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Acute Vestibular Findings in Patients with Vestibular Neuritis

Vestibüler Nöritli Hastalarda Akut Dönem Vestibüler Bulgular

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ABSTRACT Objective: This study aimed to analyze static and dynamic vestibular dysfunction in the acute phase of vestibular neuritis (VN) using videonystagmography (VNG). **Material and Methods:** Twenty-one patients (11 females, 10 males) aged between 20-63 years, who were diagnosed with VN and presented within 72 hours of symptom onset without having received any medical treatment, were included. The VNG test protocol involved the assessment of spontaneous nystagmus, gaze-evoked nystagmus, Head Shake Test (HST), Head Roll Test (HRT), and Dix-Hallpike Test (DH). The slow phase velocity (SPV) of the nystagmus observed in each test was measured and analyzed. **Results:** The mean age of the participants was 44.14±14.63 years, with no significant age difference between females and males ($p>0.05$). Spontaneous nystagmus was observed to the right in 10 patients (47.64%) and to the left in 11 patients (52.38%). Correlation analysis showed a moderate positive correlation between spontaneous nystagmus SPV and gaze right nystagmus ($p=0.019$), as well as left HRT ($p=0.005$). A strong positive correlation was found between spontaneous nystagmus SPV and HST, supine HRT, right HRT, right DH, and left DH ($p=0.001$). **Conclusion:** Our findings suggest that the maximum SPV of spontaneous nystagmus in VN shows strong positive correlations with dynamic vestibular tests, reflecting asymmetric involvement of the vestibular system. Re-recording spontaneous nystagmus in the supine HRT position may improve directionality analysis and aid in the more accurate interpretation of caloric test results.

Keywords: Vestibular neuritis; positional test; spontaneous nystagmus; gaze; acute

ÖZET Amaç: Vestibüler nörit (VN) tanılı hastalarda, videonistagmografi (VNG) kullanılarak akut dönem vestibüler disfonksiyonun statik ve dinamik testlerde analiz edilmesi amaçlanmıştır. **Gereç ve Yöntemler:** Çalışmaya, VN tanısı almış, semptom başlangıcından itibaren 72 saat içinde başvuran ve herhangi bir medikal tedavi almamış, yaşları 20-63 arasında değişen toplam 21 hasta (11 kadın, 10 erkek) dâhil edilmiştir. VNG test protokolü kapsamında spontan nistagmus, gaze nistagmus, Baş Sallama Testi (HST), Baş Yuvarlama Testi (HRT) ve Dix-Hallpike Testi (DH) uygulanmıştır. Tüm testlerde nistagmusun yavaş faz hızı [slow phase velocity (SPV)] ölçülerek analiz edilmiştir. **Bulgular:** Katılımcıların yaş ortalaması 44,14±14,63 yıl olup, kadın ve erkek katılımcılar arasında yaş açısından anlamlı bir fark saptanmamıştır ($p>0,05$). Spontan nistagmus yönü 10 hastada (%47,64) sağa, 11 hastada (%52,38) sola doğru izlenmiştir. Korelasyon analizinde, spontan nistagmus SPV'si ile gaze sağ nistagmus ($p=0,019$) ve sol HRT ($p=0,005$) arasında orta düzeyde, baş sallama nistagmusu, supin HRT, sağ HRT, sağ DH ve sol DH arasında yüksek düzeyde pozitif yönde korelasyon bulunmuştur ($p=0,001$). **Sonuç:** Bulgularımız, VN'de spontan nistagmusun maksimum SPV'nin dinamik vestibüler testlerle yüksek düzeyde pozitif korelasyon gösterdiğini ve vestibüler sistemin asimetrik tutulumunu yansıttığını ortaya koymuştur. Supin HRT pozisyonunda spontan nistagmus kaydının yeniden yapılması, yön üstünlüğü analizinin daha doğru gerçekleştirilmesine katkı sağlayabilir ve kalorik test sonuçlarının daha sağlıklı yorumlanmasını mümkün kılabilir.

Anahtar Kelimeler: Vestibüler nörit; pozisyonel test; spontan nistagmus; gaze; akut

Dizziness is defined as a sensory perception that disrupts spatial orientation and balance. While it is a prevalent complaint among the general population, it has been observed that dizziness, including vertigo, affects approximately 15-20% of the adult population annually. Vestibular vertigo comprises approximately 25% of all dizziness-related complaints. Its 12-month prevalence is estimated to be 5%, while its annual incidence is recorded to be 1.4%. The prevalence of vestibular vertigo increases with age and is approxi-

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mately 2-3 times higher in women than in men. A growing body of research has identified imbalance as a pervasive complaint, particularly with regard to its harmful impact on the healthy aging process.[1] In the field of neurotology, peripheral vertigo is most frequently linked to three specific conditions: benign paroxysmal positional vertigo, Ménière's' disease, and vestibular neuritis (VN). These 3 conditions are collectively regarded as the most prevalent peripheral vestibular disorders.[2]

Acute vestibular syndrome (AVS) is a clinical syndrome characterized by symptoms such as vertigo, nausea, vomiting, and gait instability that persist for days or weeks. The most prevalent etiologic factors contributing to AVS are identified as VN and stroke.[3] Distinguishing between these 2 clinical conditions is diagnostically and prognostically important and poses a serious diagnostic challenge for physicians.

VN develops because of acute, unilateral loss of peripheral vestibular function in the absence of central or audiologic symptoms or signs. The aforementioned evidence indicates that the diagnosis of VN should be determined on the basis of patient history, bedside clinical assessment, and, in some cases, vestibular testing. The symptoms exhibited by patients diagnosed with VN are typically characterized by an acute or, in rare instances, subacute onset of imbalance, nausea, vomiting, oscillopsia, and rotating or non-rotating vertigo. The most salient clinical observation was the presence of spontaneous peripheral vestibular nystagmus of a horizontal or torsional nature, manifesting within the plane of the pertinent semicircular canal. The severity of this condition increases in response to the removal of visual fixation.[4]

A study was conducted in which the slow phase velocity (SPV), frequency, visual suppression, and gaze position dependence of nystagmus were analyzed using videonystagmography (VNG) in the acute period of individuals with VN. The authors of the study reported that nystagmus in individuals with VN remained constant regardless of gaze direction and that its severity diminished with visual fixation.[5] In a subsequent study, it was observed that vestibular-ocular reflex gain was diminished in subjects diagnosed with VN. The horizontal and fast phases of spontaneous nystagmus tended to align with the unaffected ear in most patients. In some patients, nystagmus manifested as torsional downbeating.[6] The objective of this study was to analyze acute vestibular dysfunction in patients with VN using VNG in static and dynamic tests.

MATERIAL AND METHODS

This study was endorsed by the Health Sciences University Gülhane Scientific Research Ethics Committee (date: January 7, 2025; no: 2025-30) and was executed in accordance with the principles delineated in the Declaration of Helsinki. Written informed consent was obtained from all participants. The study population comprised 21 individuals, ranging in age from 20 to 63 years, who had been diagnosed with VN according to the Barany Society's diagnostic criteria.[4] The ICS Chart 200 (GN Otometrics, Taastrup, Denmark) was utilized for VNG during the vestibular evaluation process. The evaluation of individuals presenting with vertigo was performed in a dimly lit room using video goggles with an infrared camera. The evaluation included the spontaneous nystagmus test, the gaze test, the Head Shake Test (HST), the Head Roll Test (HRT), and the Dix-Hallpike Test (DH). These tests were performed in the sequence delineated in the VNG protocol.

The study's' inclusion criteria were met by patients who presented to the outpatient clinic within 72 hours of the onset of symptoms and had not received any medical treatment. In the course of the spontaneous nystagmus test, the patients were seated on a bed and their eye movements were recorded for duration of 30 seconds in the absence of any visual or vestibular stimuli, with the eyeglass lid closed. In the Gaze test, patients were instructed to focus on a light bar positioned at eye level and at a distance of 120 centimeters to the left and right at an angle of 25 degrees for duration of 30 seconds. During the Head Shake Test, the clinician passively shook the head passively for 15 seconds at a frequency of 2 Hz for 20-30 degrees to the right and left along the yaw axis. Then, the patient's eye movements were recorded for 60 seconds. Subsequently, the HRT and DH tests were conducted. The SPV of nystagmus was measured and analyzed in all vestibular tests.

The exclusion criteria included a history of previous ear surgery, sudden sensorineural hearing loss, Meniere's' disease, the use of psychiatric medication within the last 6 months, and neurological disorders.

STATISTICAL ANALYSIS

The categorical variables of the participants included in the study are presented with frequency (n) and percentage (%) values. The mean, standard deviation, and median values were calculated for the quantitative variables. The Kolmogorov-Smirnov test was then employed to assess the normality distribution of the data. The chi-square test was employed to compare categorical variables. In instances where the comparison of variables was between 2 independent groups, the Mann-Whitney U test was selected due to the non-compliance with the normality assumption. Spearman's' rank correlation coefficient was calculated to ascertain the relationships between the quantitative variables. The significance level was established at $p<0.05$ for all statistical analyses, which were conducted using the SPSS 26.0 statistical package program (IBM Corp., Armonk, NY, USA).

RESULTS

This study included 21 individuals. Of these, 11 (52.38%) were female and 10 (47.64%) were male. The mean age of the participants was 44.14 years (±14.63 years), with an age range of 20 to 63 years. A subsequent analysis revealed no statistically significant differences between male and female participants about age ($p>0.05$). The homogeneity of the age and gender distribution of the participants was determined.

In terms of vestibular involvement, a total of 11 individuals (52.38%) had the effected ear on the right side, while 10 individuals (47.62%) had the effected ear on the left side. An evaluation of the direction of spontaneous nystagmus revealed that rightward nystagmus was observed in 10 participants (47.62%), while leftward nystagmus was observed in 11 participants (52.38%). A subsequent analysis of the direction of nystagmus recorded post-HST revealed that 10 subjects (47.62%) exhibited nystagmus directed to the right, while 11 subjects (52.38%) demonstrated nystagmus directed to the left. It was determined that the direction of nystagmus observed after HST was congruent with the direction of spontaneous nystagmus in all participants (Table 1).

The mean, standard deviation, and change intervals of the nystagmus SPV obtained in the study are presented below.

The mean SPV of spontaneous nystagmus was 18.12±7.93, with a range of 4.2-34.9. The mean SPV value of gaze right nystagmus was 4.13±5.2 (0-16.6), and the mean SPV value of gaze left nystagmus was 4.32±4.49 (0-16.6). The mean SPV of nystagmus observed after HST was 22.8±10.39, with a range of 6-43.3. The mean SPV value of nystagmus, as determined by supine HRT, was 20.35±8.7 (6.4-37.3). The mean SPV of nystagmus observed in the right HRT was 20.92±9.74 (3.2-43.3), and in the left HRT, the mean SPV of nystagmus was 22.1±12.02 (4.8-40.4). According to the results of right DH, the mean SPV value of the nystagmus was 24.64±9.12, with a range of 6-44.2. In the case of Left DH, the mean SPV of nystagmus was 21.79±11.38, with a range of 7.8-50.8 (Table 2).

TABLE 1: Affected ear, direction, and frequency of spontaneous nystagmus and head shake nystagmus in individuals with VN

Variable	Direction	Frequency	Percent
Affected ear	Right	11	52.38%
	Left	10	47.62%
Spontaneous nystagmus	Right	10	47.62%
	Left	11	52.38%
Head shake nystagmus	Right	10	47.62%
	Left	11	52.38%

TABLE 2: SPV of spontaneous nystagmus in different vestibular tests

Variable	$\bar{X}$±SD	M (minimum-maximum)
Spontaneous nystagmus	18.12±7.93	18 (4.2-34.9)
Gaze right nystagmus	4.13±5.2	2.8 (0-16.6)
Gaze left nystagmus	4.32±4.49	3.6 (0-16.6)
Head shake nystagmus	22.8±10.39	21.4 (6-43.3)
Supine head roll	20.35±8.7	19.6 (6.4-37.3)
Right head roll	20.92±9.74	20.5 (3.2-43.3)
Left head roll	22.1±12.02	21.4 (4.8-40.4)
Right Dix-Hallpike	24.64±9.12	25.6 (6-44.2)
Left Dix-Hallpike	21.79±11.38	20.5 (7.8-50.8)

SD: Standard Deviation; M: Median

TABLE 3: Relationship between the degree of spontaneous nystagmus and other tests

Variable		Gaze right nystagmus	Gaze left nystagmus	Head shake nystagmus	Supine head roll	Right head roll	Left head roll	Right Dix-Hallpike	Left Dix-Hallpike
Spontaneous nystagmus	r value	**0.507**	0.192	**0.773**	**0.779**	**0.720**	**0.589**	**0.711**	**0.799**
	p value	**0.019***	0.404	**0.001***	**0.001***	**0.001***	**0.005***	**0.001***	**0.001***

*p<0.05; there is a statistically significant relationship between the measurements; r: Spearman correlation coefficient

TABLE 4: Relationships between age and vestibular tests

Variable		Spontaneous nystagmus	Gaze right nystagmus	Gaze left nystagmus	Head shake nystagmus	Supine head roll	Right head roll	Left head roll	Right Dix-Hallpike	Left Dix-Hallpike
Age	r value	-0.583	-0.060	0.048	-0.381	-0.608	-0.569	-0.574	-0.584	-0.658
	p value	0.006*	0.797	0.837	0.088	0.003*	0.007*	0.007*	0.005*	0.001*

*p<0.05; there is a statistically significant relationship between the measurements; r: Spearman correlation coefficient

The following section presents the results of the correlation analysis performed on the mean SPV of spontaneous nystagmus in relation to other vestibular tests.

The mean SPV of spontaneous nystagmus demonstrated a moderate correlation with gaze right nystagmus (r=0.507) and left HRT (r=0.589). Highly positive and statistically significant correlations were identified between the mean SPV value and HST nystagmus (r=0.773), supine HRT (r=0.779), right HRT (r=0.720), right DH (r=0.711), and left DH (r=0.799) (p<0.05). The findings indicate that as the SPV value of spontaneous nystagmus increases, the mean SPV values of nystagmus observed in gaze right nystagmus, HST nystagmus, supine HRT, left HRT, right DH and left DH also increase (Table 3).

A statistically significant moderate negative correlation was identified between age and spontaneous nystagmus (r=-0.583), supine HRT (r=-0.608), right HRT (r=-0.569), left HRT (r=-0.574), right DH (r=-0.584), and left DH (r=-0.658) (p<0.05). A decline in spontaneous nystagmus, supine HRT, right HRT, left HRT, right DH, and left DH was observed with increasing age (Table 4).

DISCUSSION

VN is defined as an acute dysfunction of the vestibular system, characterized by the sudden onset of severe dizziness and imbalance.[7] Although clinical symptoms are important in the diagnosis and evaluation of VN, an objective assessment of vestibular function increases diagnostic accuracy. The objective of this study was to analyze acute vestibular dysfunction in patients with VN using VNG in static and dynamic tests. The findings indicated statistically significant correlations between the SPV of spontaneous nystagmus and other vestibular tests. Spontaneous nystagmus has been shown to have a high positive correlation with dynamic tests such as HST, HRT, and DH, thereby supporting the hypothesis that asymmetric involvement of the vestibular system occurs in VN.

In the present study, the direction of spontaneous nystagmus was observed to be to the right in approximately half of the subjects and to the left in the remaining subjects, consistent with the affected ear. Furthermore, the direction of nystagmus observed post-HST corresponded with the spontaneous nystagmus direction, thereby suggesting the perpetuation of vestibular asymmetry. This finding aligns with the conclusions of other studies cited in the extant literatüre.[8,9] The nystagmus that occurs in conjunction with HST in individuals diagnosed with VN may present as either monophasic or biphasic. The slow phase of nystagmus, as observed post-HST, is characterized as monophasic when it is directed exclusively toward the lesion side. Conversely, biphasic

nystagmus is defined as the initial direction of the slow phase toward the lesion side, followed by a subsequent shift toward the intact side. In this study, individuals diagnosed with VN were evaluated within the first 72 hours from the onset of symptoms. The results indicated that the nystagmus observed after HST was monophasic in all patients. Lee et al. observed monophasic nystagmus on HST in most VN patients in the acute period. In the subsequent follow-up period, the authors reported an escalation in the incidence of conversion to a biphasic nystagmus pattern.[10] This observation may be indicative of the dynamic nature of the vestibular compensation processes over time. The fact that all patients were examined in the early period of our study may be considered as a possible reason for the observation of only monophasic nystagmus on HST.

Acute unilateral peripheral vestibular deficit leads to asymmetry in the vestibular input signals, resulting in spontaneous nystagmus with the slow phase toward the affected ear.[11] The severity of vertigo increases when the affected ear is in the supine position. In this position, an increase in the SPV of the spontaneous nystagmus is observed. This finding suggests that the horizontal semicircular canal imbalance increases in proportion to the changing orientation of the gravity vector with respect to the head.[12] In this study, the SPV of spontaneous nystagmus observed in individuals with VN increased both in the HRT and DH positions. This observation suggests that the severity of spontaneous nystagmus may have increased due to a greater degree of head extension being observed in the DH position compared to the HRT position.

In this study, spontaneous nystagmus recordings were performed on individuals diagnosed with VN while they were in a seated position. The mean SPV value of spontaneous nystagmus in the sitting position was 18.12±7.93°, while this value was 20.35±8.7° in the supine HRT position (head elevation of 30°). The degree of spontaneous nystagmus exhibited in the supine HRT position demonstrated an increase compared with the sitting position. The primary rationale for this phenomenon is likely associated with the orientation of the lateral semicircular canals, which are positioned perpendicularly relative to the direction of gravity. In patients with spontaneous nystagmus, the SPV should be re-evaluated by repeating the spontaneous nystagmus recording in the supine HRT position, especially when evaluation with caloric testing is to be performed. The degree of spontaneous nystagmus does not directly affect the percentage of caloric weakness; however, it may change the value of directional superiority. Consequently, to ensure the accuracy of the analysis of the caloric test results, it is recommended that spontaneous nystagmus recording in the supine HRT position be performed routinely and subsequently followed by caloric testing.

A study was conducted to examine the effect of age on the vestibular test results in individuals with VN. The results of the study indicated a moderate negative correlation between age and SPV values for spontaneous nystagmus, supine HRT, right-left HRT, and right-left DH tests. This finding indicates that vestibular responses undergo a decline with advancing age, suggesting a potential loss of functional strength in the vestibular system with time.[13]

CONCLUSION

The present study revealed a robust correlation between the maximum slow-phase velocity of spontaneous nystagmus in the VN and dynamic tests, thereby indicating asymmetric involvement of the vestibular system. The re-recording of spontaneous nystagmus in the supine HRT position may facilitate the accurate analysis of the directional superiority value and provide a more reliable interpretation of the caloric test results. Therefore, it is recommended that spontaneous nystagmus recording in the supine HRT position be included in routine VNG protocols for evaluating individuals with VN.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members

of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Ercan Karababa, Hatice Kübra Bozkurt, Bülent Satar;* ***Design:*** *Ercan Karababa, Hatice Kübra Bozkurt, Bülent Satar****; Control/Supervision:*** *Ercan Karababa, Bülent Satar;* ***Data Collection and/or Processing:*** *Ercan Karababa, Hatice Kübra Bozkurt;* ***Analysis and/or Interpretation:*** *Ercan Karababa, Hatice Kübra Bozkurt, Bülent Satar;* ***Literature Review:*** *Ercan Karababa, Hatice Kübra Bozkurt;* ***Writing the Article:*** *Ercan Karababa, Hatice Kübra Bozkurt;* ***Critical Review:*** *Ercan Karababa, Bülent Satar;* ***Materials:*** *Ercan Karababa, Hatice Kübra Bozkurt, Bülent Satar.*

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