# **Tinnitus and Post-Traumatic Vertigo - A Review**

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**Abstract:** Fifteen neuro-otological patients have been investigated for post-traumatic vertigo, hearing loss and tinnitus. Clinical examination and laboratory tests included audiometry and equilibriometry in all patients. Statistically significant findings are reported for tinnitus, vertigo, hearing loss. Correlations for vertigo with the type of head trauma, nystagmus frequency Slow Phase Velocity (SPV) and associated complaints of hearing loss and tinnitus were analyzed. The most frequent symptom reported was vertigo (73.3%); lift sensation (46.6%); tilting and falling (26.6%); and tinnitus (40%).

Key Words: Tinnitus, Vertigo, Post-traumatic Vertigo

## **INTRODUCTION**

he neurotological clinical manifestations of posttraumatic vestibular lesions demonstrate variation. In severe cases, peripheral and central vestibular brainstem disorders occur.

Accidental head injury and its sequelae constitute major medical problems in Europe and America. The incidence of head injury in the United States was reported in 1990 to be 3.6%. It is more frequent in men than women with a ratio of 2 to 1; and was found of increased incidence of occurrence in patients age 20 and above. Most head injuries are not severe. Hematomas are reported to have an incidence of occurrence of 2%; mortality 3%.

The Glasgow Coma Scale has reported data from 1248 patients: 21% had severe head trauma, 24% moderate, and 55% minor head injuries. Sequelae of post-traumatic head injuries report vertigo to be a common complaint. It can last for a long period of time i.e., one to two years after head and/or neck injury. One-third of patients with central vestibular disturbances complain of vertigo. Some authors consider vertigo to be a consequence of the concussion and not due to alteration only of the ear. Head trauma is well recognized as a cause of vertigo and is a common disturbance of the nervous system. Depending on the severity of the head injury, vertigo can be the chief complaint or more frequently is associated with other neurological signs and symptoms.<sup>1-3</sup>

<u>Reprint requests</u>: Jorge Said, M.D., Gabinete de Audiologia y Otoneurologia, Ejercito Nacional 42 int. 1"E, Col. Anzures, México, D.F., C.P. 11590, Tel.: (525) 2545740, Fax: (525) 2551333 Craniocorpography (CCG) is a simple and more rapid method for the evaluation of vestibular function than Computerized Electronystagmography (CNG).<sup>4,5,6</sup> Both techniques were performed in a group of 15 patients with post-traumatic vertigo in an attempt to establish the value of each test for the identification of the site of lesion. Correlations for vertigo with the type of head trauma, nystagmus frequency, Slow Phase Velocity (SPV), and associated complaints of hearing loss and tinnitus were analyzed.

## MATERIAL AND METHODS

The clinical charts of all patients with a diagnosis of posttraumatic vertigo between 1990 - 1995 seen at the Audiologic and Otoneurology Clinic were reviewed. Fifteen patients were selected for this study.

Sex, age, type and degree of head trauma, time interval that elapsed between the onset of head trauma and the complaints of hearing loss, tinnitus and vertigo, results of audiologic and otoneurologic studies were recorded. A detailed questionnaire (NODEC IV (Germany); and Neurophysiology Otoophthalmologic (Argentina) ENT-examination was completed for each patient. The chief complaint of hearing loss, tinnitus, vertigo either alone and/or in combination; and Electronystagmography (ENG) was obtained for each patient.<sup>7</sup>

The history included questions to elicit complaints reflecting involvement of other cranial nerves. The past history was explored to identify underlying disease with emphasis on past or recent post-traumatic vertigo.

Vertigo was categorized to be of five sub-groups: tilting, lift, rotation, falling, and blackouts. Neurootological

symptoms like vertigo and tinnitus were subjectively difficult to describe and to classify; and frequently varied over time and following treatment.

#### **Cranio-Corpo-Graphy (CCG)**

CCG, an objective record of the vestibulospinal function was performed for all patients. The test is simple to perform, less time consuming, objective, and a quantitative equilibriometric test.

CCG is a test initially developed as a screening procedure in occupational medicine for patients with the chief complaint of vertigo. The test includes simple stimulus instructions to the patient e.g. stepping and standing. It provides a photographic, quantifiable record using a video-camera and a computer that receives, analyzes, and prints physiologic graphic significant data of the response of the patient to stimulation by stepping and standing. The Craniocorpogram of stepping and standing procedures appears as a radar image of the head and shoulder movements.<sup>7,8</sup>

### **Computerized Electronystagmography (CNG)**

CNG was performed with both horizontal and vertical leads to record extra-ocular eye movements. The polygraphic Electronystagmogram was analyzed for coordinated or dissociated eye movements.

#### The "Butterfly" Calorigram

The "Butterfly" Calorigram is a graphic method to record caloric response. It is also called the "Butterfly Chart".4,7,8

Topodiagnostic relationships have been established.

Localization of peripheral vestibular disease can be easily differentiated from central states of dysequilibrium. The methods of statistical analysis included Chi Square and Pearson's for dependence or independent variable; and Spearman correlation for association.

## RESULTS

Fifteen neurotological patients with a diagnosis of posttraumatic vertigo were selected for this study. All patients were seen in the Clinic Audiology and Otoneurology of Mexico City.

Ten patients were male; and 5 female.

All completed the neurologic examination including the history form NODEC IV (Germany) and Neurophysiology Otoophthalmologic (Argentina) ENT examination, CCG, and ENG tests.

The mean age for female patients was 50.6 years; males 34.3 years of age.

The symptoms were reported by both male and female patients. The frequency of occurrence of the complaints were: vertigo (73.3%); lift sensation (46.6%); tilting and falling (26.6%); and tinnitus (40%). The distribution of symptoms is shown below (Figs. 1,2,3).

The incidence of occurrence of head trauma and post traumatic vertigo was found to be greater in male patients by a ratio of 2 to 1.







type of head traumas. The Pearson's test demonstrated independence of these variables.

Evaluation of the Craniocorpography (CCG) and Computerized Electronystagmography (ENG) revealed an association between both. (Tables 1-7).

## DISCUSSION

Table 1. CCG (lateral content)	teral dev	iation ri	ght) wit	h ENG	(slow pl	hase velo	ocity 44	°C left)	
SPV 44∞C LE		LATERAL DEVIATION RIGHT ( $\infty$ )							
(∞/seg)	0	25	30	35	45	90	180	360	TOTAL
< 5	1								1
5 - 15	6			1	1	1			9
> 15		1	1				2	1	5
TOTAL	7	1	1	1	1	1	2	1 .	15
Spearman Correla	tion valu	e of 0.6	- 6575, p	< 0.000	)674	-			

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Table 2. CCG (la	iteral dev	viation r	ight) wi	th ENG	(freque	ncy 44°	C left)		
FRECUENCY 44-C L	E		LATERA	L DEVIA	TION RIG	GHT (∞)			
(n)	0	25	30	35	45	90	180	360	TOTAL
< 20					1				1
20 - 60	5	1	1	1		1		1	10
> 60	2						2		4
TOTAL	7	1	1	1	1	1	2	1	15
Spearman Correla	tion valu	ue of 0.0	)2045, p	0 < 0.000	)942	•			
Table 3. CCG (la	teral dev	viation r	ight) wit	th ENG	(freque	ncy 44°C	C right )		
FRECUENCY 44∞C F	ίΕ Ο	25			10N RI	GHI(∞) 00	180	360	τοται
(11)	0	25	30	35	45	90	100	300	IUTAL
< 20					1				1
20 - 60	5	1	1	1		1		1	10
> 60	2			2			2		4
TOTAL	7	1	1	1	1	1	2	1	15
Spearman Correlat	tion valu	e of 0.1	696, p <	< 0.0005	45	•			
Table 4. CCG (lat	eral dev	iation ri	ght) with	h ENG (	slow pl	nase velo	ocity 30°	°C left)	
SPV 30∞C LE	0	25		L DEVIA	TION RIG	äHI(∞) ■ 00	120	360	TOTAL
< 5	4	23	30	33	43	30	100	300	4
5 - 15	3		1	1	1	1	2	1	10
> 15		1							1
TOTAL	7	1	1	1	1	1	2	1	15
Spearman Correla	tion val	ue of 0.5	50902, p	0.000	0526				

Т	able 5. CCG (lateral a	angulatio	on right)	with EN	IG (slow	phase v	elocity 4	44°C left)
	SPV 44∞C LE	L	ATERAL	ANGUL	ATION R	GHT (∞)		
	(∞/seg)	0	10	15	25	45	90	TOTAL
	< 5	1						1
	5 - 15	7			1	1		9
	> 15		1	1			3	5
	TOTAL	8	1	1	1	1	3	15

Spearman Correlation value of 0.73892, p < 0.001165

Ta	ble 6. CCG (lateral a	ngulatio	n right)	with EN	G (frequ	ency 44	°C right)	)
	FRECUENCY 44∞C L	E L/	ATERAL	ANGUL	ATION R	IGHT (∞)		
	(n)	0	10	15	25	45	90	TOTAL
	< 20				1			1
	20 - 60	6	1	1		1	1	10
	> 60	2					2	4
	TOTAL	8	1	1	1	1	3	15
	Spearman Correlation	n value o	f 0.6657	5, p<0.0	00674		-	

SPV 44∞C RE	SPV 44∞C RE LATERAL ANGULATION RIGHT (∞)							
(∞/seg)	0	10	15	25	45	90	TOTAL	
< 5	3						3	
5 - 15	4			1	1	1	7	
> 15	1	1	1			2	5	
TOTAL	8	1	1	1	1	3	15	

Fifteen patients with the diagnosis of post-traumatic vertigo completed a neurotologic examination which included audiometry and equilibriometry tests.

Correlates of vertigo and SPV; type of head trauma and nystagmus frequency; time interval which elapsed between the onset of the head trauma and SPV did not reveal any statistical difference. The results suggest that such variables are independent.

Statistically the tinnitus revealed a significant correlation with vertigo and head trauma (Chi-Square Value 16.72727, DF 8, p < 0.0001).

Statistically the CCG and ENG revealed a significant association of lateral eye deviation, lateral eye angulation with SPV and frequency 40° cold left ear and right ear and 30° C left ear. The correlation of SPV and frequency of 40° C left ear with LD right suggests an indirect response of the site of lesion and a central lesion.

Correlation of  $40^{\circ}$  C frequency right ear with LD right and SPV  $30^{\circ}$  C left ear with LD right suggests a peripheral lesion.

Comparison of angular deviation right with SPV 40 ° C and frequency left ear 40° C revealed an indirect association suggesting a central lesion. On the other hand the SPV right 40° C showed a direct response suggesting a peripheral lesion.

CCG is considered a useful test in the diagnosis of central and peripheral lesions of the vestibular system secondary to head trauma.

## CONCLUSIONS

The incidence of occurrence of head trauma and posttraumatic vertigo was found to be greater in male patients by a ratio of 2 to 1.

The most common neurotologic symptom was vertigo, lift and falling. Tinnitus was identified in 40% of the patients. In our series a significant associated complaint in patients with post-traumatic vertigo was identified.

CCG and the Butterfly Calorigram are considered significant tests to establish the diagnosis of central and peripheral lesions of the vestibular system secondary to head trauma.

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