Article

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Monika Kvederaitė , Maksimilian Grasevič , Antanas Vaitkus *

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Can Peripheral Vertigo be Predicted?

Monika Kvederaitė [1], Maksimilian Grasevič [1] and Antanas Vaitkus [2,*]

[1] Lithuanian University of Health Sciences, Academy of Medicine, Kaunas, Lithuania; monika.kvederaite@stud.lsmu.lt
[2] Department of Neurology, Medical Academy, Lithuanian University of Health Sciences, Kaunas, Lithuania
* Correspondence: Department of Neurology, Medical Academy, Lithuanian University of Health Sciences, Eivenių 2, 50161 Kaunas, Lithuania. antanas.vaitkus@lsmu.lt

Abstract: *Background and Objectives*: Peripheral vertigo is one of the most common symptoms for which patients are seen by a neurologist in the emergency room. Symptoms of peripheral vertigo can range from lightheadedness to an illusion of spinning. On average, vertigo is diagnosed for older patients as its predicting factors from medical history are yet to be determined. The objective of the study was to predict peripheral vertigo based on medical history and risk factors. *Materials and Methods*: A prospective case-control study at the Neurology Department of Lithuanian University Hospital was conducted. 71 patients diagnosed with vertigo and 43 controls was included. They completed questionnaires and underwent evaluation by neurologists or otolaryngologists, with statistical analysis performed using IBM SPSS Statistics. *Results*: 58% of vertigo patients were diagnosed with peripheral vertigo, with significant predictors including age (>60), motion sickness, height intolerance, gastroesophageal reflux disease and dyslipidemia, leading to the development of a risk assessment table for the peripheral vertigo prediction. *Conclusions*: This study suggest that early identification of these predictors could enhance peripheral vertigo management, while further research with larger cohorts is needed to validate and expand upon these findings, emphasizing the importance of considering medical history and risk factors for predicting peripheral vertigo and improving patient care.

Keywords: peripheral vertigo; predicting peripheral vertigo; prediction; risk factors

1. Introduction

Dizziness (including vertigo) is estimated to affect from 15% to 20% of adults yearly [1] and it is one of the ten most common symptoms for which patients are seen by a neurologist in the emergency room [2]. Dizziness is a non-specific term that refers to a vast range of sensations, ranging from lightheadedness to an illusion of spinning. Vertigo is only one of the subtypes of dizziness and is characterized by a false sensation of motion resulting from a mismatch of information between vestibular, somatosensory, and visual systems [3]. Vertigo can be either central or peripheral and this distinction is the first step towards an accurate diagnosis since peripheral vertigo is caused by damage to the components of the peripheral vestibular system (semicircular canals, otolith organs or the vestibulocochlear nerve) whereas central vertigo usually occurs in the setting of lesions affecting the brainstem or the cerebellum (e.g., in cases of stroke, multiple sclerosis, vestibular migraine). Peripheral vertigo is estimated to account for 80% of vertigo cases with the most common cause being benign paroxysmal positional vertigo (BPPV), followed by vestibular neuritis (VN) also known as acute unilateral vestibulopathy (AUVP) and Meniere's disease [4,5]. Considering the high prevalence of peripheral vertigo, attempts have been made to identify its causes and risk factors. Meta-analyses have identified five main risk factors for the occurrence of BPPV: female gender, osteoporosis, vitamin D deficiency, head trauma and high total cholesterol level [6]; and two risk factors for developing Meniere's disease: age and sleep disorders [7]. AUVP is most likely caused by the reactivation of a latent herpes simplex-1 infection, however, this has not been proven yet [8]. In addition, a genome-wide meta-analysis uncovered six sequence variants conferring risk of vertigo [9]. However, several uncommon conditions have been

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hypothesized to accompany or even precede peripheral vertigo, e.g., fear of heights, visual height, and vehicle travel intolerance [10,11]. Considering the abundance of factors potentially associated with the development of peripheral vertigo, the analysis of their combinations for each individual patient could potentially indicate the development of peripheral vertigo in advance. We hypothesize that the analysis of a patient's medical history and additional risk factors could help to predict the development of peripheral vertigo.

2. Materials and Methods

Following approval by a local bioethics committee (approval number BEC–LSMU(R)–07), a prospective case control study was conducted at the Neurology Department of the Hospital of Lithuanian University of Health Sciences Kaunas clinics. All subjects gave written consent to participate in the study. In the study we included 71 patients who came to seek medical attention due to a predominant complaint of vertigo, of whom 41 individuals were diagnosed as having peripheral vertigo, defined as one of the diagnoses H81.0-81.3 from International Disease Classification - 10 (ICD-10). In addition, 43 individuals who did not complain of vertigo were included as a control group, yielding the total sample size of 114 subjects. All subjects filled out a questionnaire and were evaluated by a neurologist or by an otolaryngologist as well. Patients who were younger than 18 years old or could not fully understand the questions of our questionnaire were not included in the study. Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated. Data normality was assessed using histograms and the Shapiro–Wilk test. Nonparametric tests were used for non-normally distributed variables. The Student's *t* and Mann–Whitney *U* tests were used to evaluate the differences between the groups. Differences in categorical variables were assessed using the chi-square test. Relative risk ratios were calculated. P values < 0.05 were regarded as statistically significant.

3. Results

Out of the 71 patients complaining of vertigo, the diagnosis of peripheral vertigo was confirmed in 58% (n=41), the majority of these patients were diagnosed as having BPPV39% (n=16) or vestibular neuronitis 24% (n=10), there were no identified cases of Meniere's disease, in addition, in 15 patients (39%) the ICD-10 code H81.3 was used for the diagnosis of peripheral vertigo without further specification as in these cases the patients did not meet any of the diagnostic criteria for more specific diagnoses. Average age of patients who had peripheral vertigo was 53-54 years old. We have found a statistically significant relation ($p<0.01$) between age and peripheral vertigo occurrence compared with people who have no vertigo symptoms: patients in a second control group were 12-14 years old younger than study groups. Also, we have noticed that 60 years old or older patients had higher risk of PV (almost 1.88 times), BPPV (2.35 times), VN (3.82 times) or other PV (2.56 times) compared with patients who had no history of vertigo. When comparing our investigated patients we have found no significant difference ($p>0.05$) between osteoporosis and vertigo as well as vitamin D deficiency. There was a statistically significant difference ($p<0.05$) among patients who had PV and motion sickness and those who had no symptoms of vertigo. Patients who had PV or BPPV, VN were more sensitive to spinning sensations. We have found a marginal distinction between PV or central type of vertigo and motion sickness. Driving motor vehicle intolerance manifested in PV (n=41), 7 (44%) and BPPV (n=16), 2(20%) patients. Implication is that we cannot differentiate PV and central vertigo based on these symptoms. Meanwhile, height intolerance was found in patients who had BPPV more often (n=16), 12 (75%) than those who had other types of vertigo. The tendency to have heigh intolerance in the future was found among almost all peripheral vertigo groups excluding vestibulopathy and vestibular hypofunction was higher compared with central type of vertigo patients. While dysfunction of the vestibular system develops further, heigh intolerance might be one of the first early symptoms for predicting PV. There is no relation between gout or hypertension and PV, BPPV or vestibular hypofunction was confirmed during our investigation. Patients who suffer from lipids metabolism dysfunction more

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often complained about peripheral vertigo. Dyslipidemia among PV patients was higher compared with patients who had central type of vertigo. At the same time, when comparing vertigo patients with patients who had no vertigo symptoms, correlation ($p<0.05$) was found among those who had gastroesophageal reflux and vestibulopathy/vestibular hypofunction. Those who had GERD symptoms everyday had 2.2 times higher risk for PV occurrence. These patients had higher risk for BPPV, VN and other peripheral vertigo occurrences 5.3 times, 6.7 times and 3.4 times respectively. We infer that risk of PV depends on frequency of GERD symptoms and not the symptoms' presence itself. However, there was no significant correlation ($p>0.05$) between middle ear inflammation or HSV-1 infection and peripheral vertigo.

4. Discussion

There is scarce data concerning the prediction of vertigo based on previous medical history. Nina Heinrichs et al. analyzed the connection between an experienced acute peripheral vestibular disorder, like BPPV, vestibular neuronitis (VN), and continued dizziness [12]. They determined that there is a risk of psychogenic dizziness, and patients should be monitored for psychological help. Also, the predictions within 3 months were only accurate for VN, not for BPPV. Another study focused on diagnosing a BPPV prior to clinical examination. Authors used the formula devised by Friedland et al. It takes into consideration the duration of symptoms, presence of vertigo and rolling over. Acquired number is then converted to a probability estimate [13]. The results were that the formula may be helpful in a clinical setting, however it does not adequately define the duration of symptoms [14]. Meanwhile we have found no studies that tried evaluating the risk of developing dizziness or vertigo based on anamnestic risk factors. On the other hand, there could be certain anamnestic factors that might be helpful to prognose PV earlier than usual. First of all- age. In our study we have found a statistically significant relation between age and peripheral vertigo. Also, patients with age 60 or older had almost 2 times higher risk for PV of which more than 2 times higher risk for BPPV and almost 4 times higher risk for VN occurrence. Another very important possible indicator of PV could be motion sickness. There was a statistically significant difference between patients who had PV and motion sickness and those who had no symptoms of vertigo. Patients who had PV or BPPV, VN, were more sensitive to spinning sensations. This could also be one of the first signs predicting vertigo. Third predictor might be heigh intolerance. The tendency to have heigh intolerance in the future was found almost among all peripheral vertigo groups - it might be the early sign of PV. We should be more accurate with patients who have been diagnosed with GERD or dyslipidemia. Patients with GERD had 2.2 times higher risk for PV and dyslipidemia among PV patients was very high. To make this prognose less complicated to understand we established a table (Table 1) with all the potent risk factors of vertigo. If the total count of points is ten or less - patient has low risk of vertigo, if total count of points is twenty-one or more patient is at high risk of vertigo. Using this table, we can quickly and efficiently calculate the possible risk of vertigo.

Table 1. Prognosis of vertigo.

PROGNOSIS OF VERTIGO						
Factor	Low risk	Points	Medium risk	Points	High risk	Points
AGE	40-60	**1**	>60	**2**	-	**-**
OSTEOPOROSIS	Osteopenia	**1**	Osteoporosis	**2**	Severe osteoporosis	**3**
DYSLIPIDEMIA						
LDL	130-159	**1**	160-189 mg/dL	**2**	>190 mg/dL	**3**

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	mg/dL					
HDL	Women: 40-59 mg/dL Men: 50-59 mg/dL	**1**	Women: <40 mg/dL Men: <50 mg/dL	**2**	-	**-**
TRIGLYCERIDES	150-199 mg/dL	**1**	200-499 mg/dL	**2**	>500 mg/dL	**3**
HERPES SIMPLEX VIRUS	Positive	**1**	-	**-**	-	**-**
GERD[1]	Grade A Grade B	**1**	Grade C	**2**	Grade D	**3**
HYPERTENSION[2]	Grade 1	**1**	Grade 2	**2**	Grade 3	**3**
EAR INFECTION[3]	Inner ear	**1**	Middle ear	**2**	Outer ear	**3**
HEIGHT INTOLERANCE	Visual heigh intolerance	**1**	Physiological visual height imbalance	**2**	Acrophobia	**3**
ALLERGIES[4]	Confirmed allergy	**1**	-	**-**	-	**-**
MIGRAINE OR ANXIETY	Diagnosed	**1**	-	**-**	-	**-**
LOW RISK OF VERTIGO	**≤ 11 POINTS**					
MEDIUM RISK OF VERTIGO	**12-19 POINTS**					
HIGH RISK OF VERTIGO	**20-28 POINTS**					

1 – Modified by Los Angeles classification of endoscopic grades of esophagitis. Grade A: one or more mucosal break <5 mm that does not extend between the tops of twho mucosal folds; Grade B: one or more mucosal break >= 5 mm that does not extend between the tops of two mucosal folds; Grade C: one or more mucosal break that is continuous between the tops of two or more mucosal folds but that involves <75% of the esophageal circumference; Grade D: one or more mucosal break that involves >= 75% of the esophageal circumference

2 – Grade 1 hypertension: systolic 140-159 mmHg and/or dyastolic 90-99 mmHg; Grade 2 hypertension: systolic 160-179 mmHg and/or diastolic 100-109 mmHg; Grade 3 hypertension: systolic >180 mmHg and/or diastolic >110 mmHg

3 – Ear infection classified by it's anatomic presence – starting from the inner ear and it's affection.

4–Allergies. Mixed IgE and cell-mediated disorders: eosinophillic oesophagitis/gastritis/gastroenteritis/colitis, atopic dermatitis; Non-IgE mediated disorders: food protein induced enterocolitis syndrome, food protein induced allergic proctocolitis, food protein enteropathy; IgE mediated disorders: immediate gastrointestinal hypersensitivity, pollen associated food allergy syndrome, anaphylaxis, delayed food induced anaphylaxis to meat, food-induced exercise-induced anaphylaxis

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5. Conclusions

In the literature on peripheral vertigo, researchers describe a lot of different risk factors. Most of them discuss whether a certain medical condition can cause vertigo symptoms and its importance on the matter. There were a few tries of predicting peripheral vertigo, notably Friedland et al. However, his formula cannot predict the duration of symptoms and the first presentation of the disorder. Our research determined that old age (<60 years old), patients with osteoporosis, vHI, dyslipidemia and GERD have a significant increase in risk of experiencing peripheral vertigo. Other risk factors, such as HSV-1, middle ear inflammation, gout, hypertension was controversial, their correlation to PV is to be investigated in a broader study. In summary, our hypothesis is supported by a statistically relevant connection between peripheral vertigo and GERD, old age (<60 years old), patients with osteoporosis, vHI and dyslipidemia. In the future, it may be possible to pay attention to those aspects and possibly predict the probability of peripheral vertigo in certain patients. In summary, age, motion sickness and sensitivity to spinning sensations, height intolerance, as well as patients with GERD and dyslipidemia, should be investigated more precisely during neurological examination. We believe that by analyzing certain anamnestic data and evaluating risk factors could help predict the occurrence of peripheral vertigo. It is also important to mention that our study had a limited sample thus the results did not always correlate with medical literature and further research is needed to bring more information to this important matter.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the local Ethics Committee of Lithuanian University of Health Sciences (protocol code BEC-LSMU(R)-07 2018-11-12).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. They were given an information sheet to read and an informed consent to sign assuring that they were free to withdraw at any point and their data would be anonymized.

Data Availability Statement: The datasets analyzed during the current study are available from the principal author on reasonable request.

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Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Neuhauser HK. The epidemiology of dizziness and vertigo. Handb Clin Neurol [Internet]. 2016 [cited 2024 Apr 21];137:67–82. Available from: https://pubmed-ncbi-nlm-nih-gov.ezproxy.dbazes.lsmuni.lt/27638063/
2. Moulin T, Sablot D, Vidry E, Belahsen F, Berger E, Lemounaud P, et al. Impact of emergency room neurologists on patient management and outcome. Eur Neurol [Internet]. 2003 [cited 2024 Apr 21];50(4):207–14. Available from: https://pubmed-ncbi-nlm-nih-gov.ezproxy.dbazes.lsmuni.lt/14634264/
3. Della-Morte D, Rundek T. Dizziness and Vertigo. 2012 [cited 2024 Apr 21];22–5. Available from: https://karger.com/books/book/2764/chapter/5796818/Dizziness-and-Vertigo
4. How common are various causes of dizziness? A critical review - PubMed [Internet]. [cited 2024 Apr 21]. Available from: https://pubmed.ncbi.nlm.nih.gov/10701780/
5. Vertigo - PubMed [Internet]. [cited 2024 Apr 21]. Available from: https://pubmed.ncbi.nlm.nih.gov/29493978/

6. Chen J, Zhang S, Cui K, Liu C. Risk factors for benign paroxysmal positional vertigo recurrence: a systematic review and meta-analysis. J Neurol [Internet]. 2021 Nov 1 [cited 2024 Apr 21];268(11):4117–27. Available from: https://pubmed.ncbi.nlm.nih.gov/32839838/
7. Hu C, Yang W, Kong W, Fan J, He G, Zheng Y, et al. Risk factors for Meniere disease: a systematic review and meta-analysis. Eur Arch Otorhinolaryngol [Internet]. 2022 Dec 1 [cited 2024 Apr 21];279(12):5485–96. Available from: https://pubmed.ncbi.nlm.nih.gov/35794275/
8. Strupp M, Bisdorff A, Furman J, Hornibrook J, Jahn K, Maire R, et al. Acute unilateral vestibulopathy/vestibular neuritis: Diagnostic criteria. J Vestib Res [Internet]. 2022 [cited 2024 Apr 21];32(5):389–406. Available from: https://pubmed.ncbi.nlm.nih.gov/35723133/
9. Skuladottir AT, Bjornsdottir G, Nawaz MS, Petersen H, Rognvaldsson S, Moore KHS, et al. A genome-wide meta-analysis uncovers six sequence variants conferring risk of vertigo. Commun Biol [Internet]. 2021 Dec 1 [cited 2024 Apr 21];4(1). Available from: https://pubmed.ncbi.nlm.nih.gov/34620984/
10. Golding JF, Patel M. Meniere's, migraine, and motion sickness. Acta Otolaryngol [Internet]. 2017 May 4 [cited 2024 Apr 21];137(5):495–502. Available from: https://pubmed.ncbi.nlm.nih.gov/27918236/
11. Kapfhammer HP, Fitz W, Huppert D, Grill E, Brandt T. Visual height intolerance and acrophobia: distressing partners for life. J Neurol [Internet]. 2016 Oct 1 [cited 2024 Apr 21];263(10):1946–53. Available from: https://pubmed.ncbi.nlm.nih.gov/27383642/
12. Heinrichs N, Edler C, Eskens S, Mielczarek MM, Moschner C. Predicting continued dizziness after an acute peripheral vestibular disorder. Psychosom Med [Internet]. 2007 [cited 2024 Apr 21];69(7):700–7. Available from: https://pubmed-ncbi-nlm-nih-gov.ezproxy.dbazes.lsmuni.lt/17766688/
13. Friedland DR, Tarima S, Erbe C, Miles A. Development of a Statistical Model for the Prediction of Common Vestibular Diagnoses. JAMA Otolaryngol Head Neck Surg [Internet]. 2016 Apr 1 [cited 2024 Apr 21];142(4):351–6. Available from: https://pubmed-ncbi-nlm-nih-gov.ezproxy.dbazes.lsmuni.lt/26913615/
14. Britt CJ, Ward BK, Owusu Y, Friedland D, Russell JO, Weinreich HM. Assessment of a Statistical Algorithm for the Prediction of Benign Paroxysmal Positional Vertigo. JAMA Otolaryngol Head Neck Surg [Internet]. 2018 Oct 1 [cited 2024 Apr 21];144(10):883–6. Available from: https://pubmed-ncbi-nlm-nih-gov.ezproxy.dbazes.lsmuni.lt/30178063/