



RESEARCH ARTICLE

VESTIBULAR DISORDERS IN PATIENTS WITH POSTURAL INSTABILITY AT THE NAVAL HOSPITAL OF HIGH SPECIALTY

***Dr. Manuel Antonio Castañeda Cabrera, Dr. Francisco Javier Mancilla Mejía and Dra. Mabel Yolitzin Peláez Ricaño**

Department of Otorhinolaryngology and Head and Neck Surgery, Naval General Hospital of High Specialty (HOSGENAES), Secretaría de Marina Armada de México

ARTICLE INFO

Article History:

Received 08th November, 2016
Received in revised form
05th December, 2016
Accepted 17th January, 2017
Published online 28th February, 2017

Keywords:

Benign Paroxysmal Positional Vertigo,
Vestibular Neuronitis,
Vestibular Diseases,
Meniere Disease,
Postural Balance.

ABSTRACT

Introduction: The disorders that alter the function vestibular are a major public health problema, both clinical as economic perspective. Objective: To identify vestibular disorders in patients with postural instability at The Naval High Specialty Hospital.

Material and Methods: A cross-sectional, non-randomized, descriptive and ambispective study was conducted, as well as a systematic review and analysis of the clinical records of each evaluated patient at the Otorhinolaryngology service, reported with postural instability symptom (dizziness, vertigo, latero-pulsion, Postural instability) as the main reason for medical care. The SPSS 19.0 statistical package for Windows was used for the data analysis. 2 x 2 factorial design to estimate prevalence. The bivariate analysis was performed with the χ^2 test, considering a $p \leq 0.05$. Student's t, Mann-Whitney U, and Kruskal-Wallis tests were used as well. A $p \leq 0.05$ was considered significant.

Results: A total of 1077 files reviewed, 374 patients with different peripheral vestibular disorders were obtained. Of the total sample ($n = 374$), 71.7% (268) are of the female gender and 28.3% (106) are male. The mean age +/- standard deviation is 55.7 +/- 16.4 years, with an age range of 18-95 years. The prevalence of benign paroxysmal postural vertigo (BPPV) is 84.0%, endolymphatic hydrops with 11.5%, posttraumatic vertigo 4.5%, vestibular neuronitis 2.4% and 5.6% with Meniere's disease, perilymphatic fistula, otosyphilis and upper semicircular canal dehiscence did not reach the 1%.

Conclusions: The prevalence of vestibular disorders is similar to that reported at literature, benign paroxysmal postural vertigo the most frequent. Consequently, and differing from the literature, the endolymphatic hydrops is the second most prevalent vestibular pathology, followed by Meniere's disease and, in lower frequency the vestibular neuritis, contrasting widely with it reported in the literature. Therefore, it is essential not only to carry out extension studies but also a complete clinical evaluation in order to establish a specific diagnosis of the vestibular disorders that affect our population that is suffering postural instability.

INTRODUCTION

The disorders that alter the function vestibular are a major public health problema, both clinical as economic perspective. Its impact is disabling, often at great risk of falls and complications (fractures, prolonged hospitalizations, session of rehabilitation, need for caregivers, etc.) that represents a significant threat for life quality in a large segment of the population in Western societies (Murdin and Schilder, 2015). The vestibular vertigo prevalence in the population is 7.4%, and the dysfunction vestibular occurs in more than one third of the adults with more than 40 years. The vertigo affects the daily activities of 80% of the people. Patients who come to the emergency room with drops of unknown cause, 80% have an alteration vestibular, and the 40% complains of vertigo.

***Corresponding author: Dr. Manuel Antonio Castañeda Cabrera,**
Department of Otorhinolaryngology and Head and Neck Surgery,
Naval General Hospital of High Specialty (HOSGENAES), Secretaria
de Marina Armada de México.

These peripherals vestibular disorders are a significant health problem (Crane and Minor, 2015). Disorders balance and their associated symptoms can have a significant impact on the quality of life, in daily work, and can be the cause of long-term disability with high probability of becoming permanent. The disorders of the balance are also a recognized risk factor for falls; especially in elders, with high associated morbidity, mortality and economic cost (Curthoys, 2012). The semicircular canals and otolithics organs play an important role in the balance maintenance. The caloric test was established as the semicircular canals examination test. Have been reported several tests to examine otolithics organs, for example, the parallel oscillation test, the linear acceleration and the outside vertical axis rotation test. These studies are not commonly used, as they require large devices to stimulate the organs. On the other hand, the assessment of Vestibular Evoked Myogenic Potential can be performed at neurotological clinics with no needed special measuring devices (Cummings *et al.*, 2015). The detection and treatment for different vestibular and neurological

disorders, that alter the ability to maintain stable the gravity center, can reduce the natural course of the disease, give an appropriate rehabilitation and decrease the risk of their secondary complications as well. On a global scale, there is a lack of information about the predominance of the vestibular disorders. Few countries have achieved gather important information and details of this condition. Nowadays in our country, there is not a study that provides information of vestibular disorders, this being the first national study that contribute with a specific and detailed information study, being thus a reliable information source and as a future basis research for these diseases.

Objective

To identify vestibular disorders in patients with postural instability at The Naval High Specialty Hospital in Mexico City from 1st March 2014 to 1st March 2016.

MATERIALS AND METHODS

Study Type: A cross-sectional, non-randomized, descriptive and ambispective study was conducted. , as well as a systematic review and analysis of the clinical records of adults patients, both genres, who were valued at the Otorhinolaryngology service, and whose symptom main referred the instability postural as motive of consultation. Patients under 18 years old, valued at the emergency room and/or consultation in other services, without having a valuation of ORL, with central vestibular pathology and with no longer attend consultation before reaching a diagnosis, all of theme, were excluded. During the review of their records and the assessment of ORL the patients with diagnosis of any pathology from the Central Nervous System, causes not vestibular of instability postural (metabolic, cardiovascular, endocrinological, psychological) and patients with vestibular pathology that has not arrived to the diagnosis of some vestibular peripheral disorder were eliminated.

Patients recruited at the Otolaryngology consultation with a vestibular disorder, initially valued by the doctors attached to the service of Otolaryngology, which were conducted into an interrogation directed to vestibular disorders and a physical and clinical exam, clarified with maneuvers of vestibular exploration (Romberg, March, Dysmetries, dysdiadochokinesia, Fukuda, Dix-Hallpike, Mc Clure, Head Hanging). If initial valuation, according to the different vestibular manoeuvres for Benign paroxysmal positional vertigo (BPPV) or any positive objectively or subjectively, namely with the presence or not of nystagmus, the diagnosis of a Benign paroxysmal positional vértigo (BPPV) was established. Once the affected semicircular canal is identified the repositioning and release procedures are made according to the specific affected semicircular canal case. If symptoms persist after two subsequent evaluations or during the vestibular exam, it is not a positional vertigo (likely endolymphatic hydrops, Neuronitis, vestibular, etc) it has to be sent to the Neuro-Otologist for thorough assessment and initiate a protocol study, which consists of complete laboratory studies and and consultancy studies,as: audiometry, Magnetic resonance imaging (MRI), computed tomography (TC), Videonystagmography (VNG), myogenic vestibular evoked potentials cervical and ocular (cVEMPS and oVEMPS

respectively), immune profile (PI), the rheumatic profile (PR), VDRL, FTA-abs, as well as the comprehensive valuation of the services of Audiology, Neurology, radiology and imaging, immunology, and Rheumatology.

Audiometry: it is a test that aims the alterations of the hearing study and figures the loss of hearing and determines the magnitude of them in relation to the acoustic vibrations perceived. It explores the airway and the track bone. The results of a hearing test are presented graphically. This graph shows how much the patient is able to hear in decibels at different frequencies that are measured in Hertz (Hz).

Magnetic Resonance: The study of magnetic resonance focuses in the image of ears with attention to angle ponto-cerebellar, in order to rule out any central lesion that is the cause of the symptoms referred by the patient. The studies were conducted by a Siemens magnetic resonator, model MAGNETOM Acanto 1.5 Tesla (TIM 32 X 8).

Computed tomography: Studies were computed tomography of the ears, in order to assess the structures of the external ear, middle and internal, to rule out or confirm diagnoses of some of the found vestibular disorders as in dehiscence of the superior semicircular canal, using a multislice tomograph Somatom Sensation 64-slice, Siemens brand.

Videoelectronystagmography: Is a diagnostic test used to obtain a record of the movements voluntary and involuntary eye (or nystagmus), which allows us to know the status of the vestibular system and nerves involved in the movement of both eyes in an indirect way. It keeps a record of voluntary movements (spontaneous) of both eyes to which the patient is asked to fix his gaze on an object or light source and follow their movements. In the second part of the study is performed a record of involuntary movements (caused) of both eyes to which used different stimuli (provocative tests) which will give rise to eye movements on the that the patient has no control. The stimuli most commonly used are: stimulus calories: is instilled a small amount of water or air first cold and after hot in the duct external of each ear (alternately) and recorded eye movements caused by this stimulus; stimulus rotary: submits the patient to rotating movements on a swivel chair and are recorded eye movements caused by this stimulus; stimulus oculomotor: used objects in movement and are recorded eye movements caused by this stimulation.

Vestibular Evoked Myogenic Potential (VEMP): It is defined as an objective test, non-invasive, fast, easy to perform and comfortable for the patient, which determine the functioning of sacculus and inferior vestibular nerve. Evaluates the generation of reflection vestibule-colic; it is generated when the sound stimuli activates the macula saccular and generates an electric potential that goes down by the below vestibular nerve until it reaches to the lateral vestibular nucleus, from there follow the course of the spinal vestibular tract to make synapses with the moto-neuron ipsilateral that stimulate the sternocleidomastoid muscle. The sound stimulation of the saccule is performed through short acoustic clicks (0.1ms) and high-intensity (> 95 db above the normal hearing level). The stimulation of saccule from clicks acoustic is justified by the strong clicks impacts on the proper position at the tympanic membrane in the same location next to the plate of the calliper.

The chart obtained after the application test corresponds to the VEMP.

Reumatological and immune profile: Laboratory tests are useful, since they enable a quick diagnosis of any immunological pathology that can influence vestibular alterations of any systemic involvement, and contribute with the appropriate treatment. Some of the studies used are: antinuclear antibodies (antinucleus factor) in the inquiry and in the identification of rheumatic specific diseases. The Erythrocyte Sedimentation Rate (ESR), the C-reactive protein (CRP), acute phase reactants; immunoglobulins profile IgG, IgM, IgE, IgD, IgA.

VDRL and FTA ABS: VDRL is a technique of flocculation that uses the cardiolipin antigen of cardiolipina to detect treponemal antibodies nonspecific produced by the individual before a syphilitic infection. Its results can be expressed both qualitative and quantitative way. It constitutes a serological technique with sufficient sensitivity and specificity to complement the diagnosis of syphilis and to analyze the response to specific treatment, the VDRL test capacity to detect syphilis depends on the disease stage. The test's sensitivity to detect syphilis nears 100% during the middle stages; it is less sensitive during the earlier and later stages. FTA-Abs is a treponemal specific test, with the fluorescent treponemal antibody-absorption method, which was mainly used to confirm the positive results obtained with the reaginic test. Produce few false positives in less than 1%. Both tests were used to rule out in our case Ootosyphilis.

RESULTS

It reviewed a total of 1077 physical and electronic files, 654 of them were excluded according to the exclusion criteria, and removed 49 files for not presenting peripheral vestibular pathology. Obtaining a sample of 374 patients with different peripherals vestibular disorders. From the total sample ($n = 374$), the 71.7% (268) are female and the 28.3% (106) are male. The average age \pm standard deviation is 55.7 \pm 16.4 years, within an age range of 18-95 years. The prevalence of Benign Paroxysmal Postural Vertigo 1 (BPPV) is 84.0%. The main symptoms reported by patients during the interrogation as reason for consultation, were dizziness with 15%, Vertigo 68.4%, 20.1% with instability and 9.4% with lateropulsion (Figure 1). The prevalence of secondary symptoms associated to the main symptoms are: nausea (42.0%), vomiting (20.1%), headache arose in 14.2%, bilateral tinnitus in 13.9%, left tinnitus at 15.2%, and right in 10.2%, other symptoms prevailed below the 10% (left hypoacusia 9.1%, right 9.1% and bilateral 8.0%; left aural fullness 7.5%, right 5.6% and bilateral 4.8%; diaphoresis 5.1% and palpitations only in 1.1%). The 84% of prevalence in Vestibular disorders peripherals diagnosed was obtained for the benign paroxysmal positional vertigo with 314 patients, endolymphatic hydrops with 43 patients, post-traumatic vertigo with 15, vestibular neuronitis and Meniere's disease with 9 and 21, respectively, 1 with fistula/perilymph, otosifilis 3 and 2 with dehiscence of CSC higher (Figure 2). Patients with benign paroxysmal positional vertigo (BPPV), the semicircular canal (CSC) back right was the most affected with a 33.7%, followed by posterior semicircular canal left 31.6%, the left side CSC 5.3%, right side CSC 6.1%, and finally the least affected were the superior semicircular canals left and

right with a rate of 3.7% and 3.5% respectively (Figure 3). Post-traumatic vertigo cases are the 4.0%, the left endolymphatic hydrops 5.6%, 3.7% and bilateral 2.1%; cases left Meniere 2.7%, right 2.7% and bilateral 0.3%; Neuronitis vestibular left 1.3% and right 1.1%; only a case of prelymphatic fistula (0.3%), three osteosyphilis (left 0.5% and right 0.3%) and finally two cases of dehiscence of CSC (0.5%). They suffered falls and accidents 2.9% respectively, injuries in a 5.9%, a 20.3% had labor involvement and only 1.1% economic involvement.

Bivariate analysis: as you can see at table 1, female sex has a 1.73 times greater than the male risk (in the interval of confidence of 95% of a risk of 0.9-3.0, $p = 0.06$) have BPPV. Separately, none of the symptoms was evaluated as primary symptom of consultation (dizziness, vertigo and imbalance) are predictors associated to BPPV; However, the presence of only one of the three symptoms compared to the presence of two of them combined, it is a significant predictor of BPPV with a risk of 2.31 (95% CI 1.1 - 4.7, $p = 0.018$), in other words, it is less likely that patients who have presenting at the same time two of the three symptoms (dizziness, vertigo, or imbalance) have BPPV if compared to those who only referred one of the three symptoms. The most predictive power is the imbalance with lateropulsion feeling, BPPV patients have a reason for probability (RP) of 3.18 express lateropulsion, or else risk 3.4 times greater for BPPV compared with those without imbalance or sense of instability (in the 95% 0.7-14.5, $p = 0.08$). The symptoms relating secondarily, as can be seen (table 2), a lower proportion of patients with BPPV presented vomiting, compared with those without BPPV, only the 17.8% of them cases with BPPV presented vomiting versus 31.7% of them cases without BPPV ($p = 0.014$) by this it OR = 0.46 (95% 0.25-0.86); Moreover, the absence of tinnitus is significantly more prevalent in them patients with BPPV (65%) that without BPPV (38,3%) more however, when bilateral tinnitus is more likely to more risk of BPPV is patients with BPPV posed without her, bilateral tinnitus 1.93, but its absence is protective. Similar Association of BPPV with tinnitus is observed with deafness. Observe the absence of deafness means 1.76 times likely to BPPV, on the other hand, there is a left the probability of BPPV is reduced to 0.19 and 0.30 if it is right, but if it exists and is bilateral then the probability that the case of BPPV climbing to 1.72 times higher ($p = 0.0001$).

The association between BPPV and aural fullness, is approximately similar, the reasons of probability corresponding in 1.35, 0.29 and 0.30-0.90 ($p = 0.0001$). The diaphoresis is less likely to occur in patients with BPPV ($p = 0.02$). The palpitations are actually, in a low prevalence: 0.6% in patients with BPPV versus 3.3% no BPPV ($p = 0.12$). Finally, nystagmus rotational-horizontal, with not doubt the greatest Predictor of BPPV, patients with this sign are 23.0 times more risk being positive to BPPV (at a 95% 5.5-95.9, $p = 0.0001$) compared against with no nistagmus, observed in the same table 2, to 44.3 nystagmus rotational- horizontal, versus only 3.3% of patients with BPPV are positive 44.3% of those who have no BPPV. Were made linear associations by linear to the different specific diagnoses of vestibular disorders (hidrops endolinfático, Menieré) with tinnitus, hearing loss, and aural fullness since somehow five diagnoses are associated with such symptoms (Table 3).

Table 1. Primary clinical factors associated with BPPV

Factores asociados	BPPV		P
	SI (n = 314)	NO (n = 60)	
Género femenino	231 (73.6%)	37 (61.7%)	0.06 chi cuadrada
Edad	56.0 +/- 16.0	53.8 +/- 18.5	0.39 t de student
1.Mareo NO	269 (85.7%)	49 (81.7%)	0.42 chi cuadrada
SI	45 (14.3%)	11 (18.3%)	
2.Vértigo NO	100 (31.8%)	18 (30.0%)	0.77 chi cuadrada
SI	214 (68.2%)	42 (70.0%)	
3.Desequilibrio		RP	
No	226 (72.0%)	38 (63.3%)	1.10
Inestabilidad	55 (17.5%)	20 (33.3%)	0.52
Lateropulsión	33 (10.5%)	2 (3.3%)	3.18
Ninguno	1 (0.3%)	0	
Uno u otro (1,2,3) +	279 (88.9%)	46 (76.7%)	0.012 chi cuadrada
Dos + simultáneos	34 (10.8%)	13 (21.7%)	
Tres + simultáneos	0	1 (1.7%)	

Note: BPPV. Benign postural paroxysmal Vertigo

Source: Data obtained from the present study

Table 2. Secondary clinical factors associated with BPPV

Factores	BPPV		P
	SI (n = 314)	NO (NO = 60)	
Cefalea	45 (14.3%)	8 (13.3%)	0.83 chi
Náuseas	129 (41.1%)	28 (46.7%)	0.42 chi
Vómito	56 (17.8%)	19 (31.7%)	0.014 chi
Acufenos NO	204 (65.0%)	23 (38.3%)	1.69
Izquierdo	38 (12.1%)	19 (31.7%)	0.38
Derecho	25 (8.0%)	13 (21.7%)	0.36
Bilateral	47 (15.0%)	5 (8.3%)	1.80
Hipoacusia NO	249 (79.3%)	27 (45.0%)	1.76
Izquierda	17 (5.4%)	17 (28.35)	0.19
Derecha	21(6.7%)	13 (21.7%)	0.30
Bilateral	27 (8.6%)	3 (5.0%)	1.72
Plenitud aural NO	269 (85.7%)	38 (63.3%)	1.35
Izquierda	17 (5.4%)	11 (18.3%)	0.29
Derecha	13 (4.1%)	8 (13.3%)	0.30
Bilateral	15 (4.8%)	3 (5.0%)	0.90
Diaforesis	12 (3.8%)	7 (11.7%)	0.02 Test exacto de Fisher
Nistagmus NO	146 (46.5%)	48 (80.0%)	
Horizontal	29 (9.2%)	10 (16.7%)	0.0001 chi
Horizontorotacional	139 (44.3%)	2 (3.3%)	

Source: Data obtained from the present study

Note: BPPV. Benign postural paroxysmal Vertigo

Table 3. Association linear by linear of specific with tinnitus diagnosis, deafness and fullness aural (%)

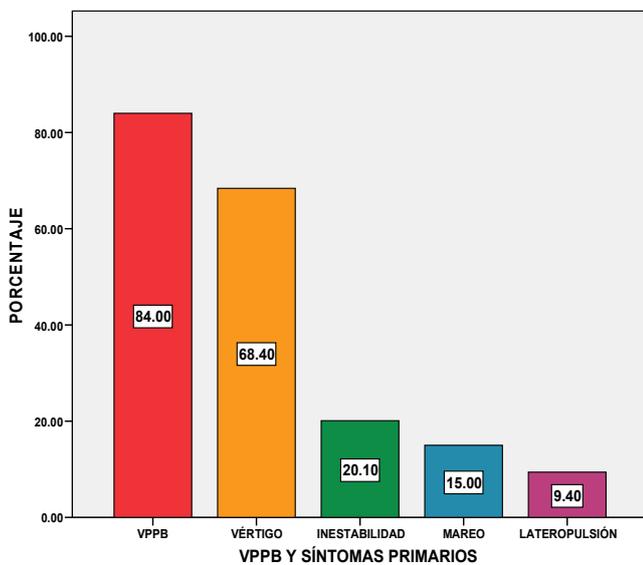
Nivel de afectación	Acufenos	hipoacusia	plenitud aural
	Hidrops endolinfático		
Ninguno-ninguno	65.5	79.5	86.4
Izquierdo-Izquierdo	57.1	52.4	42.9
Derecho-Derecho	64.3	57.1	35.7
Bilateral-Bilateral	25.0	25.0	25.0
p	0.002	0.0001	0.0001
	Menieré		
Ninguno-ninguno	63.5	77.3	85.0
Izquierdo-Izquierdo	90.0	80.0	50.0
Derecho-Derecho	70.0	60.	70.0
Bilateral-Bilateral	0.0	100.0	100.0
p	0.018	0.0001	0.0001

Source: Data obtained from the present study

Table 4. Endolymphatic hydrops with nistagmos Association

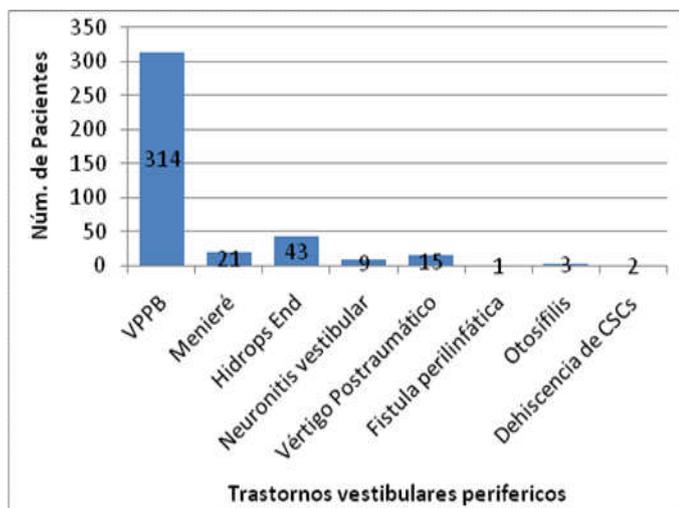
Nistagmus	Hidrops endolinfático				Total
	NO	Izquierdo	Derecho	Bilateral	
NO	157 (47.4%)	16 (76.2%)	13 (92.9%)	8 (100%)	194 (51.9%)
Horizontal	37 (11.2%)	2 (9.5%)	0	0	39 (10.4%)
Horizontorotacional	137 (41.4%)	3 (14.3%)	1 (7.1%)	0	141 (37.7%)
Total	331	21	14	8	

Source: Data obtained from the present study



Source: Own elaboration, data obtained from the present study

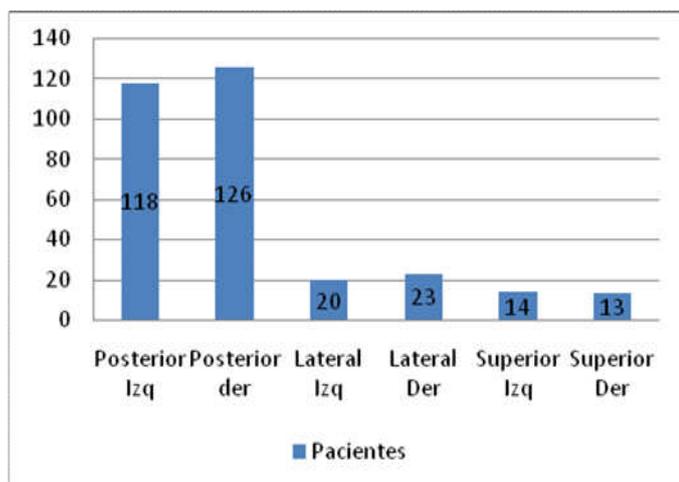
Figure 2. Prevalence of peripheral vestibular disorders



Source: Own elaboration, data obtained from the present study.

Note: BPPV benign paroxysmal vertigo, CSCs superior semicircular canal

Figure 1. Prevalence of vertigo postural (BPPV) and primary symptoms



Source: Own elaboration. Data obtained from the present study

Note: BPPV. Benign postural paroxysmal Vertigo, CSC: semicircular canal

Figure 3. Prevalence of BPPV according to the affected CSC

The presence of endolymphatic hydrops have three significant association with each of the symptoms, 65.5% of the cases without tinnitus are at the same, without hydrops, 57.1% with left tinnitus are left hydrops, 64.1% of cases with tinnitus rights are rights hydrops and 25% of bilateral tinnitus are bilateral hydrops ($p = 0.002$). In general, at the table 3 we can see the degree of the three symptoms association between each diagnosis with what symptom is more common in each disease. The presence of endolymphatic hydrops is also associated with nystagmus ($p = 0.0001$ Xi²) 11.2% of the cases without hydrops have horizontal nystagmus, 41.4% have nystagmus rotational-horizontal, the left hydrops 9.5% have nystagmus, horizontal and 14.3% rotational- horizontal; 8 cases of bilateral hydrops none have nystagmus (Table 4).

Other diagnoses such as Otosyphilis are reported ($n = 3$), upper CSC dehiscence ($n = 2$), and prelymphatic fistula ($n = 1$), all of these with a prevalence of less than 1%. Cases of BPPV, are less related to the specific main symptoms that were established; likewise, none of the designated specific diagnoses are significantly associated with primary symptoms (dizziness, vertigo, imbalance), as a result, these symptoms can be manifested or not in BPPV than in other Neuro-Otological pathologies. The nystagmus is significantly related to Meniere ($p = 0.03$) with Neurinitis vestibular ($p = 0.0001$). Vestibular neuronitis is the only specific diagnosis which is closely related to nausea ($p = 0.002$), vomiting (0.0001) and with diaphoresis ($p = 0.0001$). The only post-traumatic vertigo is related to headaches ($p = 0.011$) and three cases of Otosifilis are associated with tinnitus and deafness ($p = 0.019$ and $p = 0.004$).

DISCUSSION

According to the obtained results, it was concluded that the prevalence of vestibular disorders in this study is similar to that reported in the world's population in relation to BPPV, this being most frequent in these disorders. As a result and differing from the literature, we find the endolymphatic hydrops as the second most prevalent vestibular pathology. Followed by the disease Ménière's and even in lower frequency vestibular neuritis, contrasting widely with those reported in the literature. Cases of BPPV, are related to the main specific symptoms that were established; Likewise, none specific diagnoses mentioned are significantly associated with the primary symptoms (dizziness, vertigo, imbalance), as a result, these symptoms can submit or not alike in BPPV than in other neuro-otological pathologies. The nystagmus is significantly associated with Meniere's disease, vestibular neuronitis and caniculares and utricles dysfunctions. It should be noted that the present study did not found any patient with the diagnosis of migraine vestibular, primarily because it is considered a diagnosis of exclusion as a probable cause of vertiginous and stressing symptoms that the headache was only referred to in a 14.2% of the patients studied, and without attaching this none of the diagnostic specific vestibular, significantly. Finally, and according to the obtained results in this study it is essential to carry out, besides a complete clinical valuation, studies of extension in order to establish a specific diagnosis of the vestibular disorders that affect to our population suffering of postural instability, in many occasions in a chronic way, because not count neither with a diagnosis nor suitable treatment, or in your case a rehabilitation focused on each pathology. Avoiding in this way, establish misdiagnosis that

modify and alter the knowledge of population vestibular disorders in general. It requires a study multi-centric and covering various socio-economic levels of our population to get a better perspective of the vestibular affectations prevalence in our country. It is hoped that this research will serve as a basis for the implementation of a number of studies on the diagnosis, treatment and rehabilitation of the Peripherals vestibular disorders that affect to our community, which some projects, are already being done by our institution.

REFERENCES

- Agrawal, Y., Carey, J., Della Santina, C., Schubert, M., and Minor, L. 2009. Disorders of Balance and Vestibular Function in US Adults. *Arch intern med.*, 938-944.
- Bisdorff, A., Staab, J., and Newman-Toker, D. 2015. Overview of the International Classification of Vestibular Disorders. *Neurol Clin*, 541–550.
- Brevern, M. V., Radtke, A., Lezius, F., Feldmann, M., Ziese, T., Lempert, T., and Neuhauser, H. 2007. Epidemiology of benign paroxysmal positional vertigo: a population based study. *J Neurol Neurosurg Psychiatry*, 710–715.
- Crane, B., and Minor, L. 2015. Peripheral Vestibular Disorders. En P. W. Flint, B. H. Haughey, V. Lund, J. Niparko, K. T. Robbins, J. R. Thomas, and M. Lesperance, Cummings otolaryngology–head and neck surgery (Sexta ed., págs. 2548-2566. Philadelphia: Saunders, Elsevier Inc.
- Curthoys, I. S. 2012. The Interpretation of Clinical Tests of Peripheral Vestibular Function. *The Laryngoscope*, 1342–1352.
- Fernández, L., Breinbauer, H., and Delano, P. 26 de June de 2015. Vertigo and Dizziness in the Elderly. *Frontiers in Neurology*, 6, 1-6. doi:10.3389/fneur.2015.00144
- Flint, P., Haughey, B., Lund, V., Niparko, J., Robbins, K., Thomas, J., and Lesperance, M. 2015. Cummings Otolaryngology Head and neck Surgery (Sexta ed.. Philadelphia: Elsevier Inc.
- Friod, L., and Ramos, J. 1998. Los traumas (Vol. I. P. Lara, Ed.) México: Limusa.
- Hoy, D., Brooks, P., and Woolf, A. 27 de June de 2012. Assessing risk of bias in prevalence studies: modification of an existing tool and evidence of interrater agreement. *Journal of Clinical Epidemiology*, 934-939. doi:10.1016/j.jclinepi.2011.11.014
- Lempert, T., Olesen, J., Furman, J., Waterston, J., Seemungal, B., Carey, J., Newman, D. 2012. Vestibular migraine: Diagnostic criteria. *Journal of Vestibular Research*, 167–172.
- Murdin, L., and Schilder, A. 2015. Epidemiology of Balance Symptoms and Disorders in the Community: A Systematic Review. *Otology and Neurotology*, 387-392.
- Neuhauser, H. K., and Lempert, T. 2009. Vertigo: Epidemiologic Aspects. *Seminars in Neurology*, 29(5): 473–481.
- Neuhauser, H., Brevern, M. v., Radtke, A., Lezius, F., Feldmann, M., Ziese, T., and Lempert, T. 2013. Epidemiology of vestibular vertigo, A neurotologic survey of the general population. *Neurology*, 898-904.
- Neuhauser, H., Radtke, A., Brevern, M. v., Lezius, F., Feldmann, M., and Lempert, T. 27 de Octubre de 2008. Burden of Dizziness and Vertigo in the Community. *Arch Intern Med.*, 168(19), 2118-2124.
