Neurology Asia 2022; 27(1) : 145 – 151

Sit-up dizziness and head-shaking dizziness may be diagnostic symptoms of vestibular migraine

[1]Byung In Han *MD PhD*, [2]HoWon Lee *MD PhD*, [3]Sanghyo Ryu *MD*, [4]Miso S Park *MD PhD*, [5]Byungkun Kim *MD PhD*

[1]Do Neurology Clinic, Daegu; [2]Department of Neurology, Kyungpook National University, Daegu; [3]Department of Neurology, Dr. Ryu's Neurology Clinic, Busan; [4]Clinical Trial Center, Daejeon Korean Medicine Hospital of Daejeon University, Daejeon; [5]Department of Neurology, Eulji Medical Center, Eulji University, Seoul, South Korea

Abstract

Background: Vestibular migraine (VM) frequently presents as a diagnostic challenge because objective neurological findings consistent with this entity have not been described. Certain patients with VM present with dizziness while sitting up or shaking their head, which we have designated as sit-up dizziness (SUD) and head-shaking dizziness (HSD) respectively.
Objective: To study the prevalence of SUD and HSD in patients with acute VM and to evaluate their sensitivity and specificity for the diagnosis of acute VM. *Methods:* We examined 60 patients with VM and compared them to 61 patients with episodic migraine (EM), who were subsequently divided into 4 groups (acute-VM, symptom-free-VM, acute-EM, symptom-free-EM). SUD was induced by a positional change from lying to sitting, while HSD was induced by voluntary horizontal head-shaking. The prevalence of SUD and HSD was assessed in the patients during acute and asymptomatic periods. The sensitivity and specificity of SUD and HSD for identification of VM were assessed in an additional 85 patients with acute VM and 123 patients with acute EM. *Results:* The prevalence of SUD and HSD was 72% and 60% respectively in the acute-VM group, which was significantly higher than the symptom-free-VM, acute-EM and symptom-free-EM groups, and which was not related to sex, age, or symptom duration. SUD and HSD had a sensitivity of 80.0% and 81.2%, and specificity of 75.6% and 78.9%, respectively in diagnosing acute VM. The sensitivity and specificity for either test being positive was 91.8% and 71.5%, and 69.4% and 82.9%, when both tests were positive, respectively.
Conclusions: SUD and HSD can be used as diagnostic indicators of acute VM that possess high sensitivity and specificity. This study suggests that SUD and HSD are useful diagnostic tests in patients with new dizziness of unknown cause.

Keywords: Dizziness, sit-up dizziness, head-shaking dizziness, vestibular migraine, episodic migraine

INTRODUCTION

Vestibular migraine (VM) is the most common cause of episodic spontaneous vertigo in both adults and children.[1] VM is diagnosed based on a clinical history of recurrent vertigo attacks, unexplained by other central or peripheral otologic abnormalities, occuring in a patient with a history of migraine headaches.[2]

The neuro-otological manifestations during an acute attack of VM are heterogeneous, showing variable nystagmus features or nonspecific findings with varieties of central and peripheral vestibular dysfunction in the absence of other brainstem or cerebellar signs.[3,4] Diagnostic tests usually show nonspecific abnormalities as well.[2] During the symptom-free period, in most cases, the general neurologic examination, otologic examination, and blood tests are unremarkable.[4] There is no specific diagnostic test for VM during either the acute attack or symptom-free period; therefore, VM is essentially a diagnosis of exclusion and is usually diagnosed from the pattern of symptoms rather than from particular diagnostic tests.[5]

However, there is a potential diagnostic clue: the dizziness, occasionally triggered by position

Address correspondence to: Byung In Han, MD, PhD, Do Neurology Clinic, 359 Jungang-daero, Jung-gu, Daegu 41967, Republic of Korea. Tel: +82-53-252-2225, Email: byung_in@hotmail.com; Sanghyo Ryu, MD, Dr. Ryu's Neurology Clinic, 240, Suyeong-ro, Nam-gu, Busan 48496, Republic of Korea, Tel: +82-51-710-8881, Email: sanghyoryu@gmail.com

Date of Submission: 12 July 2021; Date of Acceptance: 25 December 2021

https://doi.org/10.54029/2022hwz

changes, accompanying VM.[5,6] More than one-third of patients report positional dizziness and head-motion intolerance during an acute attack.[7] Nystagmus mimicking benign paroxysmal positional vertigo (BPPV) has been identified in some patients with VM.[3] This led us to study the prevalence of positional dizziness and its sensitivity and specificity for the diagnosis of VM.

To identify positions that triggered dizziness, patients were examined in the course of various maneuvers: sitting-up, head shaking, lying down, head rolling, the Dix-Hallpike maneuver, and neck flexing. All positioning and maneuvers were performed on a table. These positions were selected from authors' experience and partly from those introduced by Whitney *et al*.,[8] which are assembled from various positions experienced by the patients throughout the day. One of the most important dizziness-provoking maneuvers is the Dix-Hallpike test.[8]

Among those positionings, we identified two that most strongly provoked dizziness: sitting up from a supine position and shaking the head while sitting. We named them sit-up dizziness (SUD) and head-shaking dizziness (HSD), referencing the terms "*sitting to supine"* and "*sitting-up vertigo"* in papers by Whitney *et al*.[8] and Büki*et al*.[9] Other positionings such as lying down, head rolling, the Dix-Hallpike maneuver, and neck flexing induced little dizziness. The *"returning to sit from Dix-Hallpike on either side"* test was not included because patients having SUD frequently also had dizziness with this movement.

We examined whether these types of dizziness were also present in other conditions such as BPPV and vestibular neuritis and found no symptoms of SUD or HSD. Some patients with chronic migraines had both SUD and HSD.

This study was therefore conducted to assess the sensitivity and specificity of SUD and HSD in diagnosing VM and to determine their prevalence in patients with acute VM.

METHODS

Subjects and procedure

The initial study population consisted of 121 patients (aged between 20 and 65 years) who presented to the *Do Neurology Clinic*. The patients comprised two groups: 60 with acute VM and a control group of 61 with acute episodic migraine (EM). We used clinical diagnostic criteria[5] for the definitive diagnosis of VM and the current International Headache Society (IHS) criteria[10] for the diagnosis of EM without aura. In accordance with those criteria, we recruited patients with dizziness or headache of less than 3 days duration. Patients who had both dizziness and headache when they visited our clinic were included in the group defined by the more dominant symptom. Some patients were included in both groups if they had dizziness at one visit and headache at another visit; i.e., the patients were included in the acute-VM group because they presented with dizziness, and were later also included in the acute-EM group when they presented with headache. All patients were treated with medication and asked to return to our clinic. At the follow-up visit, if the patients became asymptomatic, they were classified into symptom-free VM or symptom-free EM groups. As a result, the recruited subjects were subsequently divided into 4 groups: (1) patients with VM during acute dizziness (acute-VM), (2) the same patients with VM during a symptom-free period of dizziness (symptom-free-VM), (3) patients with EM during acute headache (acute-EM), and (4) the same EM patients during a symptom-free period of headache (symptom-free-EM). Among the 60 acute-VM and 61 acute-EM patients, 2 patients were included in both acute-VM and acute-EM groups because they had acute VM at one visit and acute EM at another.

SUD was induced via a positional change from lying down to sitting up with the face facing straight forward. The patients sat up with assistance. HSD was induced with head shaking, by having patients perform voluntary horizontal head shaking from side to side 5 times while sitting up.

We assessed (1) the prevalence of SUD and HSD in each group, (2) the relationship of age, sex, and symptom duration with the prevalence of SUD or HSD in the acute-VM group, (3) the relationship of a past history of dizziness with the prevalence of SUD or HSD in the acute-EM group, and (4) the sensitivity and specificity of SUD and HSD in the diagnosis of acute VM.

In order to achieve statistically significant sensitivity and specificity results, an additional group comprising 85 acute-VM and 123 acute-EM patients was recruited. The assessment was performed in this group by evaluating the presence of SUD, HSD, and dizziness induced by four additional positions (lying down, head rolling, the Dix-Hallpike maneuver, and neck flexing). The maneuvers were performed as follows: Lying down was performed by moving from sitting up

to a supine position. Head rolling was performed by rolling the head from side to side on a pillow while supine. The Dix-Hallpike maneuver was performed by moving the patients from sitting to a supine position, with the head turned 45 degrees to one side and the neck hyperextended about 20 degrees. The Dix-Hallpike maneuver was performed on both sides. Neck flexing was performed by flexing the neck while sitting. Tests were considered positive if dizziness was provoked with any of the maneuvers.

Exclusion criteria

We excluded patients who had anxiety or depressive disorders based on relevant diagnostic criteria, patients with identifiable neurological, psychiatric, cardiac, visual, or somatosensory problems as well as patients with other medical conditions that could potentially cause dizziness or headache.[11,12]

All subjects underwent an extensive neuro-otologic evaluation to exclude identifiable causes of dizziness and headache, including auditory and vestibular function testing and appropriate imaging studies, if feasible. All subjects, apart from having symptoms related to VM, were neuro-otologically normal, with no spontaneous nystagmus, positional nystagmus, or head-shaking nystagmus, and with normal bedside head-impulse testing. None of the subjects had hearing loss or any other auditory features of Ménière's disease. If body oscillations (abnormal antero- and retropulsion of the trunk) while sitting up were strong, that particular patient was then assumed to have BPPV and also excluded from this study.

Statistics

The demographic data of the VM and EM groups was compared between the groups using Student's *t*-test and the Chi-square test. We used the Chi-square test to compare the prevalences of SUD and HSD between VM and EM groups, acute and symptom-free groups, as well as groups with and without a history of dizziness. We used the Chi-square test and multiple logistic regression analysis to determine whether symptom duration, age, and sex were related to the prevalence of SUD or HSD. Statistical significance was set at $p<.05$. All data were analyzed using Python 3.9.1 (Python Software Foundation, Wilmington, DE, USA).

The study was performed under the Declaration of Helsinki and approved by the local institutional review board. Permission from the local ethics review board was obtained.

RESULTS

Demographic and clinical characteristics of the 60 VM and 61 EM patients are shown in Table 1. The prevalence of SUD and HSD in VM and EM patients during acute and symptom-free periods is shown in Table 2. The acute-VM group had the highest prevalence of SUD and HSD: 72% and 60% respectively. Based on the Chi-square test results, there were significant differences in SUD and HSD prevalence between the four groups ($p<.001$ and $p<0.001$, respectively). We performed pairwise comparisons for each pair of subgroups (acute-VM, symptom-free-VM, acute-EM, symptom-free-EM) across the SUD, HSD, and SUD or HSD categories. The results showed that the patients in the acute-VM group had a significantly higher prevalence of SUD and HSD than the other 3 groups (false discovery rate (FDR)- corrected *p*-value using the Benjamini-Hochberg procedure was <.001 for all comparisons). In addition, patients in the symptom-free-EM group had a significantly lower prevalence of HSD than the other 3 groups (FDR-corrected *p*-value<.001 for acute-VM vs. symptom-free-EM group, <.05 for symptom-free-VM vs. symptom-free-EM group and acute-EM vs. symptom-free-EM group).

Table 1: Demographic and clinical characteristics of the 60 VM and 61 EM patients

Group	VM (n=60)	EM (n=61)	p
Age, years	42.4 ± 11.9	37.0 ± 11.0	.021*
Sex (%)			.972
Female	52 (86.7%)	53 (86.9%)	
Male	8 (13.3%)	8 (13.1%)	
Symptom duration, days	2.1 ± 0.9	1.9 ± 0.9	.395

VM, vestibular migraine; EM, episodic migraine
* p<.05, ** p<.01, *** p<.001

Table 2: Prevalence of SUD and HSD in VM and EM patients during acute and symptom-free periods

	VM patients (n = 60)		EM patients (n = 61)		P for
Group	Acute	Symptom-free	Acute	Symptom-free	Chi-square test
Sign					
SUD	43 (72%)	5 (8%)	7 (11%)	2 (3%)	.000***
HSD	36 (60%)	9 (15%)	8 (10%)	1 (2%)	.000***
SUD or HSD	50 (83%)	10 (17%)	9 (15%)	2 (3%)	.000***
SUD and HSD	29 (48%)	4 (6%)	6 (10%)	1 (2%)	.000***

VM, vestibular migraine; EM, episodic migraine; SUD, Sit-up dizziness; HSD, Head-shaking dizziness
* p<.05, ** p<.01, *** p<.001

We also checked the significance of combined SUD and HSD. We investigated whether each patient had either SUD or HSD or both during acute and symptom-free periods. The Chi-square test analysis revealed a significant difference in the prevalence of SUD and HSD among the four groups (p<.001 for both *SUD or HSD* and *SUD and HSD*). The result from pairwise comparisons indicated that the acute-VM group had a significantly higher prevalence of either SUD or HSD or both compared with the other 3 groups (FDR-corrected p-value<.001 for all comparisons). In addition, the symptom-free-EM group had a significantly lower prevalence of either SUD or HSD or both than the symptom-free-VM group (p=.046).

SUD and HSD were found to be unrelated to sex (Chi-square test: p =0.926 for SUD, 0.345 for HSD), age (Chi-square test: p =0.430 for SUD, 0.266 for HSD), or symptom duration (Chi-square test: p =0.155 for SUD, 0.939 for HSD). The logistic regression results also suggested that SUD and HSD were not related to sex, age, or symptom duration (Table 3).

The demographic profile and clinical characteristics of the additional 85 VM and 123 EM patients are shown in Table 4. The mean symptom duration of these VM and EM patients was 2.4 ± 0.8 days and 1.9 ± 1.0 days, respectively. There were no significant differences in age (p=0.237) and sex (p=0.087) between the two groups. However, there was a significant difference in symptom duration (p=0.004) between the two groups (Table 4).

The sensitivity, specificity, positive predictive value, and negative predictive value of the SUD, HSD, lying down, head rolling, Dix-Hallpike test, and neck-flexing signs were calculated in the additional VM and EM patients (n=85 and n= 123, respectively) (Table 5). For diagnosis of VM, the SUD and HSD had a sensitivity of 80.0% and 81.2%, and a specificity of 75.6% and 78.9%, respectively. The results calculated from the SUD and HSD signs individually and in combination are presented in Table 5. The combination of SUD and HSD (in which either test was positive) increased the diagnostic sensitivity for VM from 80.0% and 81.2% to 91.8%. The combination of SUD and HSD (in which both tests were positive) slightly increased the diagnostic specificity from 75.6% and 78.9% to 82.9%.

Among the patients in the acute-EM group (n= 123), those with a history of dizziness had a higher prevalence of SUD, HSD, and neck-

Table 3: The results of multiple logistic regression analysis

	Regression coefficient (β)	Exp(β) (odds)	Standard error	Statistics (P-value)
SUD				
Symptom duration	.548	1.729	.308	.076
Age	.004	1.003	.016	.834
Sex	.103	1.108	1.188	.931
HSD				
Symptom duration	.291	1.337	.288	.313
Age	.021	1.021	.016	.209
Sex	-.518	.551	.949	.585

Table 4: Demographic and clinical characteristics of the 85 VM and 123 EM patients

Group	VM (n=85)	EM (n=123)	p
Age, years	39.4 ± 12.9	37.3 ± 11.8	.237
Sex (%)			.087
Female	77 (90.6%)	101 (82.1%)	
Male	8 (9.4%)	22 (17.9%)	
Symptom duration, days	2.4 ± 0.8	1.9 ± 1.0	.004**

VM, vestibular migraine; EM, episodic migraine
* p<.05, ** p<.01, *** p<.001

flexing positioning dizziness than those without. (Table 6).

Representative case

Case 1

A 38-year-old woman with VM presented with acute dizziness for 2 days. She had suffered from migraine since her late teens and often had dizziness without headache lasting half to a whole day at a time. Neuro-otologic examinations were negative. She had SUD and HSD. She was given flunarizine 5 mg, topiramate 25 mg, amitriptyline 5 mg once daily in the evening, and dimenhydrinate 50 mg, and mosapride 15 mg to be taken as needed. At follow-up 3 days later, her dizziness had disappeared and she had no SUD and HSD.

Case 2

A 25-year-old woman with the first episode dizziness presented to our clinic with no signs of vestibular imbalance. She had not experienced migraines before. Observing that she had SUD and HSD, we prescribed migraine prophylactics and her dizziness disappeared in few days.

Case 3

A 63-year-old man with right posterior canal BPPV presented with continuous residual dizziness for several days after successful canalith repositioning. He presented with SUD without HSD on the day of his visit, so we put him on migraine prophylactics, which cleared the patient's residual dizziness by the next day.

Case 4

A 65-year-old man who was a known migraineur presented to our clinic with continuous mild dizziness for most of his life since his thirties. He could not ride a bus because of this condition, so he had to use his own vehicle and could not join group tours which used a bus for transport. We identified SUD and gave him migraine prophylactics. His dizziness disappeared after few days. He was subsequently able to use public transportation and to join group tours.

Table 5: The sensitivity and specificity of SUD, HSD, and other positionings for diagnosis of VM (in 85 VM and 123 EM patients)

Sign	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
SUD	80.0	75.6	69.4	84.5
HSD	81.2	78.9	72.6	85.8
Lying-down	1.2	99.2	50.0	59.2
Head-rolling	8.2	98.4	77.8	60.8
Dix-Hallpike	8.2	96.7	63.6	60.4
Neck-flexing	41.1	93.5	83.7	70.1
SUD or HSD	91.8	71.5	69	92.6
SUD and HSD	69.4	82.9	73.8	79.7

SUD, Sit-up dizziness; HSD, Head-shaking dizziness; "or" indicates when either test was positive for the two signs; "and" indicates when both tests were positive for the two signs

Table 6: Prevalence of the SUD, HSD, and other positionings in EM patients with and without past history of dizziness

Group	EM patients (n = 123)		
	Patients with past history of dizziness (n = 35)	Patients without past history of dizziness (n = 88)	P for Chi-square test
Sign			
SUD	18 (51%)	12 (14%)	.000***
HSD	20 (57%)	6 (7%)	.000***
Lying-down	1 (3%)	0 (0%)	.632
Head-rolling	2 (6%)	0 (0%)	.141
Dix-Hallpike	3 (9%)	1 (1%)	.125
Neck-flexing	7 (20%)	1 (1%)	.001***
SUD or HSD	22 (63%)	13 (15%)	.000***
SUD and HSD	16 (45%)	5 (6%)	.000***

* p<.05, ** p<.01, *** p<.001

DISCUSSION

VM is usually diagnosed by clinical diagnostic criteria[5] as: (1) definite VM, or (2) probable VM as follows:

Definite VM
1. Episodic vestibular symptoms of moderate or severe intensity
2. Migraine according to IHS criteria
3. At least one of migraine symptoms (migrainous headache, photophobia, phonophobia, visual or other auras) occur during at least two vertiginous attacks
4. Cannot be accounted for another vestibular or headache diagnosis

Probable VM
1. Episodic vestibular symptoms of moderate or severe intensity
2. At least one of the following : migraine according to the criteria of the IHS; migrainous symptoms during vertigo; migraine-specific precipitants of vertigo, e.g., specific foods, sleep irregularities, hormonal changes; response to antimigraine drugs
3. Cannot be accounted for another vestibular or headache diagnosis

Case 1 had clinical symptoms fulfilling the criteria for definite VM, and demonstrated SUD and HSD. As indicated by our study findings, SUD and HSD can be included as diagnostic pointers for VM.

Case 2, is an example of where the clinical diagnostic criteria for either definite and probable VM were not fulfilled, since the dizziness was the patient's first episode and there were no signs of vestibular imbalance. However, since SUD and HSD were observed, we treated the patient as VM. In this case, SUD and HSD enabled accelerated diagnosis of VM, and shortened the duration of patient-related morbidity.

The residual dizziness after successful BPPV repositioning in Case 3 was resolved by migraine prophylactics. This shows that SUD and HSD can be an indication to use migraine prophylactics even without the criteria for VM being fulfilled.

Case 4 shows how a positive SUD can be an indication to initiate migraine prophylactics even when the patient does not present with acute dizziness.

There are more symptoms in addition to SUD and HSD that are also noteworthy. The VM patients had also experienced other dizziness-inducing motions in daily life, such as rotating the head from side to side during sleep and looking down to put on one's shoes. However, hyperextending the neck and lying down induced only rare or slight dizziness. These symptoms should be appreciated in order to diagnose VM sooner.

This study has some limitations. First, the broader spectrum of entities causing dizziness was not studied for evaluating the prevalence of SUD and HSD. Prior to beginning this study, we observed several patients with BPPV and vestibular neuritis which demonstrated neither SUD nor HSD, leading us to deduce that these conditions were not associated with SUD or HSD and could be excluded from our study. However,

SUD and HSD was found in several patients with chronic migraine,. Further studies of other conditions causing dizziness such as cervical vertigo, motion sickness, mal de debarquement syndrome, psychogenic dizziness, etc., would give us more understanding of SUD and HSD in these conditions and perhaps provide clinical pointers as to the usefulness of migraine prophylactics in each of these. Second, quantitative measures such as the Dizziness Handicap Inventory or Visual Analog Scale score were not measured, so the relationship between the prevalence of SUD or HSD and the severity of dizziness were not evaluated. Further studies also might be needed to evaluate those methods in the future. Last, this study introduces a treatment strategy to utilizes migraine prophylactics for patient with dizziness. Migraine prophylactics may be beneficial whenever patients present with SUD or HSD regardless of the etiology of dizziness. This may indicate certain unexplained mechanisms which might be responsible for SUD or HSD that needs to be addressed in further studies.

In conclusion, SUD and HSD are highly prevalent in acute VM patients. These clinical signs may be used as diagnostic indicators of acute VM that possess high sensitivity and specificity, and can point to the diagnosis in the first episode or unknown causes of dizziness. This can then permit effective treatment with migraine prophylactics.

DISCLOSURE

Financial support: None

Conflicts of interest: None

REFERENCES

1. Dieterich M, Obermann M, Celebisoy N. Vestibular migraine: the most frequent entity of episodic vertigo. *J Neurol* 2016;263(Suppl 1):S82-9. doi: 10.1007/s00415-015-7905-2.
2. Cha Y. Migraine-associated vertigo: Diagnosis and treatment. *Semin Neurol* 2010; 30(2): 167-74. doi: 10.1055/s-0030-1249225.
3. von Brevern M, Radtke A, Clarke AH, Lempert T. Migrainous vertigo presenting as episodic positional vertigo. *Neurology* 2004;62(3):469-72. doi: 10.1212/01.wnl.0000106949.55346.cd.
4. Neuhauser H, Lempert T. Vertigo and dizziness related to migraine: a diagnostic challenge. *Cephalalgia* 2004;24(2):83-91. doi: 10.1111/j.1468-2982.2004.00662.x.
5. Neuhauser H, Leopold M, von Brevern M, Arnold G, Lempert T. The interrelations of migraine, vertigo, and migrainous vertigo. *Neurology* 2001;56(4):436-41. doi: 10.1212/wnl.56.4.436.
6. McFeely WJ, Jr., Bojrab DI. Taking the history: Associated symptoms. In: Goebel J. 2nd ed. Practical management of the dizzy patient. Lippincott Wiliams & Wilkins. Philadelphia. 2008.21-41.
7. von Brevern M, Zeise D, Neuhauser H, Clarke AH, Lempert T. Acute migrainous vertigo: clinical and oculographic findings. *Brain* 2005;128:365-74. doi: 10.1093/brain/awh351.
8. Whitney SL, Herdman SJ. Physical therapy assessment of vestibular hypofunction. In: Herdman SJ. Vestibular rehabilitation. 3rd ed. Philadelphia: F.A. Davis Company. 2007;272-99.
9. Büki B, Simon L, Garab S, Lundberg YW, Jünger H, Straumann D. Sitting-up vertigo and trunk retropulsion in patients with benign positional vertigo but without positional nystagmus. *J Neurol Neurosurg Psychiatry* 2011;82(1):98-104. doi: 10.1136/jnnp.2009.199208.
10. Headache Classification Committee of the International Headache Society (IHS). The International Classification of Headache Disorders, 3rd edition (ICHD-3). *Cephalalgia* 2018;38:1-211. doi: 10.1177/0333102417738202.
11. Anxiety disorders. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed. Arlington, VA: American Psychiatric Association; 2000: 393-4.
12. Mood disorders. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed. Arlington, VA: American Psychiatric Association; 2000:317-91.