

VNG FINDINGS IN PATIENTS WITH AGE RELATED ISCHEMIC CHANGES.

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ABSTRACT:

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Background: Older people develop gait and balance dysfunction that is associated with gradual onset of cerebral white matter disease. The term cerebral small vessel disease refers to a group of pathological processes with various etiologies that affect the small arteries, arterioles, venules, and capillaries of the brain. White matter disease is easily detected by neuroimaging, whereas small vessels are not, hence the term small vessel disease is frequently used to describe the parenchyma lesions rather than the underlying small vessel alterations.

Aim of the work: To investigate the relationship between presence and/or absence of white matter disease identified on magnetic resonance imaging with the vestibular findings in elderly patients with dizziness.

Patients and Method: Study population: 30 elderly patients complaining of dizziness & / or instability. Inclusion criteria: Patients above 55 years old with history of vertigo & / or instability. Exclusion criteria: 1- Meniere's disease. 2- Bilateral vestibulopathy. 3- Recent vestibular neuritis or labyrinthitis. 4- History of head trauma or surgery. 5- Neurological diseases as (Intracranial space occupying lesions, Multiple Sclerosis, Parkinsonism, Paresis). 6- Patients with otologic history of otorrhea or Ear surgery. Study Procedure: 1- Full history taking. 2- Otological examination. 3- Hearing assessment. 4- Immittanceometry. 5- Video-nystagmography test (VNG). 6- Magnetic resonance imaging (MRI) & Magnetic resonance angiography (MRA) "Stroke protocol".

Results: Abnormal VNG test results were significantly higher in patients with atherosclerotic changes (0.04). The most common VNG finding was positional nystagmus.

Conclusion: Presence of risk factors for white matter disease (WMD) in elderly patients as hypertension, diabetes mellitus, ischemic heart disease, hyperlipidemia and migraine is an indication for requesting further radiological assessment. The most frequent VNG abnormality in elderly patients with WMD is positional & positioning nystagmus. Presence of atherosclerotic changes is significantly related to presence of VNG test abnormality.

Keywords: Dizziness, Age related ischemic disease, white matter disease and Small vessel disease.

INTRODUCTION:

Dizziness, imbalance and gait disturbance are one of the most common complaints in elderly⁽¹⁾. It is commonly

associated with gradual onset of cerebral white matter disease⁽²⁾. However, the mechanism through which it affects the gait is unknown^(3&4).

White matter disease (WMD) is a radiological term used to describe diffuse white matter changes thought to be related to small vessel disease. Several theories were proposed to explain the mechanism of gait disturbances in the elderly⁽⁵⁾. VNG is the gold standard for assessment of dizziness and vertigo in the elderly.

To the best of authors' knowledge, there is limited researches examined the relation between age related ischemic changes as a radiological findings in (MRI & MRA) and the vestibular findings detected by VNG in elderly patients complaining of dizziness and / or imbalance. Therefore, the present study is designed to evaluate vestibular findings using VNG in elderly patients and its relation to white matter changes detected by magnetic resonance imaging.

AIM OF THE WORK

To investigate the relationship between presence and/or absence of white matter lesions identified on magnetic resonance imaging with the vestibular findings in elderly patients with dizziness.

PATIENTS AND METHODS

Study Setting: At audio-vestibular outpatient clinic & Radiology department in El-demerdash hospital Ain Shams University.

Study Period: From February 2018 to October 2018.

Study population: 30 elderly patients complaining of dizziness and/or instability from the vestibular outpatient clinic EL-demerdash hospital Ain Shams University.

Inclusion criteria: Age group above 55 years old & positive history of vertigo and/or instability.

Exclusion criteria: Patients diagnosed with known cause for dizziness as Meniere's disease, bilateral vestibulopathy, recent vestibular neuritis or labyrinthitis, history of head trauma or surgery, neurological diseases (Intracranial space occupying lesions, Multiple Sclerosis, Parkinsonism & Paresis) and patients with otologic history of otorrhea or Ear surgery.

Ethical consideration: The protocol was ethically approved by the ENT department board, the research Ethical Committee, Faculty of Medicine Ain Shams University.

Methods: Each participant underwent: Full neuro-otological history, Hearing assessment: (Otological examination, Pure tone audiometry: (Air conduction thresholds at 0.25, 0.5, 1, 2, 4, 8 KHz, Bone conduction thresholds at 0.5, 1, 2, 4 KHz, Speech audiometry and acoustic Immittance testing), Video-Nystagmography Test (VNG) and Radiological assessment: Magnetic resonance Stroke Protocol is a group of magnetic resonance sequences put together to best approach brain ischemia: consists of T1, T2, T2/FLAIR, diffusion- (DWI) images and MR angiography (MRA)^(6,7,8,9&10). Fazekas classification⁽¹¹⁾: It divides the white matter in periventricular (PVWM) and deep white matter (DWM), and is given a grade depending on the size and confluence of lesions on a scale range from (0-3) with the highest grade indicating more severe lesions.

Data Management and Analysis: Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA).

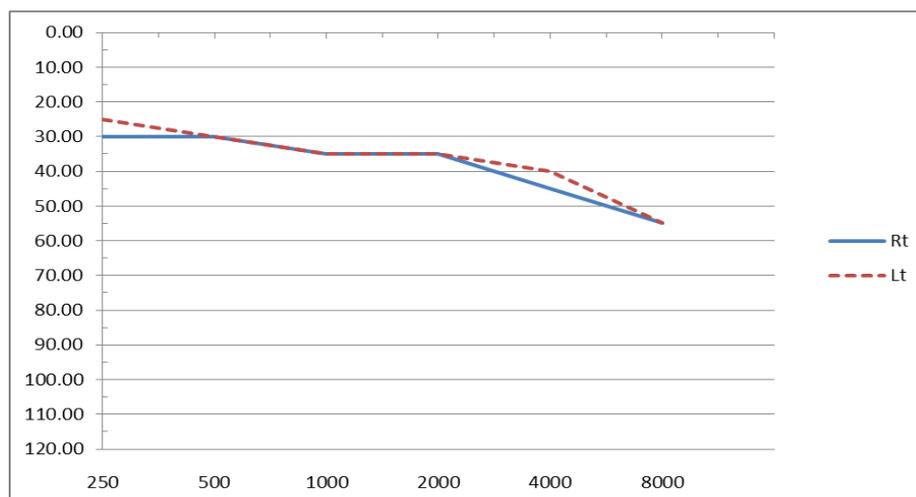
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RESULTS:

Table (1): Mean (X), Standard deviation (SD) and range of age & gender distribution for the study group:

Age			Gender				Total	
X	SD	Range	Male		Female		Number (No.)	Percentage (%)
			Number (No.)	Percentage (%)	Number (No.)	Percentage (%)		
65.07	7.19	55-80	17	56.7	13	43.3	30	100

Mean age of the study group was 65 and the male % was higher than the female in the study group.



Mean of Pure tone audiometry results of the study group in dB HL

Table (2): Distribution of patients according to known medical history:

Risk factors*	Present		Absent	
	(No.)	(%)	(No.)	(%)
Diabetes	13	43.3	17	56.7
Hypertension	16	53.3	14	46.7
Ischemic heart disease	7	23.3	23	76.7
Hyperlipidemia	9	30.0	21	70.0
Migraine	5	16.7	25	83.3
**Multiple risk factor	14	46.7	16	53.3

* All patients had at least one risk factor for WMD.

**In some patients, there were multiple risk factors in the same patient.

The table shows that (46.7 %) of the study group had more than one risk factor. The most common risk factors were Hypertension (53.3 %) and diabetes (43.3%).

Table (3): Distribution of the study group according to site of lesion based on VNG test:

VNG test results	(No.)	(%)
Normal VNG study	12	40
abnormal VNG	18	60
Total patient in study group	30	100

The table shows that 60 % of the study group had abnormal VNG findings. Number of abnormal patients 60 % is lesser than

total number of VNG test findings due to presence of multiple test findings in the same patient.

Table (4): Distribution of patients according to VNG test findings:

VNG findings	No abnormality		Abnormal	
	No. of patients	(%)	No. of patients	(%)
Spontaneous nystagmus	26	86.7	4	13.3
Gaze test	30	100	0	0
Optokinetic	30	100	0	0
Pursuit	30	100	0	0
Saccade	30	100	0	0
*Positioning	25	83.3	5	16.7
**Positional	17	56.7	13	43.3
***Unilateral Caloric weakness	26	86.7	4	13.3

N.B.: No isolated central vestibular deficit was detected in the study group. Some patients had multiple VNG abnormality.

All the patients in the study group showed no abnormality in the oculomotor tests and the most frequently encountered VNG abnormality was the presence of positional nystagmus.

*There was abnormality in positioning test in 5 patients 3 of them had in addition to the positioning nystagmus either spontaneous and / or positional nystagmus (of mixed peripheral and central criteria of vestibular lesion) as following; (vertical nystagmus, one of them diminished while others abolished or diminished with fixation, with minimal subjective sense of dizziness).

**The other patients with positional nystagmus were either peripheral with the following criteria; (horizontal nystagmus, directional fixed, abolished with fixation & with subjective sense of dizziness) or mixed

peripheral and central criteria of vestibular lesion as following; (vertical nystagmus, abolished or diminished with fixation with minimal subjective sense of dizziness). Among the study group, 13.3 % of the patients had non localizing positional nystagmus based on the presence of positional nystagmus as the only VNG finding with the criteria of positional nystagmus not clearly matching a peripheral or central site of lesion (vertical nystagmus, abolished or diminished with fixation with minimal subjective sense of dizziness).

***13.3 % of the study group had unilateral caloric weakness 2 of them were uncompensated as accompanied with spontaneous or positional nystagmus and the other 2 were compensated with the unilateral caloric weakness as the only VNG finding.

Table (5): Distribution of patients according to different radiological findings:

	Present		Absent		*Total	
	No.	%	No.	%	No.	%
Involution brain changes	15	53.6	13	46.4	28	100
White matter disease	22	78.6	6	21.4	28	100
Old multi lacunar infarction	12	42.9	16	57.1	28	100
Atherosclerotic changes	20	71.4	8	28.6	28	100
Mixed lesion**	22	78.57	6	21.42	28	100

* Two patients were excluded from 30 patients due to contraindication of MRI due to metallic heart prosthesis and metallic clips, so the total radiological investigated patients were 28.

**Mixed lesion based on presence of more than one radiological finding in the same patient. No single patient was normal in the radiological assessment.

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Table (6): Distribution of the patients according to Fazekas Scoring:

PVWM 0		PVWM 1		PVWM 2		PVWM 3		Total		PVWM+DWM	
No	%	No	%	No	%	No	%	No	%	No	%
8	28.6	4	14.3	4	14.3	12	42.9	28	100	No	%
DWM 0		DWM 1		DWM 2		DWM 3		Total		19	67.9
No	%	No	%	No	%	No	%	No	%		
7	25	5	17.9	6	21.4	10	35.7	28	100		

The table shows that the most common Fazekas scorings in the study group are grade 3 WMD; Periventricular white matter (PVWM) & Deep white matter (DWM) and combined lesion of both PVWM & DWM.

Table (7): Chi square test between VNG test results & different radiological findings:

		VNG results				P value
		Normal		Abnormal		
		No.	%	No.	%	
Atherosclerotic changes	Yes	6	50.0%	14	87.5%	0.044
	No	6	50.0%	2	12.5%	
Old lacunar inf.	Yes	4	33.3%	8	50.0%	0.378
	No	8	66.7%	8	50.0%	
WMD	Yes	9	75.0%	13	81.3%	1
	No	3	25.0%	3	18.8%	
Involution brain changes	Yes	7	58.3%	8	50.0%	0.662
	No	5	41.7%	8	50.0%	

The table shows that the presence of atherosclerotic changes as a finding detected by MRA was statistically significantly higher in patients having abnormal VNG test findings (P value = 0.04).

DISCUSSION:

In the present work, the authors are demonstrating the vestibular results of 30 dizzy patients in addition to their radiological findings. In 25 of them no clear etiological diagnosis could be reached after full history taking and VNG testing (5 patients had BPPV) (Table 4).

The most common risk factors for WMD in the present study were hypertension (53.3 %) and diabetes mellitus (43.3 %). Other risk factors included, hyperlipidemia (30 %), ischemic heart disease (23.3 %), migraine (16.7 %) and 46.7% of the study group had more than one risk factor (Table 2).

Other study also found that arterial hypertension was found to be the most common risk factor of the dizziness associated white matter disease in elderly patients with a percentage of 81%⁽¹²⁾. Cardiovascular factors also could have a

pathogenic role in WMD as well as in vestibular disorders and in aggravating symptoms of both diseases⁽¹²⁾.

The value of the present work can be looked for from two prospective; first is the normal VNG test results in 40 % of patients. In cases of elderly “or adults above age of 55 years” testing shouldn’t stop at this stage. All subjects in this group (including the 40 % normal VNG) (Table 3) had one or more radiological abnormality as detected by MRI and/ or MRA (Table 5).

Furthermore, the 50 % of normal VNG subjects had atherosclerotic changes as detected by MRA compared to 87.5 % of the abnormal VNG group (Table 7). Chi square test results showed a statistically significant difference (P value = 0.044). Elderly dizzy patients with normal VNG findings who have more risk factors for WMD as diabetes or hypertension should be subjected to radiological studies to receive appropriate medical treatment if needed.

Another interesting finding in the present work is the normal oculomotor test results in all subjects (Table 4). Contrary to the present study, another study found that there was positive predictive value of abnormal oculomotor test findings in relation to magnetic resonance imaging abnormalities. Compared to the present work, their group included cortical and cerebellar atrophy subjects' accordingly central vestibular lesion and abnormal oculomotor abnormalities can be expected⁽¹⁴⁾.

Moreover, oculomotor abnormalities are often accompanied by CNS diseases with symptoms such as blurred vision, oscillopsias, double vision or staggering⁽¹⁵⁾. Such conditions were among the exclusion criteria in the present study.

Concerning subjects with abnormal VNG findings, 60 % of the study group showed vestibular abnormality. This agreed with another study who found that there was a higher prevalence of pathological vestibular signs in patients with WMD^(16&17). Also, BPPV was found to be the main cause of the dizziness in 26% of patients with WMD (Fazekas 2–3)⁽¹⁷⁾.

In the present study, the most frequent VNG abnormality was the presence of positional nystagmus in 43.3 % of patients (Table 4). In the present authors' experience, the presence of positional nystagmus of non-localizing character as "the only anomaly in VNG" is almost always related to the presence of age related ischemic changes⁽¹⁸⁾. In fact peripheral vestibular involvement or CNS involvement may provide similar finding during testing. The delineation between peripheral and central site of lesion within the vestibular system based on the criteria of positional nystagmus alone should be avoided. It was reported that positional tests could evaluate the state of cerebral perfusion contralateral to the direction of head movement⁽¹⁹⁾. In agreement with the present results, it was

reported that Lack of fixation suppression of positional nystagmus supports CNS involvement, but it is also not uncommon for some suppression to occur. Both age-related CNS changes and migraine may be the cause of positional nystagmus. They also reported an imperative need for correlation with patient history and symptoms, in addition to results of VNG and other diagnostic evaluation⁽²⁰⁾.

In the present study 5 patients had BPPV, 2 of them had the disease diagnosed by positioning Dix Hallpike test alone while the rest of this group (3 subjects) had in addition positional nystagmus (Table 3).

The clinical implication of these findings in patients with BPPV is remarkable. Full VNG test battery is recommended in persistent dizziness after successful repositioning maneuver. The underlying cause of such dizziness may be due to the presence of combined condition as WMD. In the latter case neurological consultation, radiological assessment and medical treatment are warranted.

The most common radiological findings among the study group were white matter disease (WMD) (78.6 %), atherosclerotic changes (71.4 %) (Table 5). Periventricular white matter Fazekas score 3 (PVWM 3) was found in 42.9 % and Deep white matter Fazekas score 3 (DWM 3) was found in 35.7 % reflecting the degree of severity of WMD in the dizzy patients (Table 6). Combined lesions (Both PVWM & DWM) were also very prevalent (67.9 %) regardless of severity.

Conducting statistical analysis of the present data showed that presence of atherosclerotic changes detected by MRA was associated with higher percentage of VNG abnormalities (p value = 0.04) (Table 7). It is reported that the cause of this correlation between dizziness induced gait abnormality and WMD could be the disruption of neuronal networks that mediate

higher vestibular cortical function⁽¹²⁾. Also a systematic review indicated that WMD are common in older people and are significantly associated with impaired balance, gait, mobility and falls. However, in many studies these findings were only evident in people who have the most severe degree of WMD⁽²¹⁾.

Moreover, small vessel disease SVD is a dynamic and highly variable disease process with progression and in some regression of SVD^(22&23). In a recent study reduction in blood pressure was associated with reduction in WMD volume⁽²³⁾. This suggests that better blood pressure control could attenuate or even reverse the WMD growth and consequently could lead to better gait function over time.

Age related ischemic changes as a disease prevalent among older adults present with various degrees of dizziness and gait impairment. Dizzy patients with no clear etiology above age of 55 years old have radiological signs of white matter disease with variable degrees of severity and different radiological presentations.

The present results suggest that elderly patients with dizziness, without a clear diagnosis and despite clinical and vestibular assessment, should undergo brain imaging to assess the level of WMD and possible comorbid condition as presence of atherosclerotic changes.

Conclusions:

Presence of risk factors of white matter disease (WMD) as hypertension, diabetes mellitus, ischemic heart disease, hyperlipidemia and migraine is a medical indication for requesting further radiological assessment in dizzy patients. The most frequent VNG abnormality in elderly patients with white matter disease is positional & positioning nystagmus. Presence of atherosclerotic changes is significantly related to presence of VNG test abnormality.

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نتائج اختبار فيديو تخطيط رآة العين في المرضى الذين يعانون من قصور الدورة الدموية الدماغية ذات الصلة بالعمر

إن الدوار والاختلال في التوازن في المرضى كبار السن دائماً ما يرتبط بمرض المادة البيضاء الدماغية ذو التطور التدريجي. مرض المادة البيضاء يسهل اكتشافه بواسطة التصوير الإشعاعي علي عكس مرض قصور الدورة الدموية الدماغية الذي دائماً ما يشار اليه بالتغيرات في الانسجة بدلاً من التغيرات في الأوعية الدموية الصغيرة.

الهدف من هذه الدراسة هو استقصاء العلاقة بين وجود أو عدم وجود مرض المادة البيضاء بواسطة التصوير بالرنين المغناطيسي مع نتائج اختبارات التوازن بواسطة جهاز فيديو تخطيط رآة العين في المرضى كبار السن الذين يعانون من الدوخة.

أجريت هذه الدراسة في العيادة الخارجية بوحدة السمع و الاتزان و قسم الأشعة بمستشفى الدمرداش جامعة عين شمس في الفترة من فبراير ٢٠١٨ و حتي أكتوبر ٢٠١٨ علي عدد ٣٠ مريض من كبار السن الذين يعانون من الدوخة و عدم الاتزان.

وكانت معايير الادمج هي الفئة العمرية التي تزيد عن ٥٥ سنة و التاريخ الإيجابي للدوخة و/أو عدم الاتزان وفي حين أن معايير الاستبعاد هي: المرضى الذين تم تشخيصهم بمرض مينبير، اعتلال الدهليز الثنائي، التهاب الخلايا العصبية الدهليز أو التهاب اللوتينثروس الأخير، تاريخ إصابة الرأس أو الجراحة، الأمراض العصبية مثل: (مساحة داخل القحف التي تحتل الأفات، التصلب المتعدد، مرض باركنسون و الشلل الجزئي) والمرضى الذين لديهم تاريخ مرضي لسيلان الأذن أو جراحة الأذن.

كل المشتركين في الدراسة خضعوا للاتي: تاريخ عصبي كامل، تقييم سمعي، اختبار فيديو تخطيط رآة العين و التقييم الإشعاعي بواسطة الموجات المغناطيسية بروتوكول السكتة الدماغية الذي يتكون من (ت١، ت٢، استرداد انعكاس ضعف طاقة السوائل، التصوير الموزون بالانتشار و تصوير الأوعية الدموية باستخدام الرنين المغناطيسي. تم عمل تصنيف فازيكاس للمادة البيضاء الدماغية.

وجود حركات للعين غير طبيعية اثناء اختبارات حركات الراس كان الأكثر تكراراً في النتائج الغير طبيعية لاختبار فيديو تخطيط رآة العين بعضهم طرفي الموقع و اخرون لهم صفات غير محددة (في حالة عدم وجود اي نتائج اخري في اختبار فيديو تخطيط رآة العين). من ناحية أخرى، كانت نتائج اختبار فيديو تخطيط رآة العين الغير طبيعية مرتبطة بشكل إيجابي بانتشار التغيرات في تصلب الشرايين. وتكشف هذه النتائج عن ارتباط بمرض المادة البيضاء وليس بسبب الشيخوخة.

ولهذا السبب يشار إلى التقييم الإشعاعي للمرضى من كبار السن المصابين بدوار الذين لديهم عوامل مرجحة لمرض المادة البيضاء مثل ارتفاع ضغط الدم، داء السكري.