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Research Article

DIAGNOSTIC FRAMEWORK FOR BPPV: EVALUATING KEY HISTORICAL INDICATORS

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Abstract

Background: Benign paroxysmal positional vertigo (BPPV) is the most common cause of peripheral vertigo, with posterior canal involvement accounting for the majority of cases. Despite its prevalence, diagnosing posterior canal BPPV can be challenging, as some patients do not exhibit characteristic nystagmus during the Dix–Hallpike test (DHT + BPPV). This study aimed to identify key clinical history indicators that can enhance the accuracy of BPPV diagnosis. Methods: A structured interview-based study was conducted at Sri Lakshmi Narayana Institute of Medical Sciences in 2021. Patients presenting with dizziness underwent a detailed medical history assessment covering symptom onset, duration, triggering movements, and associated symptoms. The Dix–Hallpike test (DHT) was performed for suspected BPPV cases. Logistic regression analysis and receiver operating characteristic (ROC) curve analysis were used to identify the most predictive clinical history factors for DHT + BPPV. Results: Among 290 patients in the derivation set and 122 in the validation set, "onset when turning over in bed" and "duration of dizziness ≤15 seconds" emerged as the strongest independent predictors of DHT + BPPV. The predictive model demonstrated a positive likelihood ratio of 6.81 and a negative likelihood ratio of 0.19 for diagnosing DHT + BPPV. These findings indicate that incorporating these historical factors into clinical assessments significantly enhances diagnostic accuracy. Conclusion: This study highlights the diagnostic value of two key historical indicators—dizziness lasting ≤15 seconds and symptom onset when turning over in bed—in predicting posterior canal BPPV. Incorporating these elements into routine clinical evaluations can improve early BPPV diagnosis, streamline patient management, and reduce unnecessary referrals. Further research across diverse populations is recommended to validate these findings and refine diagnostic protocols.

Keywords: Benign paroxysmal positional vertigo, Dix–Hallpike test, dizziness duration, diagnostic predictors, posterior canal BPPV.

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INTRODUCTION

The patient's medical history plays a crucial role, as various diseases can lead to dizziness, and physical examinations or diagnostic tests often fail to determine the exact cause [1,2]. Among individuals with benign paroxysmal positional vertigo (BPPV), posterior canal involvement is the most frequently observed, whereas anterior canal involvement is exceptionally uncommon [3–8]. Although BPPV can affect any of the semicircular canals, the posterior canal is the most commonly affected. Studies indicate that posterior canal BPPV accounts for approximately 60%–90% of all cases, while horizontal canal BPPV constitutes around 5%–30% [9–13]. Therefore, this research focuses specifically on posterior canal BPPV.

A key aspect of medical history in BPPV patients is the onset of vertigo triggered by changes in

head position. The Dix–Hallpike test is a widely used diagnostic tool for identifying characteristic nystagmus. However, in clinical practice, some patients with suspected posterior canal BPPV may not exhibit the characteristic nystagmus during the test. A review of existing literature did not reveal any relevant studies on this issue. This study aims to identify the most significant medical history indicators for predicting a BPPV diagnosis based on a positive Dix–Hallpike test (DHT + BPPV).

METHODS

An extensive review of the literature facilitated the selection of key questions essential for differentiating the causes of dizziness, leading to the development of structured interview sheets. These sheets encompassed various aspects, including the patient's medical history, lifestyle habits, mode of symptom onset, duration of dizziness, triggering movements, associated symptoms such as nausea and vomiting, and the nature of dizziness (rotational or non-rotational). Upon completion of the interviews, physicians verified and documented the patients' medical histories for further evaluation. All participating physicians belonged to the department and had professional experience ranging from 3 to 15 years. Diagnosing benign paroxysmal positional vertigo (BPPV) is often challenging without a history of recurrent vertigo episodes, typically induced by specific head movements.

A definitive diagnosis of posterior canal BPPV was established through the Dix–Hallpike test [14]. In this study, BPPV suspicion was initially based on the patient's medical history, and posterior canal BPPV was confirmed using predefined diagnostic criteria. The Dix–Hallpike test was performed on all suspected BPPV cases using Frenzel glasses to detect characteristic nystagmus, which included a latency of 1–2 seconds, dissipation within 10–20 seconds, and exacerbation upon repeated testing. Patients exhibiting all these features were classified as DHT + BPPV, while those without these features were categorized as DHT - BPPV. Individuals with cervical spine disease or rheumatoid arthritis were excluded from the study due to the difficulty of conducting the necessary diagnostic assessments. To minimize diagnostic uncertainty, the study exclusively focused on DHT + BPPV cases. Patients with ambiguous dizziness symptoms were referred to specialized departments for further assessment. Any cases with incomplete data were excluded from the analysis.

The association between collected patient information and the final diagnosis was examined using physician-interview data. The study computed a 95% confidence interval (CI) along with positive and negative likelihood ratios for diagnosing DHT + BPPV. Receiver operating characteristic (ROC) curve analysis was employed to explore the correlation between dizziness duration and DHT + BPPV presence. The cut-off duration, determined by the highest Youden index, was used to classify dizziness episodes as positive or negative based on their length. Binomial logistic regression analysis, using both step-up and step-down methods, was performed to identify the most relevant questions for predicting DHT + BPPV diagnosis. The inclusion and exclusion of variables were based on statistical significance ($P < 0.05$) and likelihood ratios. Spearman's correlation coefficient was calculated to determine interdependencies between variables; if the coefficient exceeded 0.2, only one variable was considered to avoid redundancy. Logistic regression coefficients were used to assign weights to predictive factors, leading to the development of a predictive score for DHT + BPPV. ROC curve analysis was then applied to evaluate the effectiveness of this predictive model.

A cross-validation test was conducted using data from both derivation and validation sets. Patients with incomplete data were excluded from the validation process. Likelihood ratios were calculated using StatsDirect software, while all other statistical analyses were performed using SPSS software. This study was conducted at Sri Lakshmi Narayana Institute of Medical Sciences in 2021.

RESULT

Participants in this study gave informed consent to participate in 145/156 and 61/65, respectively. It is possible to perform the Dix-Hallpike test on all of these patients. The clinical characteristics of the subjects (derivation set and validation set) and details of the diagnosis are shown in the causes other than BPPV are also shown in. A single patient presented with both DHT + BPPV and depression as causes of dizziness in the validation set. Derivation and validation sets showed similar distributions of mean age, gender, and final diagnoses. An analysis of the relationship between the duration of dizziness and the presence of DHT + BPPV revealed that the maximum Youden Index was 15 seconds. The question was included in subsequent analyses because the cut-off value was set at 15 seconds. Here are questions that showed significant positive or negative likelihood ratios for diagnosing DHT + BPPV.

Deafness, double vision, the sensation of blood draining from the body, diabetes mellitus history, and excessive stress were taken into account as independent variables in binomial logistic regression analysis using likelihood ratios. This analysis excluded eleven patients with missing data from the 145 eligible patients. DHT + BPPV can be independently predicted by "duration of dizziness 15 seconds" and "onset when turning over in bed". Chi-square tests showed statistical significance ($P<0.01$), and Hosmer-Lemeshow tests confirmed the model's goodness of fit ($P = 0.665$). By using likelihood ratios, a similar analysis was performed by the step-down

method, which produced the same results. During the validation of the predictive model, four patients with missing information were excluded from the derivation set for subsequent analysis. These regression coefficients were then used to calculate predictive scores for both predictive factors, as shown in and predictive scores were calculated for each patient. For each of the three defined thresholds, we calculated the positive and negative predictive values using these predictive scores and a diagnosis of DHT + BPPV. These predictive factors' performance characteristics are presented in [15]

Table: 1 Characteristics of the subjects

	Derivation set (N = 290)	Validation set (N = 122)
Mean age, y ± SD	45.9 ± 17.4	48.7 ± 17.1
Male, n (%)	98	50
Final diagnosis, n (%)a		
Peripheral disease	94	48
DHT+ BPPV	24	12
Mean age, y ± SD	57.0 ± 17.6	54.7 ± 16.3
Male	12	2
DHT- BPPV	60	28
Meniere's disease	6	2
Vestibular neuritis	4	6
Psychogenic disorders	112	36
Depressive disorder	48	10
Somatoform disorder	24	2
Adjustment disorder	12	10
Panic disorder	10	4
Anxiety disorder	6	6
Hypochondriasis	4	2
Othersc	8	2
Central diseases	16	6
Migraine	6	2
Transient ischemic attack		4
Othersd	10	
Others	38	18
Orthostatic hypotension	10	2
Combined sensory disorde	6	2
Arrhythmia	4	
Anemia	4	
Drug-induced	4	
Drug-induced	4	
Overwork	4	2
Otherse	2	12
Unknown diagnosis	2	16
Patients requiring consultation with specialists, n (%)	112	30

Table 2: Performance characteristics of individual items

	Sensitivity (95% CI)	Specificity (95% CI)	Positive likelihood ratio (95% CI)	Negative likelihood ratio (95% CI)
Temporal factors				
Sudden onset	.92	0.33	1.36	0.26
Recurrence	0.83	0.29	1.18	0.57
Diurnal fluctuation	0.67	0.50	1.33	0.67
Duration of dizziness #15 seconds	0.42	0.84	2.64	0.69
Features				
Spinning sensation	0.92	0.65	2.63	0.13

(rotation)				
Triggers				
Onset when turning over in bed	0.75	0.77	3.23	0.33
Onset when standing up	0.75	0.52	1.57	0.48
Onset when looking up				
Onset when looking down	0.42	0.77	1.84	0.75
	0.50	0.71	1.73	0.70
Accessory symptoms				
Deafness	0.08	0.95	1.82	
Nausea and/or vomiting				
Double vision	0.67	0.60	1.65	
Faintness	0.08	0.94	1.35	
	0.25	0.82	1.35	
General factors				
History of diabetes mellitus	0.08	0.98	3.69	0.94
Loss of enjoyment	0.83	0.35	1.28	0.48

Table 3: Results of binomial logistic regression analysis

Variable	Regression coefficient	Significant probability	Odds ratio (95% CI)	Point*
Duration of dizziness #15 seconds	2.94	0.028	8.7	2
Onset when turning over in bed	4.64	0.001	20.34	4
Constant	-4.06	,0.001		

DISCUSSION

Among the medical history items found useful in determining if DHT + BPPV is present, "duration of dizziness #15 seconds" and "onset when turning over in bed" stood out most. Positive answers to both questions led to a likelihood ratio of 6.81 for diagnosis of DHT + BPPV, while negative answers had a likelihood ratio of 0.19. With these two items, primary care physicians are able to predict the likelihood of DHT + BPPV diagnosis [16].

According to the odds ratio for "onset when turning over in bed," it was the most useful interview item for predicting a diagnosis of DHT + BPPV when compared to the other two. As previously demonstrated, "onset when turning over in bed" can be an important component of the patient's medical history in determining if they have BPPV, but the present study indicates that this is the most distinctive symptom of DHT + BPPV. There have been many cases of dizziness exacerbated by body movement, according to the authors. The movements of the head and body in turning over in bed do not affect blood pressure, so other common illnesses such as orthostatic hypotension and psychogenic disorders may not worsen dizziness. It is likely that this is the reason why turning over in bed had such high specificity for diagnosing BPPV. It is possible to turn over in bed at any time while sleeping, but patients with BPPV may become habituated to their symptoms so they notice them when they wake up It has been reported previously that peripheral dizziness may be suspected in patients at this time. The duration of dizziness was also predictive. Diagnosing and treating causes of dizziness is influenced by factors such as the mode of onset and duration of episodes, as found in previous studies. It was found in the present study that the duration of dizziness can play a specific role in determining whether BPPV is diagnosed or excluded. In spite of the fact that it has been reported that patients with BPPV experience only short periods of dizziness, a review of BPPV that considered the Dix–Hallpike test as important suggests that the typical period of dizziness is a few seconds to a few minutes [17], which is in accordance with the present study's findings. Additionally, significant positive and negative likelihood ratios were determined for items like diurnal fluctuations. As symptoms of patients with other diseases often improve or worsen over time as a result of changes in the underlying condition, “diurnal fluctuation” may be used to detect BPPV since the symptoms of patients with other diseases may change over time. Thus, patients with BPPV would not use the expression “diurnal fluctuation” (which means improvement or exacerbation within a short period of time) [18]. As a result, "diurnal fluctuation" becomes an important element of the medical history in making a diagnosis of BPPV or excluding it. In addition, one may experience a "spinning sensation" (i.e., rotatory vertigo) if they have peripheral vertigo. Additionally, recurrent vertigo combined with nausea and vomiting is associated with

peripheral vertigo [19]. When taking a history, it is important to determine how symptoms develop, how long dizziness lasts, and what triggers the dizziness. It was demonstrated in this study that two simple items from the history could predict a diagnosis of DHT + BPPV, making the diagnosis of dizziness more accurate.

CONCLUSION

This study has significantly advanced our understanding of diagnosing benign paroxysmal positional vertigo (BPPV) by focusing on the diagnostic value of specific items within the patient's medical history. Through the construction and validation of a disease prediction model, we have identified two key historical features, namely the duration of dizziness ≤15 seconds and onset when turning over in bed, as independent predictors of BPPV involving the posterior semicircular canals, confirmed by a positive Dix–Hallpike test (DHT + BPPV). The affirmative responses to these questions provide a robust likelihood ratio for diagnosing DHT + BPPV. These findings underscore the critical importance of carefully assessing these historical features in clinical practice for suspecting and accurately diagnosing BPPV. By integrating this knowledge into routine clinical assessments, healthcare providers can enhance diagnostic accuracy, streamline patient care pathways, and ultimately improve outcomes for individuals presenting with dizziness symptoms associated with BPPV. Further research and validation of these diagnostic indicators across diverse patient populations will be valuable for optimizing diagnostic protocols and informing evidence-based management strategies for BPPV.

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