang and southern Terengganu.

MATERIALS AND METHODS

This study is a retrospective analysis of patients who attended the Vestibular Clinic of Sultan Ahmad Shah Medical Centre @IIUM within an 18-month period, from September 2019 to March 2021. A total of 121 patients were included in this study. Patients were identified from the clinic attendance report of the hospital's 'iPesakit' system which is the online patients' records system at Sultan Ahmad Shah Medical Centre@IIUM. All patients who attended the clinic were included in this study. Case records of the patients were reviewed through the Electronic Medical Record (EMR) subsystem beginning from the first clinic visit, following through until the diagnosis has been achieved. Variables documented included the age, gender, ethnicity, presenting complaints, tests performed, diagnoses and the total number of visits before diagnoses were achieved.

In each visit, all the patients were seen by three members of the clinic team—an otorhinolaryngology consultant, a trained audiologist in vestibular and balance assessment, and an otorhinolaryngology medical officer. The otorhinolaryngology medical officer will perform a thorough history taking and clinical examinations which includes cerebellar examination, cranial and peripheral nerves examination followed by gait, otological and bedside vestibular assessments. Subsequently, the trained audiologist will perform vestibular tests such as positional tests with nystagmography, video head impulse tests (vHIT), video nystagmography tests, and oculomotor tests in all patients to aid in establishing the diagnoses. Patients with associated hearing impairment or tinnitus based on clinical assessment will be sent for audiological tests which include a pure tone audiometry, tympanometry, and acoustic reflex. Caloric test was

performed on patients who do not have conclusive vHIT and nystagmography tests, and in our study, only one patient was subject to this test. The final diagnosis will be made by the consultant otorhinolaryngologist in-charge, based on literature review from the latest edition of otorhinolaryngology textbooks.

Patients will be referred for imaging such as MRI and/or CT scan if central causes were suspected. Treatment was according to the different achieved. We would like to highlight specifically on the treatment for BPPV as it is the most common differential diagnosis, and it is important to recognize the types of manoeuvres that may be employed in managing the pathologies in different locations of the semicircular canals. The treatment is conducted by a trained audiologist in vestibular and balance assessment.

Subsequent follow up appointments will also be given to re-evaluate patients' conditions and resolution of symptoms. With all these variables reviewed, descriptive statistical analyses were performed to summarise the findings.

RESULTS

A total of 121 patients were included in this study. All of these patients were referred from the general otorhinolaryngology clinic, the hospital's emergency department, other hospitals in Pahang and government and private primary care clinics. There were 72 female patients (59.5%) and 49 male patients (40.5%) who attended the clinic within the study period (Figure 1). Out of these patients, 114 or 94.2% were of Malay ethnicity, three patients (2.5%) were of Chinese ethnicity and the remaining four were of Indian ethnicity (3.3%). The largest proportion of patients attending the clinic were from the 60-69 years old age group (24.8%). This is followed by the 50-59 years old group (22.3%) and 40-49 years old group (16.5%). There were only two patients (1.7%) who were of 19 years old or less. The mean age of presentation to the clinic was 52.9 years old with a standard deviation of 15.5. The median age of presentation is 55 years old.

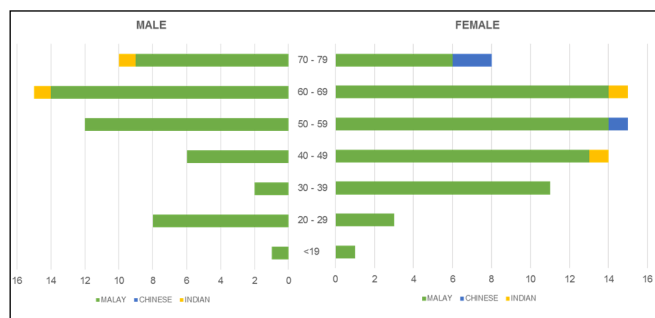


Figure 1: Distribution of patients attending vestibular clinic based on age, gender, and ethnicity at Sultan Ahmad Shah Medical Centre @IIUM

In this retrospective analysis, peripheral causes of vertigo make up the bulk of the diagnosis (59.5%), followed by central causes (27.3%), others (5.8%) and systemic causes (4.1%). Among the individual diagnoses, the most prevalent cause of vertigo was benign paroxysmal positional vertigo (BPPV) (Table 1). Fifty patients (41%) were diagnosed with BPPV in which the majority of these (70%) were posterior canal BPPV. The remaining were anterior canal BPPV—which made up of 16% of the cases followed by lateral canal BPPV (14%). Out of the seven patients with lateral canal BPPV, only one patient was known to have apogeotropic BPPV (Table 2). The other common peripheral causes diagnosed in our centre include Meniere's disease (5.8%), vestibular neuritis (3.3%) and labyrinthitis (1.7%). Besides these, other peripheral causes of vertigo identified are as summarized in Table 1.

Vestibular migraine was one of the more prevalent diagnosis in our centre, constituting 20.7% of all the patients who attended the clinic in the study period, making it the second commonest diagnosis after BPPV. Other central causes of vertigo besides vestibular migraine made up 6.6% of all the causes seen in this study period. Five of these were caused by ischaemic stroke, with another three patients diagnosed as cerebellar encephalomalacia, posterior cranial fossa arachnoid cyst and vertebral artery compression syndrome respectively. Four patients who attended the clinic in this study period showed no abnormalities in both clinical examinations and vestibular assessments. These patients were referred to the internal medicine and neurology department for further evaluation.

Table 1: Diagnosis of patients attending Vestibular Clinic, Sultan Ahmad Shah Medical Centre @IIUM

DIAGNOSIS	Number	Percentage (%)
BPPV	50	41.3
Vestibular migraine	25	20.7
Meniere's disease	7	5.8
Vestibular neuritis	4	3.3
Labyrinthitis	2	1.7
Chronic vestibulopathy	1	0.8
Other peripheral causes	8	6.6
<i>Otitis media with effusion (n=2)</i>		
<i>Chronic otitis media (n=2)</i>		
<i>Lateral semicircular canal injury (n=1)</i>		
<i>Sudden sensorineural hearing loss (n=1)</i>		
<i>Bell's palsy (n=1)</i>		
<i>Dysplastic posterior semicircular canal (n=1)</i>		
Systemic causes	5	4.1
<i>Postural hypotension (n=3)</i>		
<i>Drug induced dizziness (n=1)</i>		
<i>Anaemia (n=1)</i>		
Other central causes	8	6.6
<i>Ischaemic stroke (n=5)</i>		
<i>Cerebellar atrophy (n=1)</i>		
<i>Posterior cranial fossa arachnoid cyst (n=1)</i>		
<i>Vertebral artery compression syndrome (n=1)</i>		
Others	7	5.8
<i>Ocular (n=4)</i>		
<i>Cervical vertigo (n=2)</i>		
<i>Agoraphobia (n=1)</i>		
Referred/workup	4	3.3
TOTAL	121	100.0

Table 2: Breakdown of Semicircular Canals Implicated in Patients Diagnosed with BPPV and Treatment Required at the Vestibular Clinic, Sultan Ahmad Shah Medical Centre @IIUM

TYPES OF BPPV	TREATMENT	NUMBER OF PATIENTS	PERCENTAGE (%)
Anterior canal BPPV	Deep head hanging manoeuvre	8	16
Geotropic lateral canal BPPV	Gufoni manoeuvre	5	10
	BBQ roll manoeuvre	1	2
Apogeotropic lateral canal BPPV	Gufoni manoeuvre	1	2
Posterior canal BPPV	Epley manoeuvre	34	68
	Self-resolution	1	2
TOTAL		50	100

In this 18-month study period, 79% or 95 patients attended the vestibular clinic required only one visit before a diagnosis can be made (Table 3). There were 22 patients (18%) who required two visits to the clinic and two patients required three and four visits respectively before a diagnosis can be achieved. The mean number of visits to diagnosis is 1.3 with a standard deviation of 0.6. The median number of visits is one. Subsequent follow up appointments were given to patients depending on the severity and resolution of their symptoms.

Table 3: Summary of number of outpatient clinic visits to diagnosis for patients attending vestibular clinic, Sultan Ahmad Shah Medical Centre @IIUM

NUMBER OF VISITS TO DIAGNOSIS	NUMBER OF PATIENTS	%
1	95	79%
2	22	18%
3	2	2%
4	2	2%
TOTAL	121	100%

DISCUSSION

Dizziness is a relatively common complaint by patients, affecting about 20% to 30% of the general population.⁷ Ward et al (2013) reported that in the US National Health Interview Survey, about 15% of adult Americans reported dizziness or balance problems, and the prevalence increases with the age (about 20% in those aged 65 years and older).⁸ Our study found that most patients were in their 60s (24.8%) followed by the 50s (22.3%). The mean age of presentation in our study was 52.9 years old with a standard deviation of 15.5, which correlates to a study in Taiwan that revealed a mean age of 55.1 with a standard deviation of 17.3 years. With regards to gender differences, a study in Ottawa, Canada revealed that out of two-hundred and ninety-two (n=292) patients, 66.4% were female and 33.6% were male.⁹ Within the Asian countries, the Taiwan study showed a female predominance, with a male to female ratio of 1:1.96. Our study also shows the prevalence of dizziness being higher in female patients, with 59.5% being female and 40.5% being male patients, resulting in a ratio of 1:1.5.¹⁰ This is also in tune with the findings of Abdul Wahat et al (2013) of higher prevalence among female patients. This could be attributed to the fact that women were found to be more proactive in seeking help with regards to dealing with their health-related problems compared to men.¹¹ Women-related health conditions such as migraine and pre-menstrual syndrome also tend to affect the inner ear physiology leading to the onset of vestibular symptoms.¹² Approximately 80% of vertigo is attributed to a peripheral cause, whereas approximately 20% is central in origin. Most patients in our study also suffer from a peripheral cause to their vertigo (59.5%) compared to a central cause (27.3%).¹³

In view of the various causes of dizziness and vertigo, assessing each patient who presents with these symptoms is tedious, often requiring more than what a conventional general ENT clinic consultation could provide. A complete history, focused otorhinolaryngological examination and detailed vestibular assessment, via diagnostic tools such as the Video Head Impulse Test (vHIT), Video Nystagmography (VNG) and Caloric tests will be able to facilitate accurate diagnosis and proper management. Dedicated vestibular clinics, like the one in our centre, are often created to achieve these goals.¹⁴

Benign Paroxysmal Positional Vertigo (BPPV) is by far the most common cause of vertigo. The proportion of vertigo patients with BPPV is about 17% to 42% according to a study by Hanley et al (2001).¹⁵ This coincides with our findings of 41.3% of patients in our clinic having BPPV. BPPV usually affects patients in the age range between 50 and 55 years but can reach a cumulative incidence of 10% in patients 80 years old and above. Our study also shows that the mean age of presentation for patients with BPPV is 52.9 years.¹⁶ With regards to the specific semicircular canals implicated in BPPV, a recent study by Adegbiyi et al (2019) states that posterior canal BPPV is the most implicated (66.2%), followed by lateral canal (24.7%) and anterior canal (0.6%).¹⁷ However, in our study we found that the posterior canal is the most implicated (70%), while the anterior and lateral semicircular canal BPPV are almost equal in number, affecting 16% and 14% of patients, respectively. We diagnosed anterior canal BPPV when a torsional downward beating nystagmus is observed during a positive Dix Hallpike manoeuvre. We postulate that the reason we find a higher proportion of anterior canal BPPV in our study is due to most of the patients being of Malay Muslim descent, with a higher possibility of the otoconia dislodging into the anterior semicircular canal when they prostrate during their daily prayers.

In our study, various positional tests are employed to provoke the typical signs of nystagmus, and canalith repositioning treatment will be applied, as necessary. Most posterior canal BPPV were treated with Epley manoeuvre (68%), anterior canal BPPV were treated with

deep head hanging manoeuvre (16%), while most lateral canal BPPV were treated with Gufoni manoeuvre (12%) (Table 2). For lateral canal BPPV, we perform the Gufoni manoeuvre on more patients as it is easier to perform compared to the BBQ roll manoeuvre. This is because it requires the assessor to only identify the side of weaker nystagmus prior to performing this manoeuvre and not necessarily the side involved. On patients whose symptoms did not resolve with Gufoni manoeuvre, we performed the BBQ roll.¹⁸

Our study found that the second commonest cause of vertigo is Vestibular Migraine, contributing 20.7% of the total number of patients. However, this is rarely the referring diagnosis to our clinic, and the diagnosis is often made after a careful history taking and assessment in our clinic. This is also in keeping with a recent study in a tertiary vertigo centre, where the diagnosis was made in 20.2% of the patients, while the referring doctors had suspected vestibular migraine in only 1.8% of the patients.¹⁹ It is diagnosed via a set of criteria which include vestibular symptoms of moderate or severe intensity lasting for five minutes to 72 hours, with at least 50% of the episodes associated with migrainous headache, photophobia or phonophobia, and visual aura.²⁰

The third commonest cause of vertigo is Meniere's disease, which accounted for 5.8% of all our cases. According to a German study in 2009, Meniere's disease is implicated in 10.1% of the various forms of vertigo diagnosed.²¹ It also has specific diagnostic criteria that includes two or more episodes of vertigo or dizziness, lasting 20 minutes to 24 hours; associated with fluctuating hearing loss, tinnitus or aural fullness. A low to medium frequency sensorineural hearing loss documented on pure tone audiometry frequently helps with the diagnosis.²²

Vestibular neuritis is also another common cause of vertigo, accounting for 3.3% of all our cases, making it the third most common peripheral cause of vertigo. Our findings correlate with the findings of Strupp & Brandt (2009), although their percentage is slightly higher at 7%. The key diagnostic feature includes an acute onset of vertigo lasting several days with spontaneous horizontal

nystagmus towards the unaffected ear. In our centre, the diagnosis can be facilitated via the finding of a pathologic vHIT towards the affected ear.²³

Diagnosis remained uncertain in 3.3% of our patients and they had to be referred to other departments for further work up. However, with the help of the facilities of a specialized Vestibular Clinic, the diagnosis and subsequent management of patients with dizziness and vertigo has improved to 96.7% in our series. Out of these, 79% of patients who attended the vestibular clinic required only one visit before a diagnosis can be made. This is a good achievement in comparison to the incidence of undiagnosed cases in a recent study in Switzerland, which was as high as 24.5%.²⁴ Sometimes, repeated assessments are necessary and may yield the aetiology, as is the case with 22% of our patients who were diagnosed between the second to fourth visits to the clinic.

CONCLUSION

Dizziness always poses a diagnostic challenge to clinicians and therefore requires a systematic evaluation via a comprehensive history taking and clinical examination, complemented by a detailed vestibular assessment using various diagnostic tools. Therefore, a specialized Vestibular Clinic is set up to achieve these goals. BPPV was the most common cause of dizziness in our series, followed by Vestibular Migraine and Meniere's Disease. With an accurate diagnosis, prompt and precise treatment can be administered, which would ultimately result in symptom relief and improvement in the quality of life among patients who are affected by balance disorders.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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REFERENCES

1. Parker IG, Hartel G, Paratz J, Choy NL, Rahmann A. A Systematic Review of the Reported Proportions of Diagnoses for Dizziness and Vertigo. *Otology & Neurotology*. 2019; 40(1):6–15.
2. Kim HJ, Lee JO, Choi JY, Kim JS. Etiologic distribution of dizziness and vertigo in a referral-based dizziness clinic in South Korea. *Journal of Neurology*. 2020; 267(8):2252–2259
3. Isaradisaiikul S, Navacharoen N, Hanprasertpong C, Kangsanarak J, Panyathong R. Causes and time-course of vertigo in an ear, nose, and throat clinic. *European Archives of Oto-Rhino-Laryngology: Official Journal of the European Federation of Oto-Rhino-Laryngological Societies (EUFOS): Affiliated with the German Society for Oto-Rhino-Laryngology - Head and Neck Surgery*. 2010; 267(12):1837–1841.
4. Philip R, Prepageran N. Dizziness, a review of walk-in patients at a specialised neurotology clinic. *Med J Malaysia*. 2009; 64(1):56–8.
5. Abdul Wahat NH, Sevasankaran R, Abdullah A, Azman Ali R. Prevalence of Vestibular Disorders among Otology Patients in a Tertiary Hospital in Malaysia. *International Medical Journal*. 2013; 20(3):316–8.
6. Aslynn WAW, Mohd Sakeri NSB, Bt Arshad SA. Balance disorders among walk-in patients in the International Islamic University Malaysia (IIUM) Ear, Nose And Throat (ENT) clinic: An exploratory study. *IIUM Medical Journal Malaysia*. 2016; 15(1):1823-463.
7. Chu YT, Cheng L. Vertigo and dizziness. *Acta Neurol Taiwan*. 2007; 16(1):50-60.
8. Neuhauser HK. The epidemiology of dizziness and vertigo. *Handbook of Clinical Neurology*. 2016; 137:67–82.
9. Staibano P, Lelli D, Tse D. A retrospective analysis of two tertiary care dizziness clinics: a multidisciplinary chronic dizziness clinic and an acute dizziness clinic. *Journal of Otolaryngology - Head & Neck Surgery*.

- 2019; 48(11):1-8.
10. Lai YT, Wang TC, Chuang LJ, Chen MH, Wang PC. Epidemiology of vertigo: a National Survey. *Otolaryngology--Head and Neck Surgery: Official Journal of American Academy of Otolaryngology-Head and Neck Surgery*. 2011; 145(1):110–116.
 11. Alaedein JM. Psychological help seeking attitudes and personality factors among Jordanian college students. *Eur J Soc Sci*. 2011; 25(4), 606-629.
 12. Neuhauser HK, Brevern MV, Radtke A, Lezius F, Feldmann M, Ziese T, Lempert T. Epidemiology of vestibular vertigo: a neurotologic survey of the general population. *Neurology*. 2005; 65(6), 898-904.
 13. Baumgartner B, Taylor RS. Peripheral Vertigo. In: *Nih.Gov; StatPearls Publishing [online]*. Available at: www.ncbi.nlm.nih.gov/books/NBK430797. Accessed April 27, 2021.
 14. Olusesi AD, Abubakar J. 10 years of Vertigo Clinic at National Hospital Abuja, Nigeria: what have we learned? *European Archives of Oto-Rhino-Laryngology*. 2016; 273(11):3567–3572.
 15. Hanley K, O'Dowd T, Considine N. A systematic review of vertigo in primary care. *Br J Gen Pract*, 2001; 51(469):666–671.
 16. Gnerre P, Casati C, Frualdo M, Cavalleri M, Guizzetti S. Management of vertigo: from evidence to clinical practice. *Italian Journal of Medicine*, 2015; 9(2):180–192.
 17. Adegbiyi WA, Olajide TG, Olubi O, Olajuyin OA, Aluko AA. Clinicoepidemiology of benign paroxysmal positional vertigo in Nigerian. *Journal of Family Medicine and Primary Care*. 2019; 8(10):3220–3224.
 18. Gold DR, Morris L, Kheradmand A, Schubert MC. Repositioning Maneuvers for Benign Paroxysmal Positional Vertigo. *Current Treatment Options in Neurology*. 2014; 16(8).
 19. Geser R, Straumann D. Referral and final diagnoses of patients assessed in an academic vertigo center. *Front Neurol*. 2012; 3:169.
 20. Dieterich M, Obermann M, Celebisoy N. Vestibular migraine: the most frequent entity of episodic vertigo. *Journal of Neurology*. 2016; 263(S1):82–89.
 21. Strupp M, Dieterich M, Brandt T. The Treatment and Natural Course of Peripheral and Central Vertigo. *Deutsches Aerzteblatt Online*. 2013; 110(29–30):505-16.
 22. Lopez-Escamez JA, Carey J, Chung WH, et al. Classification Committee of the Barany Society, Japan Society for Equilibrium Research, European Academy of Otolology and Neurotology (EAONO), Equilibrium Committee of the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS), & Korean Balance Society. Diagnostic criteria for Menière's disease. *Journal of Vestibular Research: Equilibrium & Orientation*. 2015; 25(1):1–7.
 23. Strupp M, Brandt T. Vestibular neuritis. *Seminars in Neurology*. 2009; 29(5):509–519.
 24. Comolli L, Goeldlin M, Gaschen J, et al. Dizziness and vertigo in a tertiary ENT emergency department. *HNO*. 2020; 68(10):763–772.