VDT
Vertigo Deafness Tinnitus

18th WORKSHOP ON NEUROTOLOGY
and MEDICAL AUDIOLOGY in KOLKATA

29th Nov to 1st Dec 2019

Migraine vertigo and Meniere's disease: the "overlapping syndrome"

Francesco Dispenza MD PhD

First report on hypothetic association

- coincident migraine associated Meniere's disease (MD): successively or coincidentally

- equivalent migraine associated MD: alternating attacks

- delayed MD: end of headache and start of vertigo spells

Arch Otolaryngol. 1962 Mar;75:220-5.

Migraine and Meniere's disease.

ATKINSON M.

PMID: 13863111 DOI: 10.1001/archotol.1962.00740040228008

Mechanism

Several years ago I pointed out [1] that the same vascular mechanism was operative in the *vasoconstrictor group* of Ménière cases as had been demonstrated by Wolff and his collaborators [2] in 1940 for migraine, that is to say, a primary vasospasm followed be a secondary vasodilation. Pathogenetically, the 2 conditions would appear to be the same, the only difference being the organ involved. The *clinical impact* of the vaso-

Vestibular Migraine

- VM is a clinical diagnosis
- VM patients have to match all point of clinical features reported

1. Vestibular migraine

A. At least 5 episodes with vestibular symptoms[1] of moderate or severe intensity[2], lasting 5 min to 72 hours[3]

B. Current or previous history of migraine with or without aura according to the International Classification of Headache Disorders (ICHD)[4]

C. One or more migraine features with at least 50% of the vestibular episodes[5]:
- headache with at least two of the following characteristics: one sided location, pulsating quality, moderate or severe pain intensity, aggravation by routine physical activity
- photophobia and phonophobia[6],
- visual aura[7]

D. Not better accounted for by another vestibular or ICHD diagnosis[8]

2. Probable vestibular migraine

A. At least 5 episodes with vestibular symptoms[1] of moderate or severe intensity[2], lasting 5 min to 72 hours[3]

B. Only one of the criteria B and C for vestibular migraine is fulfilled (migraine history *or* migraine features during the episode)

C. Not better accounted for by another vestibular or ICHD diagnosis[8]

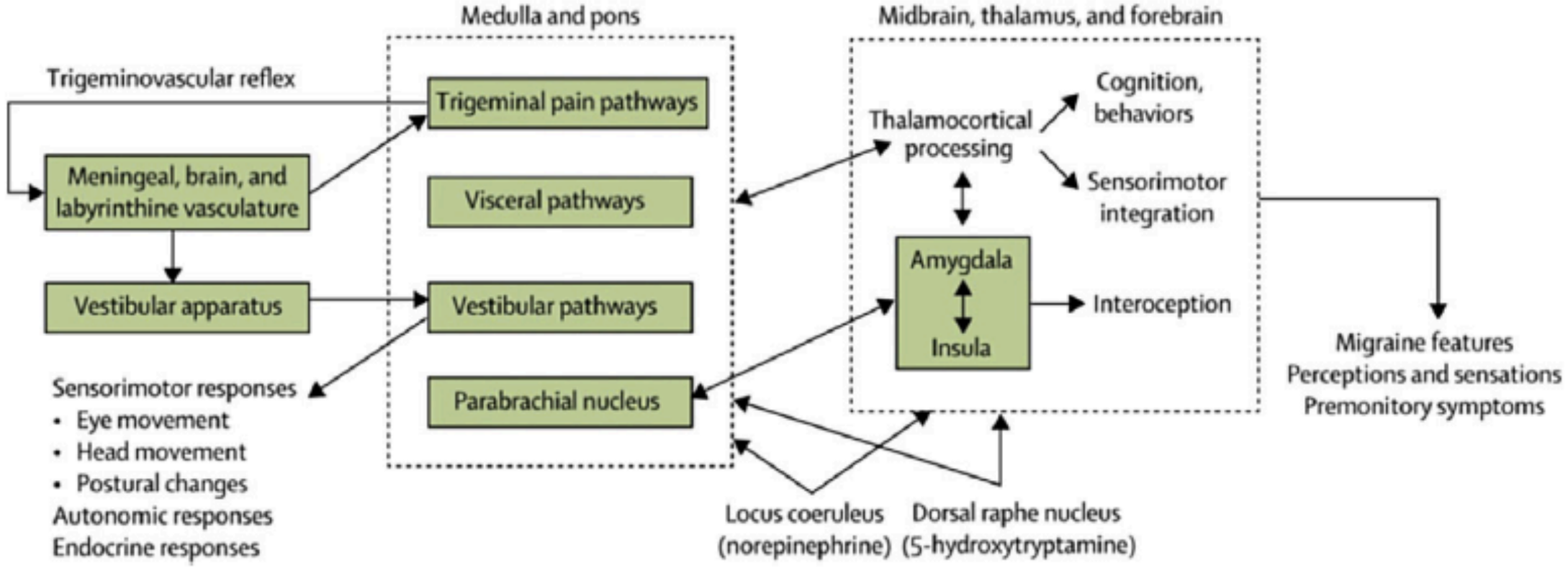
J Vestib Res. 2012;22(4):167-72. doi: 10.3233/VES-2012-0453.

Vestibular migraine: diagnostic criteria.

Lempert T[1], Olesen J, Furman J, Waterston J, Seemungal B, Carey J, Bisdorff A, Versino M, Evers S, Newman-Toker D.

Vestibular Migraine

- prevalence 1%
- male/female ratio 1:5
- first clinical manifestation at 40 years-old (mean age)
- cortical spreading depression (CSD) with activation of trigeminal afferent on inner ear vessels resulting in vasodilatation of peripheral vestibular system



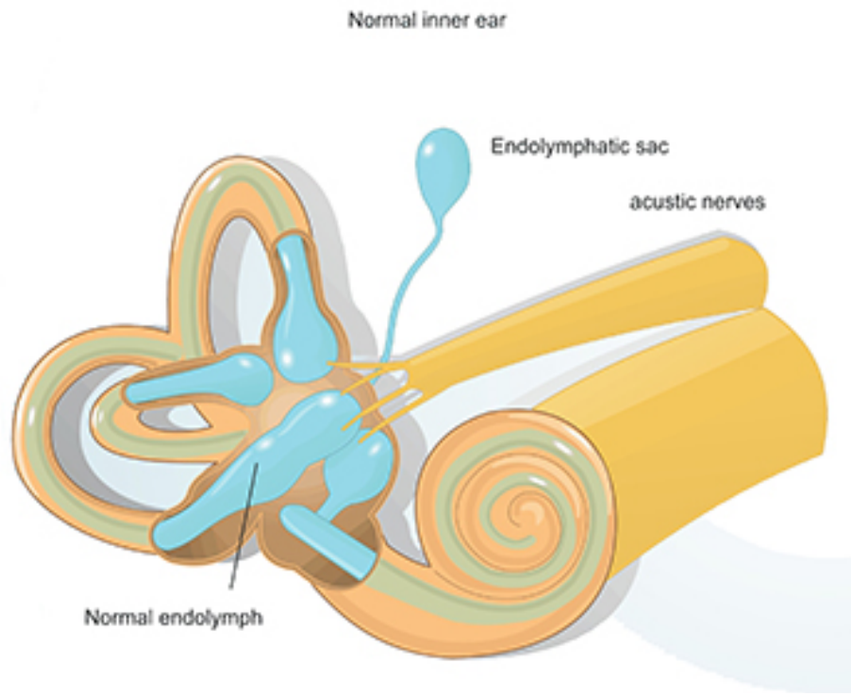
Meniere's Disease

- multifactorial disorder that combines effects of genetics and environmental factors

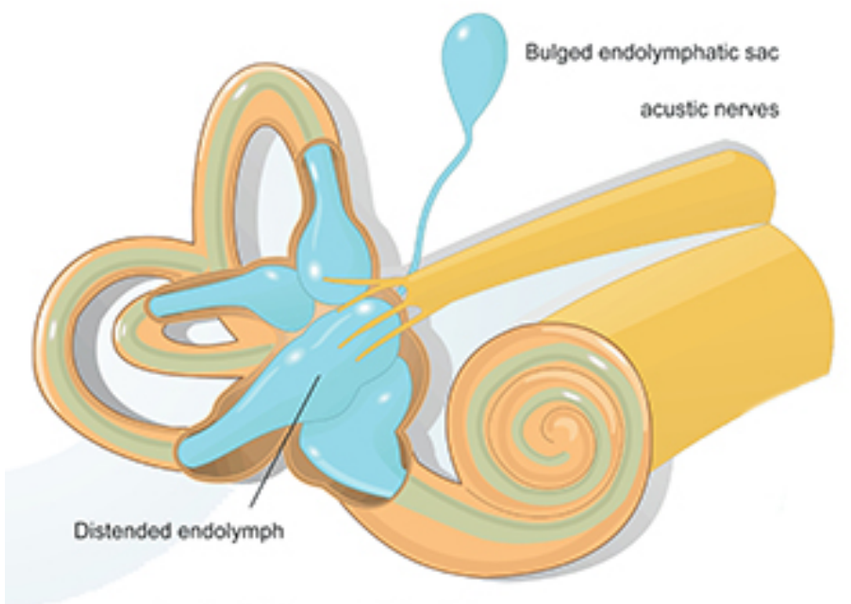
- accumulation of endolymph in the cochlear duct and vestibular organs

- episodes of spontaneous vertigo usually associated with unilateral fluctuating hearing, fullness and tinnitus

- MD is a clinical diagnosis



Inner ear in Meniere's Disease



Swelling distorts sound information

Meniere's Disease

- vertigo as sensation of self-motion

- hearing loss of 30 dB HL in two contiguous frequencies below 2 kHz

- fluctuating aural symptoms must be present during vertigo spells with increased intensity in the first year

Journal of Vestibular Research 25 (2015) 1–7
DOI 10.3233/VES-150549
IOS Press

Diagnostic criteria for Menière's disease

Jose A. Lopez-Escamez[a,k,*], John Carey[b], Won-Ho Chung[c], Joel A. Goebel[d], Måns Magnusson[e], Marco Mandalà[f], David E. Newman-Toker[g], Michael Strupp[h], Mamoru Suzuki[i], Franco Trabalzini[f] and Alexandre Bisdorff[j]

Definite MD

A. Two or more spontaneous episodes of vertigo[1,2], each lasting 20 minutes to 12 hours[3].
B. Audiometrically documented low- to medium-frequency sensorineural hearing loss[4,5] in one ear, defining the affected ear on at least one occasion before, during or after one of the episodes of vertigo[6,7].
C. Fluctuating aural symptoms (hearing, tinnitus or fullness) in the affected ear[8].
D. Not better accounted for by another vestibular diagnosis[9].

Probable MD

A. Two or more episodes of vertigo or dizziness, each lasting 20 minutes to 24 hours.
B. Fluctuating aural symptoms (hearing, tinnitus or fullness) in the affected ear[1].
D. Not better accounted for by another vestibular diagnosis[2].

Overlap MD with VM

- some migraine features are common in patient with MD

A. Radtke, T. Lempert, M.A. Gresty, G.B. Brookes, A.M. Bronstein and H. Neuhauser, Migraine and Menière's disease: Is there a link? *Neurology* **59** (2002), 1700–1704.
Q. Gopen, E. Virre and J. Anderson, Epidemiologic study to explore links between Ménière syndrome and migraine headache, *Ear Nose Throat J* **88** (2009), 1200–1204.

- patients may fit both classifications

A. Radtke, H. Neuhauser, M. von Brevern, T. Hottenrott and T. Lempert, Vestibular migraine-validity of clinical diagnostic criteria, *Cephalalgia* **31** (2011), 906–913.

Symptoms	Relative frequency (%)					
	MD		VM		Probable VM	
	Mostly	Sometimes	Mostly	Sometimes	Mostly	Sometimes
Nausea	80.7	13.4	76.2	17.9	43.1	43.1
Tinnitus	68.1	15.1	20.2	26.2	9.2	21.5
Hearing loss	61.3	16.0	10.7	15.5	9.2	6.2
Fullness of ear	61.3	19.3	14.3	20.2	7.7	20.0
Phonophobia	31.1	31.1	60.7	19.1	32.3	29.2
Photophobia	21.0	20.2	57.1	22.6	26.1	33.9
Visual aura	0.8	10.1	13.1	19.0	6.2	9.2
Anxiety	34.4	43.7	50.0	40.5	44.6	35.4
Vomiting	46.2	37.8	23.8	45.2	7.7	20.0
Palpitations	3.4	31.1	14.3	35.7	13.9	41.5
Choking	5.0	6.7	7.1	15.5	7.7	10.8
Diplopia	0.0	7.6	2.4	9.5	1.5	6.2
Headache	41.2		95.2		66.1	
Migraine-type headache	8.4		69.1		16.9	
Headache features						
Worse on effort	20.4	40.8	62.5	23.8	27.9	51.2
Moderate of severe	20.4	40.8	57.5	35.0	18.6	53.5
Unilateral	10.2	40.8	52.5	27.5	14.0	48.8
Pulsating quality	18.4	38.8	45.0	35.0	20.9	48.8

- some Authors suggested a common pathophysiology

P. Gates, Hypothesis: Could Menière's disease be a channelopathy? *Intern Med J* **35** (2005), 488–489.
R. Gürkov, C. Kantner, M. Strupp, W. Flatz, E. Krause and B. Ertl-Wagner, Endolymphatic hydrops in patients with vestibular migraine and auditory symptoms, *Eur Arch Otorhinolaryngol* **271** (2014), 2661–2667.

frontiers in NEUROLOGY

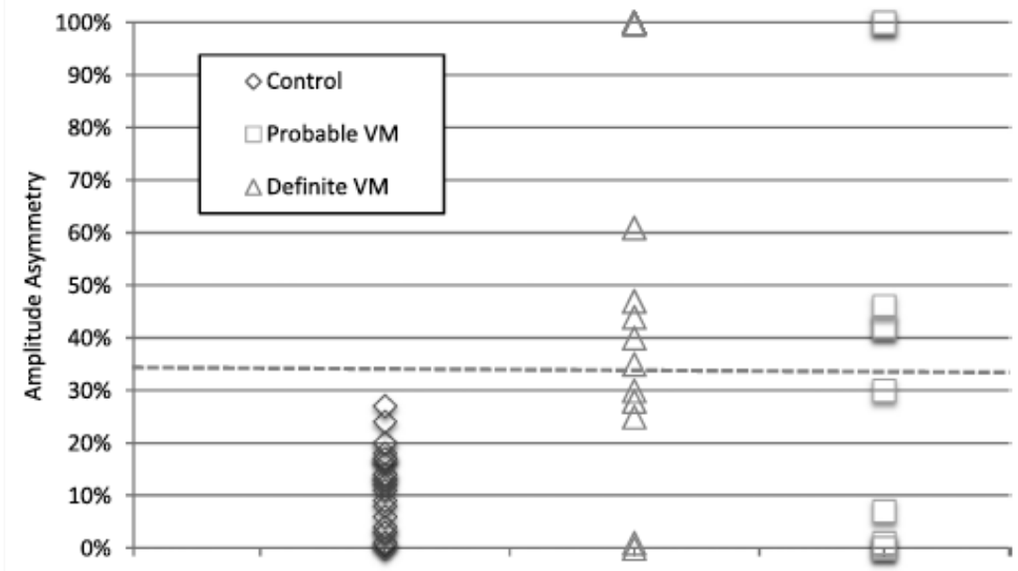
ORIGINAL RESEARCH ARTICLE
published: 15 December 2014
doi: 10.3389/fneur.2014.00265

Accompanying symptoms overlap during attacks in Menière's disease and vestibular migraine

Jose Antonio Lopez-Escamez[1,2], Julia Dlugaiczyk[3], Julien Jacobs[4], Thomas Lempert[5], Roberto Teggi[6], Michael von Brevern[7] and Alexandre Bisdorff[8]*

Have we some instrumental tests to segregate the two diseases?

VEMPs in Vestibular Migraine

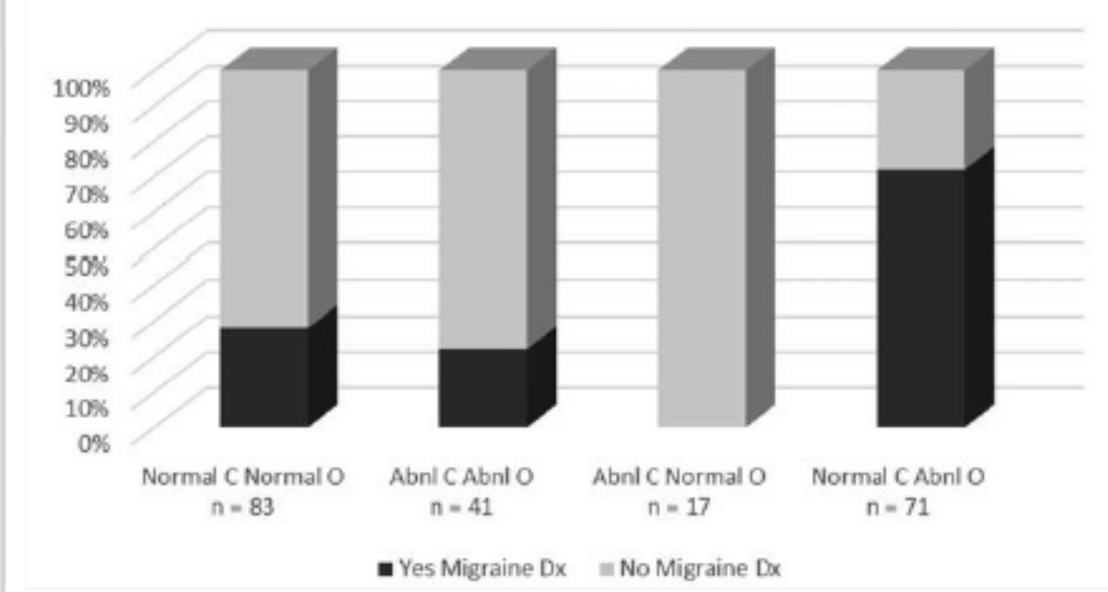


high rate of oVEMP abnormality

Otology & Neurotology
36:295–302 © 2015, Otology & Neurotology, Inc.

Vestibular Evoked Myogenic Potentials in Patients With Vestibular Migraine

*Ashley Zaleski, *Jamie Bogle, †Amaal Starling, ‡David A. Zapala, *Laurie Davis, *Matthew Wester, and *Michael Cevette



high rate of oVEMP abnormality

Otology & Neurotology
39:e561–e567 © 2018, Otology & Neurotology, Inc.

Ocular and Cervical Vestibular Evoked Myogenic Potentials in Patients With Vestibular Migraine

*Kathryn F. Makowiec, †Erin G. Piker, *Gary P. Jacobson, ‡Nabih M. Ramadan, and *Richard A. Roberts

VEMPs in Meniere's Disease

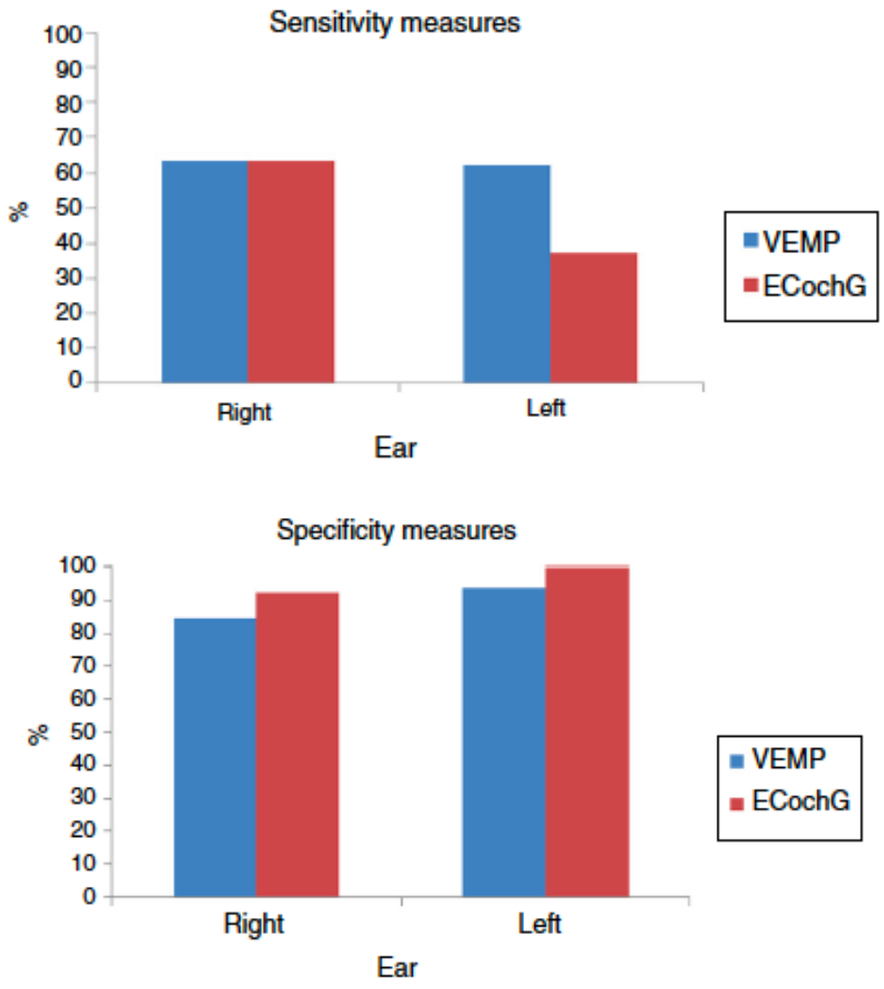


Table 1 Descriptive statistics calculated from the VEMP measurements at 500 and 1000 Hz

	Meniere's ear ($n = 42$)		Unaffected ear ($n = 42$)		Control ear ($n = 42$)	
	CVEMP	OVEMP	CVEMP	OVEMP	CVEMP	OVEMP
500 Hz						
Response prevalence (%)	**83.33**	90.48	**88.10**	97.62	**95.24**	88.10
Mean amplitude (μV) (±SEM)	**55.83 (±10.00)**	3.93 (±0.79)	**87.41 (±16.09)**	7.22 (±1.45)	**54.53 (±7.33)**	3.12 (±0.64)
Median amplitude (μV)	**29.25**	2.5	**67.16**	3.22	**38.53**	2.14
Mean asymmetry ratio (±SEM)	**0.21 (±0.08)**	0.25 (±0.06)			**−0.05 (±0.05)**	0.08 (±0.11)
1000 Hz						
Response prevalence (%)	**85.71**	90.48	**88.10**	95.24	**92.86**	88.10
Mean amplitude (μV) (±SEM)	**40.18 (±6.15)**	3.13 (±0.61)	**57.26 (±8.58)**	4.81 (±1.13)	**37.95 (±5.83)**	2.22 (±0.38)
Median amplitude (μV)	**24.69**	1.75	**39.44**	2.42	**27.34**	1.46
Mean asymmetry ratio (±SEM)	**0.15 (±0.07)**	0.14 (±0.06)			**0.08 (±0.08)**	0.03 (±0.1)
500/1000 Hz ratio						
Mean ratio (±SEM)	**2.44 (±1.08)**	1.36 (±0.12)	**2.07 (±0.58)**	1.70 (±0.12)	**1.75 (±0.23)**	1.45 (±0.13)
Median ratio	**1.00**	1.19	**1.35**	1.6	**1.42**	1.26

The items are in bold to help aid the differentiation between the cVEMP and the oVEMP figures

Braz J Otorhinolaryngol. 2017;83(4):394–403

Brazilian Journal of
OTORHINOLARYNGOLOGY
www.bjorl.org

ORIGINAL ARTICLE

Evaluation of vestibular evoked myogenic potentials (VEMP) and electrocochleography for the diagnosis of Ménière's disease☆

Pauliana Lamounier[a,b], Thiago Silva Almeida de Souza[c], Debora Aparecida Gobbo[b], Fayez Bahmad Jr.[a,d,*]

Eur Arch Otorhinolaryngol (2017) 274:85–93
DOI 10.1007/s00405-016-4206-z

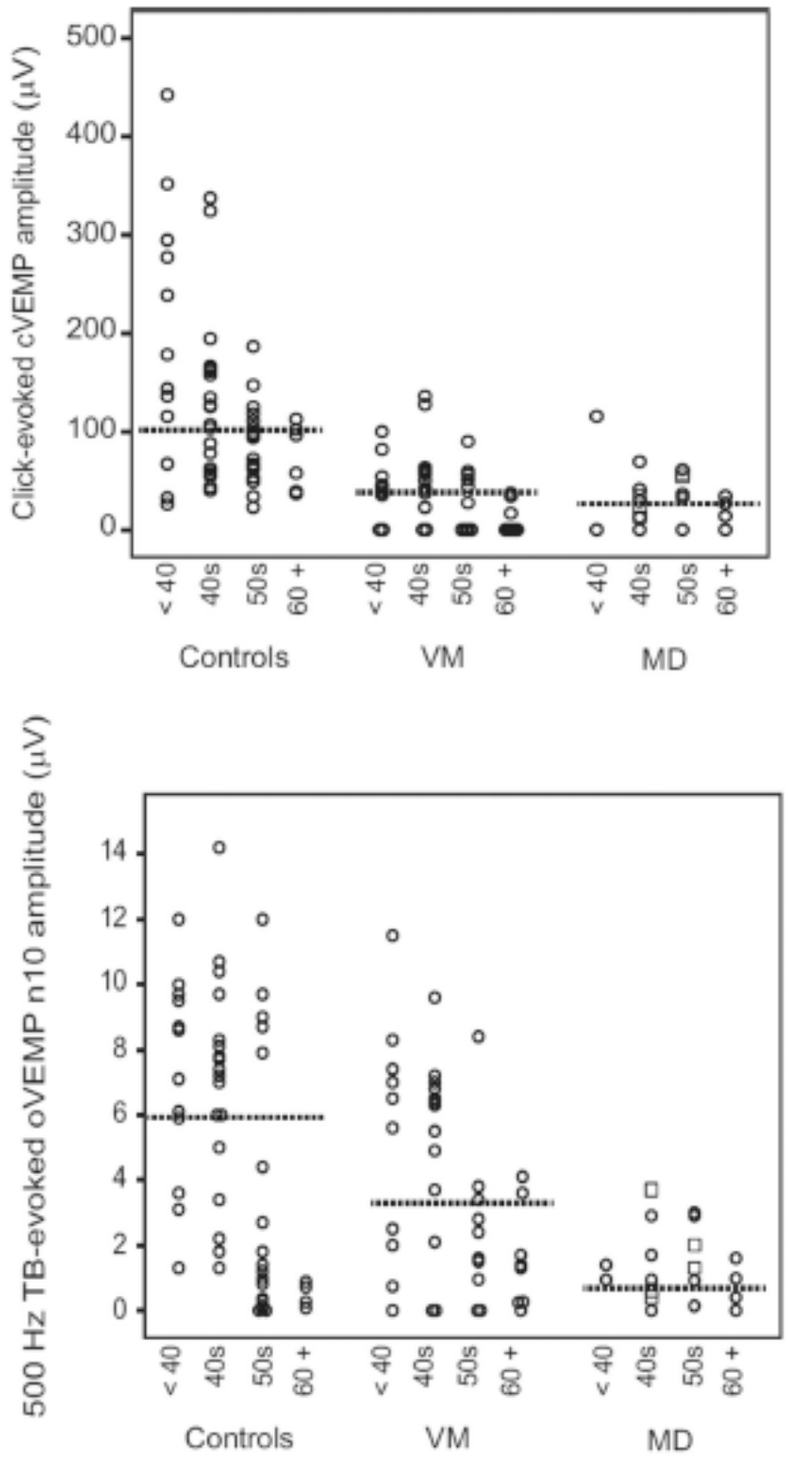
OTOLOGY

Utilisation of multi-frequency VEMPs improves diagnostic accuracy for Meniere's disease

Rebecca Maxwell[1] · Claudia Jerin[1] · Robert Gürkov[1]

VEMPs in MD and VM

- VM and MD behave similarly on most VEMP tests
- the main finding was a low amplitude compared to healthy subjects
- the Authors hypothesized a link in pathophysiology between the two disease
- no VEMP test can segregate individuals with MD from those with VM



Otolaryngol Head Neck Surg. 2012 May ; 146(5): 788–796. doi:10.1177/0194599811434073.

Can Vestibular-Evoked Myogenic Potentials Help Differentiate Ménière Disease from Vestibular Migraine?

M. Geraldine Zuniga, MD[1,2], **Kristen L. Janky, AuD, PhD**[1], **Michael C. Schubert, PT, PhD**[1], and **John P. Carey, MD**[1]

vHIT in Vestibular Migraine

Table 1
The mean VOR gain for each semicircular canal in the VM group and in normal healthy subject.

	Cases (n = 80)	Control (n = 40)	U	P
LL				
Mean ± SD.	0.84 ± 0.13	0.89 ± 0.15	1278.0	0.072
Median (Min. – Max.)	0.87 (0.5–1.1)	0.89 (0.4–1.3)		
LA				
Mean ± SD.	1.1 ± 0.3	1.2 ± 0.3	1508.0	0.607
Median (Min. – Max.)	1(0.5–1.8)	1.2(0.8–1.8)		
LP				
Mean ± SD.	1.2 ± 0.3	1.2 ± 0.3	1526.50	0.680
Median (Min. – Max.)	1.2(0.4–1.8)	1.2(0.8–1.7)		
RL				
Mean ± SD.	0.9 ± 0.3	1 ± 0.3	1450.50	0.403
Median (Min. – Max.)	0.9(0.4–1.8)	0.9(0.4–1.8)		
RA				
Mean ± SD.	1.2 ± 0.3	1.3 ± 0.3	1412.0	0.293
Median (Min. – Max.)	1.2(0.3–1.8)	1.2(0.9–1.8)		
RP				
Mean ± SD.	0.98 ± 0.25	1.10 ± 0.27	978.0[a]	<0.001[a]
Median (Min. – Max.)	0.89 (0.8–1.8)	1.03 (0.4–1.8)		

Quantitative data was expressed in mean ± SD, median (Min. - Max.) and compared using **Mann Whitney test.**

[a] Statistically significant at $p \leq 0.05$.

- VOR gain: ratio between head and eye velocity
- Compensatory movement: covert and overt saccades
- the time required to correct any gaze error to fix a target
- the vestibular-saccades interaction mechanism

Journal of Otology 13 (2018) 65–67

Contents lists available at ScienceDirect

Journal of Otology

journal homepage: www.journals.elsevier.com/journal-of-otology/

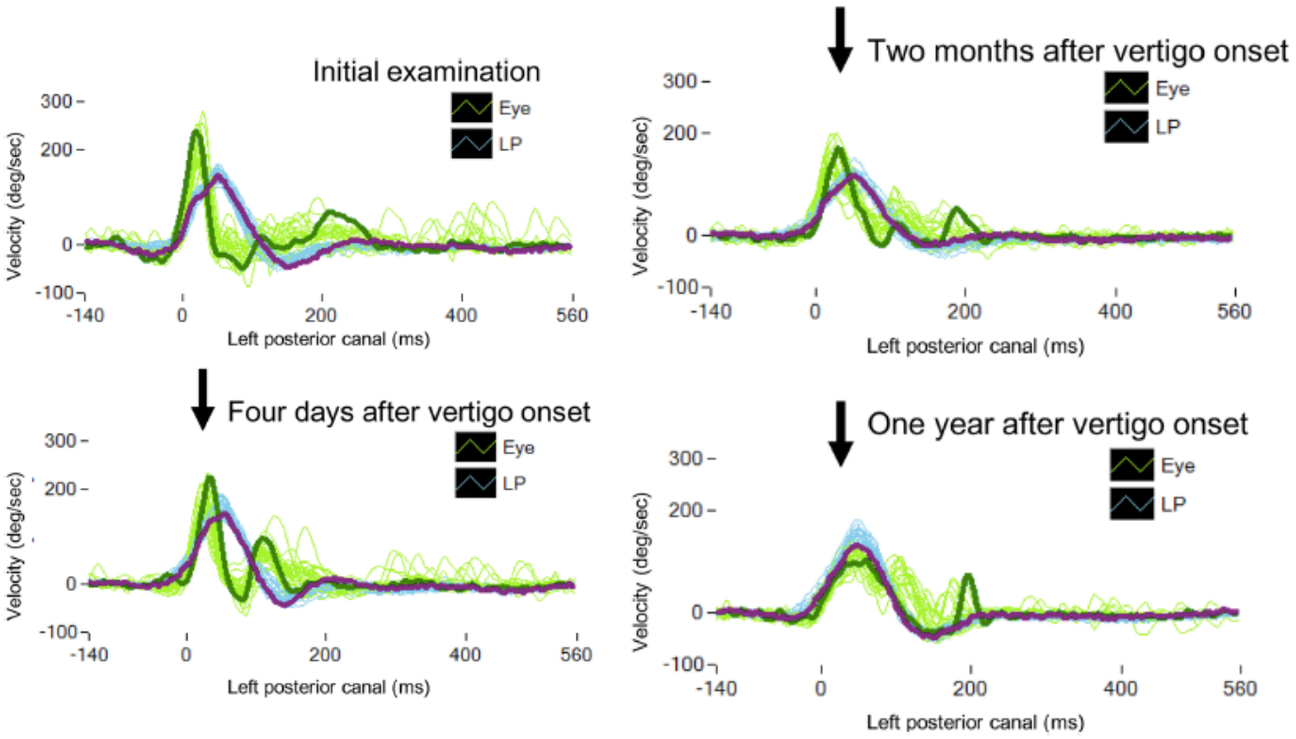
Video head impulse test (vHIT) in migraine dizziness

Mayada ElSherif [a, *], Mohamed Ihab Reda [b], Horeya Saadallah [c], Mona Mourad [a]

Table 2
The frequency of saccades depending on the VOR gain in the VM group.

	Frequency	Percent
No saccades	59	73.8
Saccades with normal VOR gain	15	18.8
Saccades with low VOR gain	6	7.5

vHIT in Vestibular Migraine



Journal of Neurology
https://doi.org/10.1007/s00415-018-9088-0

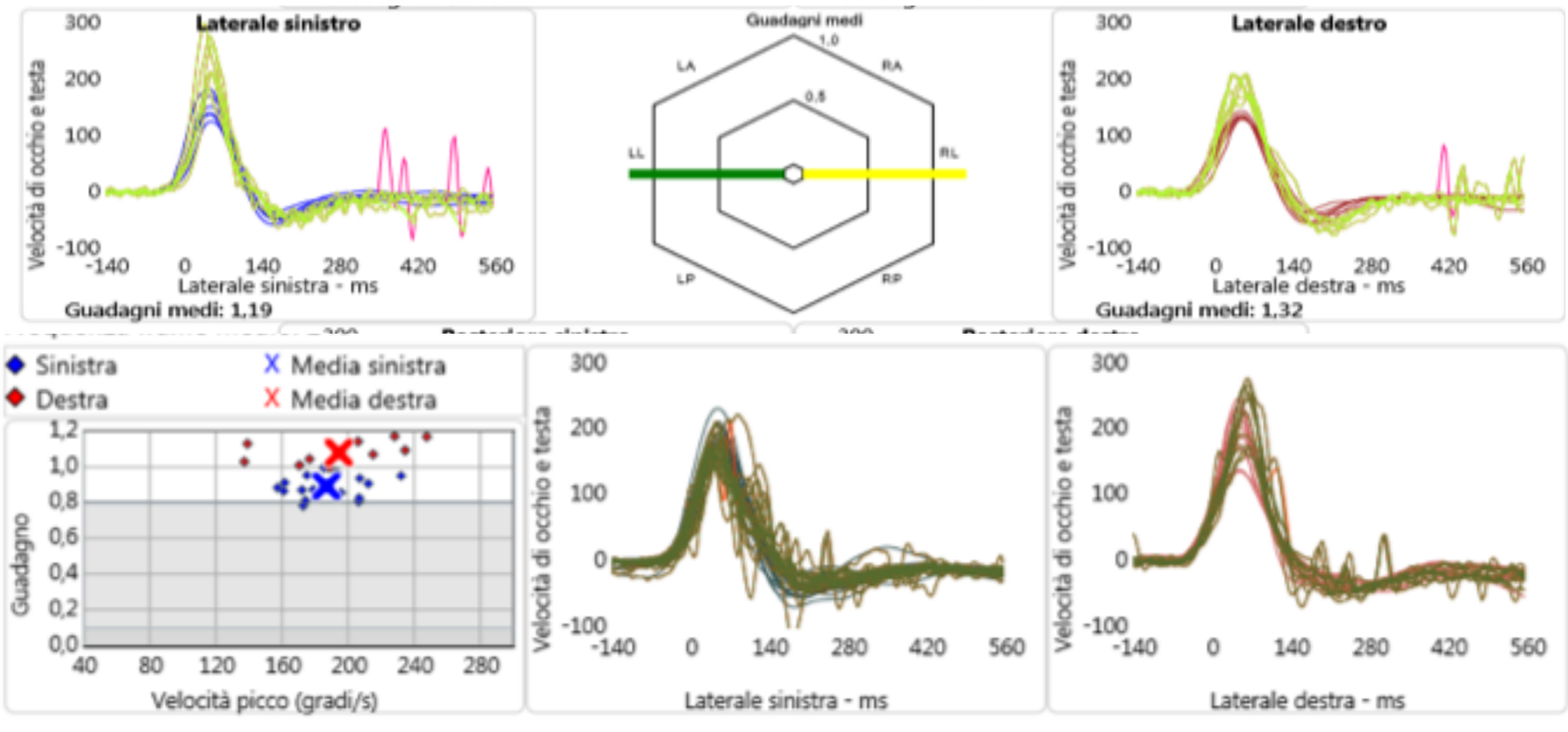
LETTER TO THE EDITORS

Video head impulse findings in the ictal period of vestibular migraine

Seunghee Na[1] · Eek-Sung Lee[2] · Jong Dae Lee[3] · Ki-Bum Sung[2] · Tae-Kyeong Lee[2]

- EAPD: early acceleration and premature deceleration in acute phase
- Overgain

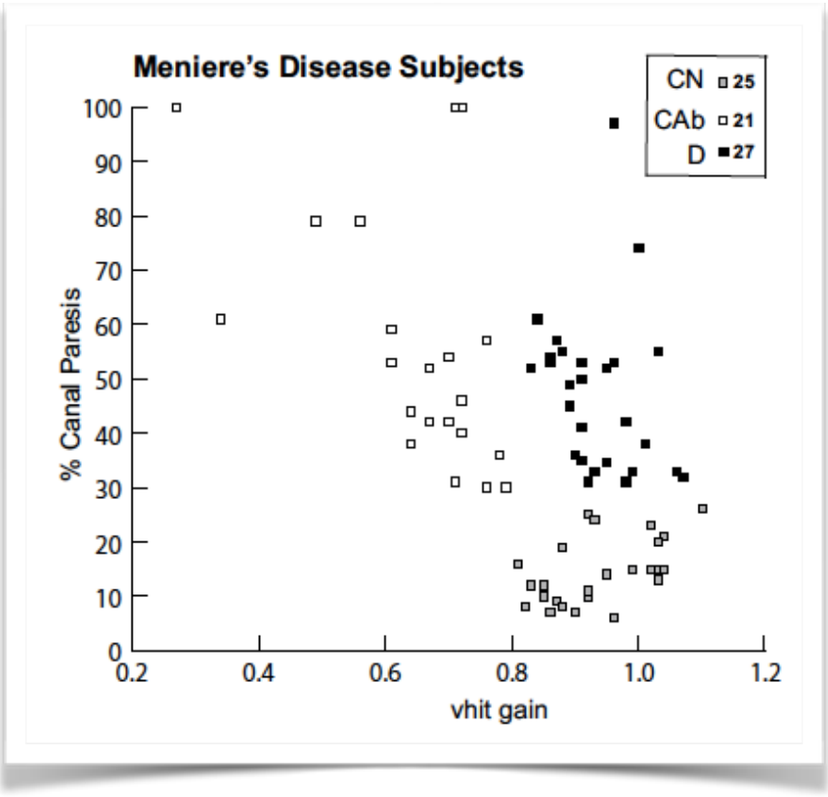
Personal Observation



vHIT in Meniere's Disease

Table 1
Studies of VHIT in Menière's disease.

	Definition of MD (AAO-HNS 1995).	Number of patients	Threshold for normal VHIT gain	Percentage normal VHITs	Percentage of VHITs performed during vertigo episode
Park et al. (2005) [9]	Definite	38	0.74	71%	0%
Blodow et al. (2013) [7]	Not specified	22	0.79	45.5%	0%
Mahringer and Rambold (2014) [8]	Not specified	26	0.8	73% ($n=19$)	27% ($n=7$)
Heuberger et al. (2014) [5]	Possible/probable/ definite	35	0.7	100%	0%
McGarvie et al. (2015) [6]	Definite	22	?	100%	0%
Lee et al. (2017) [10]	Definite	14	0.7 for lateral and anterior semicircular canals 0.74 for posterior	71% (10)	100%
Present study	Definite, on 2015 definition	37	0.64 for vertical semicircular canals 0.78 for lateral	100%	8% ($n=3$)



European Annals of Otorhinolaryngology, Head and Neck diseases 135 (2018) 167–169

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Original article

Comparison of Video Head Impulse Test and Caloric Reflex Test in advanced unilateral definite Menière's disease

F. Rubin[a,b,*], F. Simon[c], B. Verillaud[c], P. Herman[c], R. Kania[c], C. Hautefort[c]

Journal of Neurology
https://doi.org/10.1007/s00415-019-09431-9

REVIEW

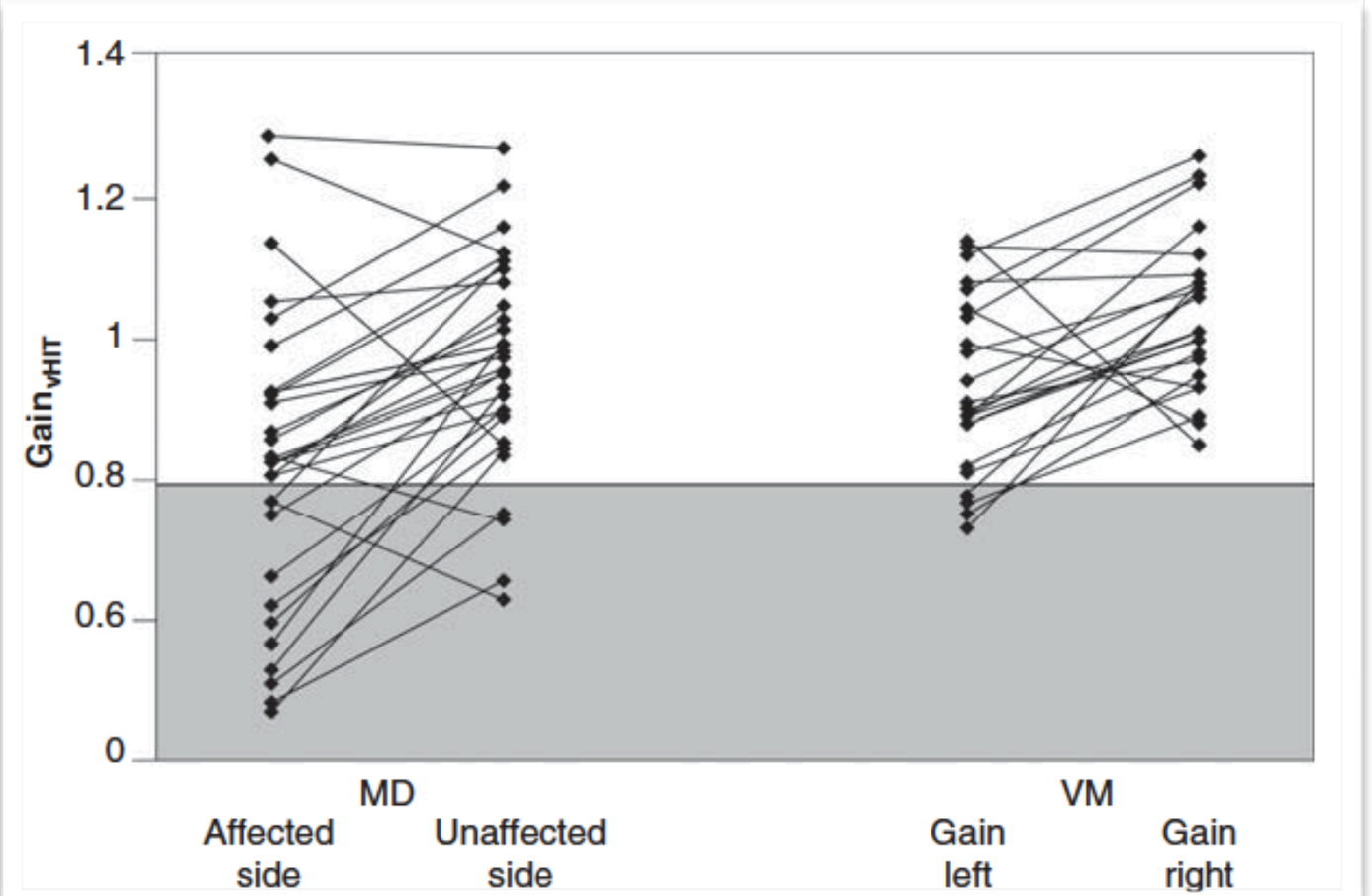
Dissociation of caloric and head impulse tests: a marker of Meniere's disease

I. P. Hannigan[1,2] · M. S. Welgampola[2,3] · Shaun R. D. Watson[1,4]

vHIT in MD and VM

TABLE 3 | Vestibular function tests.

No.	cVEMP AR	500-1,000 Hz cVEMP slope	vHIT	CP% in caloric test
1	**100%**	**−100%**	LAP WNL	Left 2%
2	BAR	**−100%**	L WNL	Left 13%
3	17.6%	**−45.8%**	L WNL	X
4	BAR	NI	X	**Right 44%**
5	19.1%	**−27.8%**	X	Left 5%
6	**100%**	**−100%**	LAP WNL	0%
7	29.4%	**−21.5%**	LAP WNL	X
8	BAR	**−100%**	LAP WNL	Right 6%
9	−26.3%	**−31.5%**	LAP WNL	X
10	25.3%	**−29.20%**	LAP WNL	X



frontiers in Neurology

ORIGINAL RESEARCH
published: 10 September 2018
doi: 10.3389/fneur.2018.00749

Simultaneous Presentation of Definite Vestibular Migraine and Definite Ménière's Disease: Overlapping Syndrome of Two Diseases

Toshihisa Murofushi[1], Masahito Tsubota[1], Kyoko Kitao[1] and Eriko Yoshimura[2]*

Acta Oto-Laryngologica. 2014; 134: 1239–1244

informa healthcare

ORIGINAL ARTICLE

Caloric stimulation and video-head impulse testing in Ménière's disease and vestibular migraine

ALEXANDER BLÖDOW[1], MARGARETE HEINZE[2], MARC BORIS BLOCHING[1], MICHAEL VON BREVERN[3], ANDREA RADTKE[4] & THOMAS LEMPERT[2]

Otology & Neurotology
33:1235–1244 © 2012, Otology & Neurotology, Inc.

Auditory and Vestibular Symptoms and Chronic Subjective Dizziness in Patients With Ménière's Disease, Vestibular Migraine, and Ménière's Disease With Concomitant Vestibular Migraine

*Brian A. Neff, †Jeffrey P. Staab, ‡Scott D. Eggers, *Matthew L. Carlson, *William R. Schmitt, *Kathryn M. Van Abel, *Douglas K. Worthington, *Charles W. Beatty, *Colin L. Driscoll, and *Neil T. Shepard

In this study of consecutive patients evaluated in a tertiary dizziness clinic, 28% of patients diagnosed with MD also had VM and 23% of patients with VM also had MD. An additional 31% of MD patients had migrainous features in their clinical histories, but did not fulfill all diagnostic criteria for VM. An additional 8% of VM patients had hearing loss that required some effort to recognize as inconsistent with MD. How these patients are

TABLE 5. *Demographics, audiovestibular symptoms, family history, and self-ratings by diagnostic group*

	Disease			*p* value			Sensitivity and specificity			Sensitivity index (d')		
Variable	VM (n = 71)	MDVM (n = 21)	MD (n = 55)	VM versus MD	VM versus MDVM	MDVM versus MD	VM	MDVM	MD	VM	MDVM	MD
Demographic data												
Race (Caucasian)	62 (87%)	19 (90%)	49 (89%)	0.76	0.7	0.9	NA	NA	NA	NA	NA	NA
Sex (female)	59 (83%)	12 (57%)	19 (35%)	**<0.0001**	**0.013**	0.07	83%/59%	57%/38%	35%/23%	1.182	−0.129	−1.124
Age onset (yr)	41	42	51	**0.0007**	0.71	0.07	NA	NA	NA	NA	NA	NA
Illness duration	6 months	1 year	1 year	**<0.0001**	**0.007**	0.338	NA	NA	NA	NA	NA	NA
Vestibular symptoms												
Vertigo duration (h)	19 (38%)	14 (70%)	47 (90%)	**<0.0001**	**0.04**	0.09	38%/15%	70%/36%	90%/53%	−1.342	0.166	1.357
Unsteadiness	49 (92%)	16 (100%)	44 (86%)	0.31	0.26	0.11	92%/10%	100%/11%	86%/6%	0.124	1.1	−0.474
Dizziness (nonvertiginous)	38 (78%)	5 (50%)	25 (50%)	**0.0044**	0.07	1	78%/50%	50%/36%	50%/27%	0.772	−0.358	−0.613
Auditory symptoms												
Fluctuating HL	9 (14%)	13 (62%)	43 (78%)	**<0.0001**	**<0.0001**	0.14	14%/26%	62%/57%	78%/75%	−1.724	0.482	1.447
Progressive HL	14 (22%)	18 (86%)	51 (93%)	**<0.0001**	**<0.0001**	0.34	22%/9%	86%/46%	93%/63%	−2.113	0.98	1.808
Tinnitus	37 (55%)	18 (86%)	53 (96%)	**<0.0001**	**0.014**	0.09	55%/7%	86%/26%	96%/38%	−1.35	0.437	1.445
Aural fullness	33 (51%)	14 (67%)	43 (78%)	**0.0026**	0.227	0.3	51%/25%	67%/37%	78%/45%	−0.649	0.108	0.647
Otalgia	17 (27%)	4 (24%)	9 (17%)	0.09	0.75	0.4	27%/82%	24%/78%	17%/73%	0.303	0.066	−0.341
Hearing loss related to vertigo	8 (44%)	4 (22%)	21 (43%)	0.91	0.16	0.12	44%/63%	22%/55%	43%/67%	0.181	−0.647	0.264
Tinnitus related to vertigo	13 (50%)	7 (39%)	27 (59%)	0.47	0.47	0.15	50%/47%	39%/44%	59%/55%	−0.075	−0.43	0.353
Aural fullness related to vertigo	16 (70%)	7 (50%)	24 (65%)	0.71	0.23	0.33	70%/39%	50%/33%	65%/47%	0.245	−0.44	0.31
Family history												
Family history of vertigo/dizziness	16 (30%)	10 (56%)	7 (17%)	0.16	**0.04**	**0.002**	30%/72%	56%/76%	17%/63%	0.058	0.857	−0.622
Family history of hearing loss	11 (25%)	8 (44%)	13 (33%)	0.74	0.19	0.35	25%/64%	44%/73%	33%/69%	−0.316	0.462	0.056
Other												
Mean DHI score	51	40	41	**0.02**	**0.03**	0.76	NA	NA	NA	NA	NA	NA
HADS (abnormal)	32 (48%)	6 (32%)	22 (45%)	0.58	0.11	0.26	48%/59%	32%/53%	45%/56%	0.177	−0.392	0.025
Comorbid CSD	29 (41%)	1 (5%)	2 (4%)	**<0.0001**	**0.002**	0.82	41%/96%	5%/75%	4%/76%	1.52	−0.97	−1.044

Gray shaded boxes mark variables with statistical significance ($p < 0.05$) in the 3-way multivariate logistical regression analysis; bold *p* values are significant in bivariate analysis.
CSD indicates chronic subjective dizziness; DHI, Dizziness Handicap Index; HADS, Hospital anxiety and depression scale.

MD, VM, AND CSD

TABLE 7. *Physical examination and laboratory test results by diagnostic group*

Variable	Disease			*p* value			Sensitivity and specificity			Sensitivity index (d')		
	VM (n = 71)	MDVM (n = 21)	MD (n = 55)	VM versus MD	VM versus MDVM	MDVM versus MD	VM	MDVM	MD	VM	MDVM	MD
Physical examination												
Headshake nystagmus (abnormal)	9 (15%)	14 (70%)	28 (62%)	**<0.0001**	**<0.0001**	0.55	15%/35%	70%/65%	62%/71%	−1.42	0.91	0.86
Head thrust (abnormal)	2 (3%)	6 (29%)	16 (37%)	**<0.0001**	**0.0017**	0.3	3%/66%	29%/83%	37%/89%	−1.47	0.40	0.90
Nystagmus with mastoid vibration (abnormal)	7 (12%)	7 (35%)	25 (60%)	**<0.0001**	**0.03**	0.17	12%/48%	35%/68%	60%/82%	−1.23	0.08	1.17
Smooth pursuit (abnormal)	5 (8%)	3 (14%)	2 (5%)	0.09	0.43	0.18	8%/92%	14%/93%	5%/90%	0	0.40	−0.36
Saccades (abnormal)	0 (0%)	1 (5%)	2 (5%)	0.46	0.09	0.98	0%/95%	5%/98%	5%/99%	−0.68	0.41	0.68
Vestibular testing												
Mean caloric asymmetry (%)	13%	30%	33%	**<0.0001**	**0.02**	0.75	NA	NA	NA	NA	NA	NA
Caloric asymmetry (abnormal)	12 (17%)	12 (63%)	37 (69%)	**<0.0001**	**0.0001**	0.67	17%/33%	63%/60%	69%/73%	−1.39	0.59	1.11
Mean directional prep. (%)	13%	21%	19%	0.09	0.11	0.58	NA	NA	NA	NA	NA	NA
Directional prep. (abnormal)	5 (15%)	6 (46%)	13 (29%)	0.15	**0.03**	0.24	15%/67%	46%/77%	29%/76%	−0.60	0.64	0.15
Rotary chair phase (abnormal)	5 (18%)	8 (47%)	34 (68%)	**<0.0001**	**0.04**	0.12	18%/37%	47%/50%	68%/71%	−1.25	-0.08	1.02
Rotary chair gain (0.01 Hz)	0.36	0.28	0.25	**<0.0001**	**0.03**	0.48	NA	NA	NA	NA	NA	NA
Rotary chair symmetry (abnormal)	8 (29%)	2 (12%)	18 (35%)	**0.02**	0.91	0.07	29%/71%	12%/67%	35%/78%	0	−0.74	0.39
Rotary chair summary (abnormal)	8 (29%)	8 (47%)	41 (82%)	**<0.0001**	0.21	**0.005**	29%/27%	47%/37%	82%/64%	−1.17	−0.41	1.27
Posturography (SOT composite)	16 (27%)	5 (33%)	21 (42%)	0.1	0.1	0.69	27%/60%	33%/66%	42%/72%	−0.36	−0.03	0.38
VEMP (abnormal)	9 (16%)	8 (57%)	14 (45%)	**0.0068**	**0.03**	0.46	16%/51%	57%/74%	45%/76%	−0.97	0.82	0.58
Audiometry												
PTA ≥ 25 dB initial	10 (7%)	19 (83%)	50 (83%)	**0.0011**	**0.0001**	0.3	7%/17%	83%/69%	83%/82%	−2.43	1.45	1.87
PTA ≥ 25 dB worst	12 (9%)	24 (100%)	60 (100%)	**<0.0001**	**<0.0001**	0.79	9%/0%	100%/63%	100%/78%	−3.67	2.66	3.10
Discrimination ≤85% initial	3 (2%)	14 (61%)	37 (63%)	**<0.0001**	**0.015**	0.21	2%/38%	61%/79%	63%/89%	−2.36	−0.80	1.56
Discrimination ≤85% worst	3 (2%)	19 (86%)	51 (86%)	**<0.0001**	**<0.0001**	0.52	2%/14%	86%/72%	86%/86%	−3.13	1.66	2.16
Change in discrimination (%/month—mean ± standard deviation)	0.02 ± 0.14	−0.48 ± 3.7	0.6 ± 2.0	**0.0002**	0.31	0.88	NA	NA	NA	NA	NA	NA
Hearing class (initial class B–D)	6 (5%)	20 (83%)	42 (71%)	**<0.0001**	**<0.0001**	0.57	5%/25%	83%/74%	71%/83%	−2.32	1.60	1.51
Hearing class (worst class B–D)	8 (6%)	23 (96%)	56 (95%)	**<0.0001**	**<0.0001**	0.52	6%/5%	96%/66%	95%/79%	−3.20	2.16	2.45
Hearing loss pattern (low tone)	0 (0%)	10 (42%)	24 (40%)	**<0.001**	**<0.0001**	0.32	0%/60%	42%/82%	40%/71%	−2.84	0.71	0.3

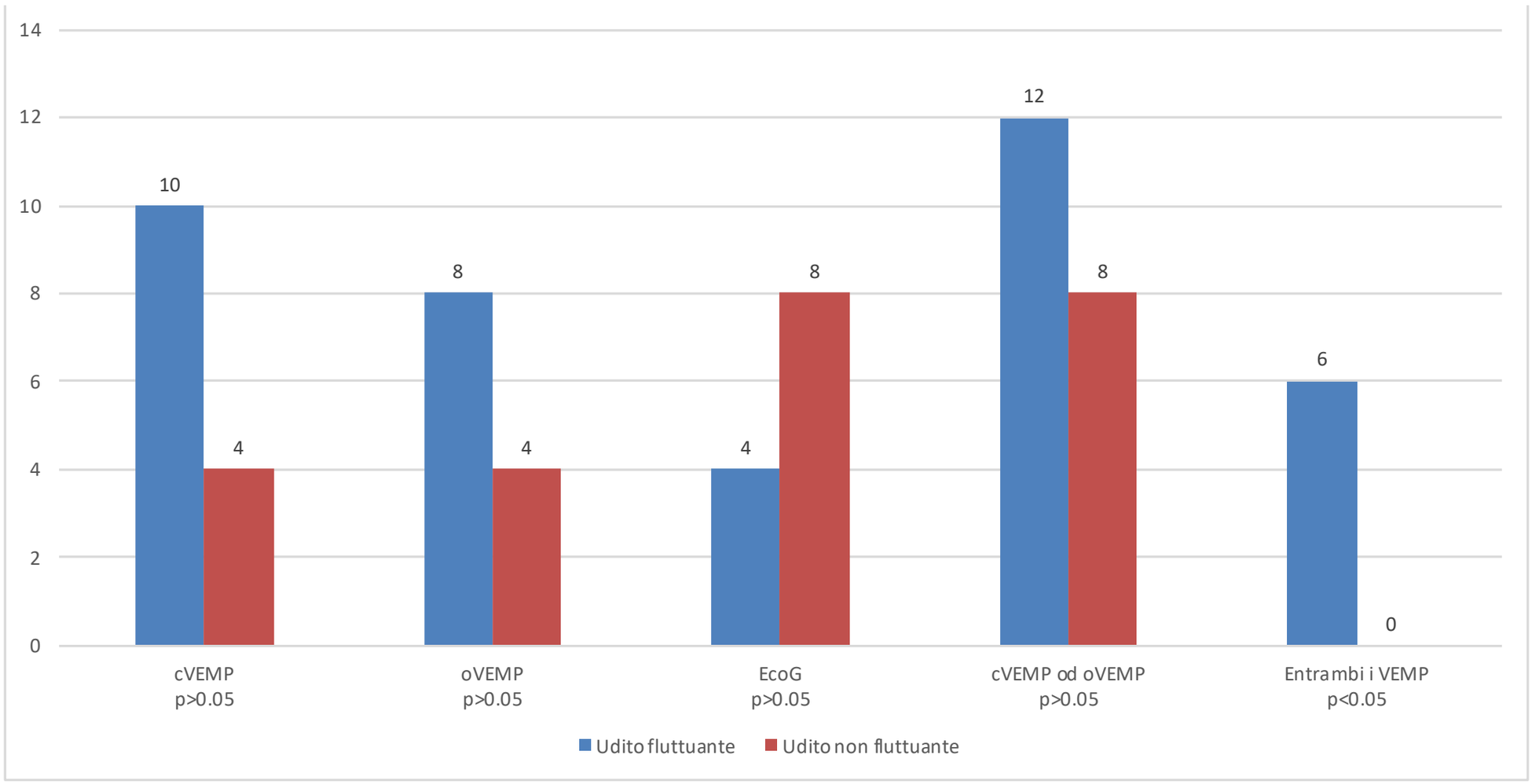
Gray shaded boxes mark variables with statistical significance ($p < 0.05$) in the 3-way multivariate logistical regression analysis; bold p values are significant in bivariate analysis.
Disc. indicates word discrimination score; NA, not applicable; PTA, pure tone average (500, 1,000, 2,000, and 3,000 Hz); SOT, sensory organization test; VEMP, vestibular evoked myogenic potential.

ing previously reported (2,22). A history of fluctuating hearing loss and progressive hearing loss was reported by 14% and 22% of VM patients, respectively, even though audiograms failed to show hearing loss that met MD criteria. If we consider all patients with VM including those with MDVM, then the rate of subjective fluctuating hearing loss and progressive hearing loss increases to 24% (22/92) and 35% (32/92), respectively.

helpful as a distinguishing tool. Perhaps emerging diagnostic modalities such as the ocular VEMP, cervical vestibular evoked myogenic potentials tuning curves, and intratympanic gadolinium enhanced MRI scans will be better for VM, MDVM, and MD categorization. Electrocochleography may be another measure to consider, but its low sensitivity and specificity for MD alone limits its potential (44).

Development of fluctuating hearing loss in Vestibular Migraine patients (2 years of follow-up)

- Asymmetry of both c-VEMPs and o-VEMPs were significantly related to development of fluctuating hearing in VM patients

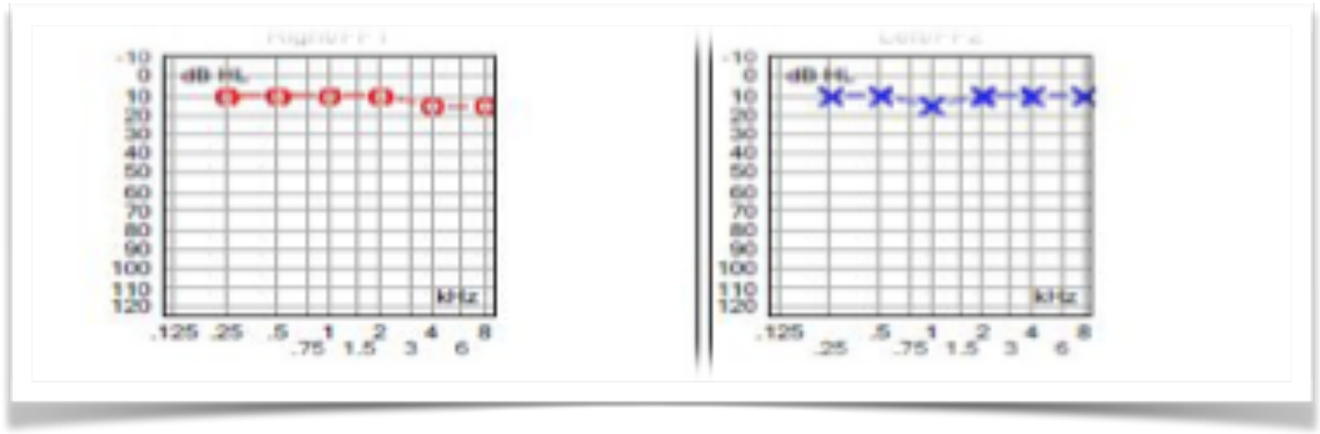


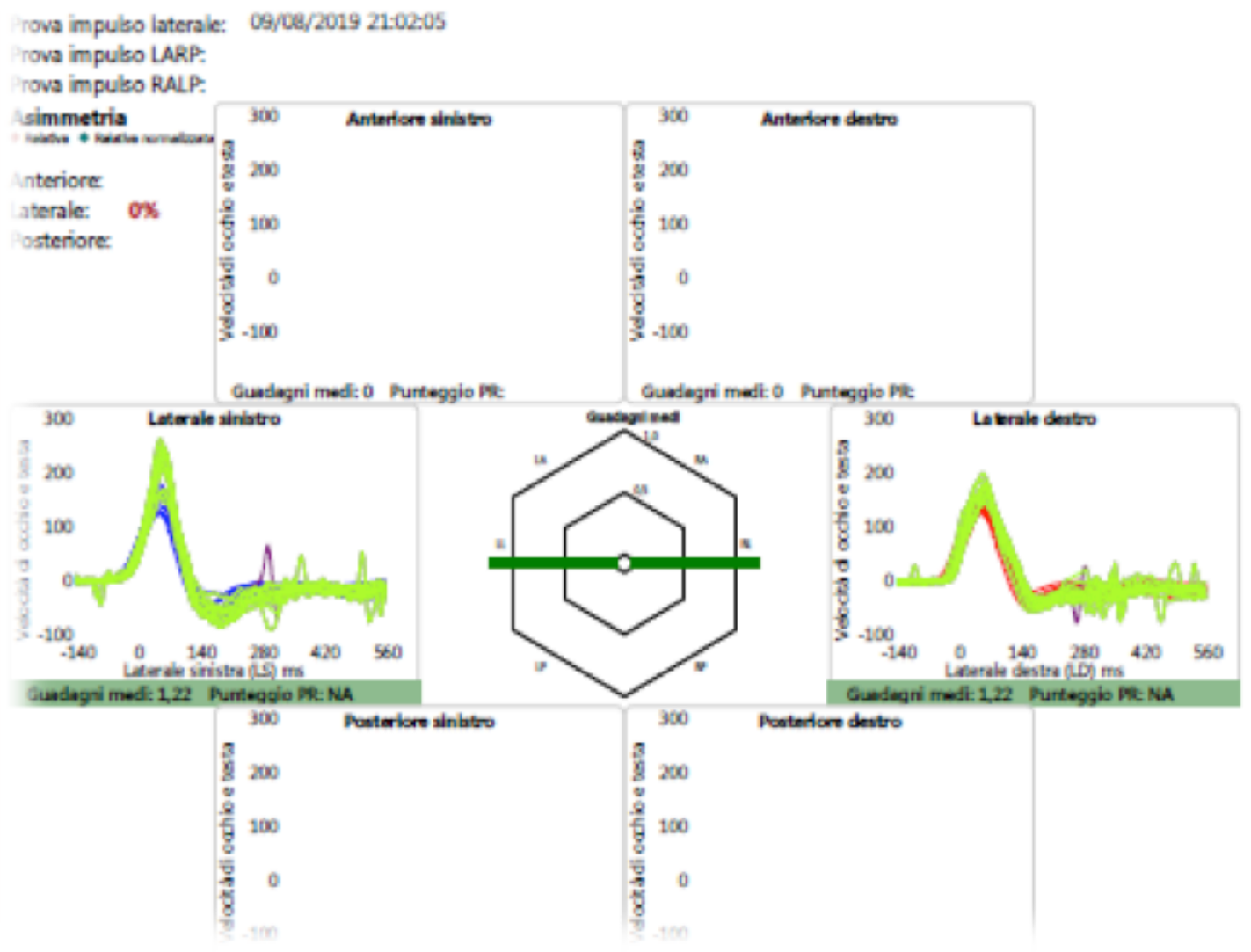
12/30 patients developed SP/AP > 40 at ECochG

Clinical Reports

Case 1

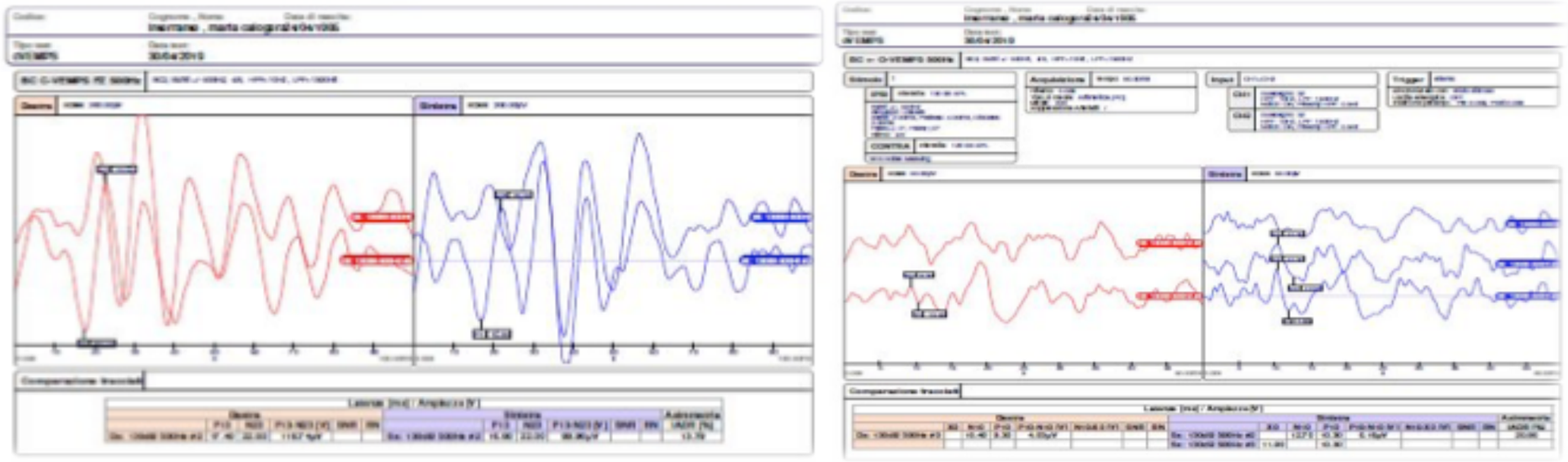
- female 34 years-old
- history of migraine headache
- dizziness and unsteadiness
- one year later: fullness, tinnitus and persistent dizziness
- any hearing loss or others neurologic symptoms
- Definite Vestibular Migraine





- vHIT bilateral overgain with left EA

Case 1



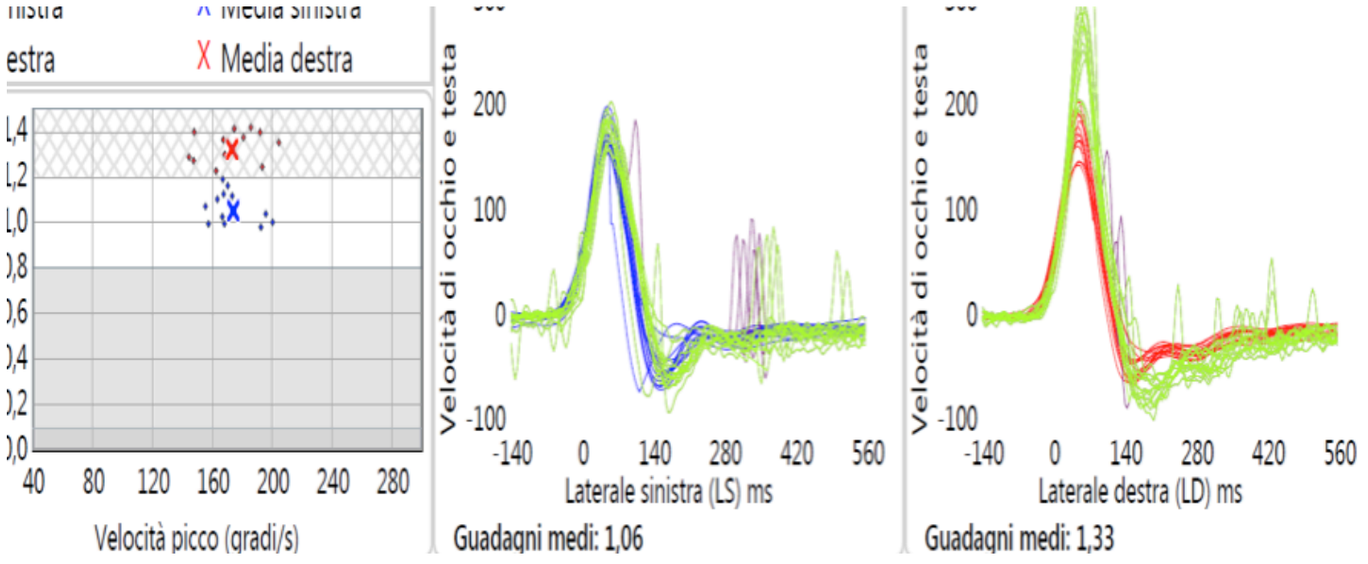
- Normal VEMPs without asymmetry

- ECochG: SP/AP ratio **47**

Case 2

- female 54 years-old
- history of migraine headache with visual aura
- familiar history of migraine (mother)
- dizziness and unsteadiness
- in the last year: vertigo spells (>20 min) with nausea and vomiting

- Normal VEMPs without asymmetry
- Normal pure tone audiometry



- vHIT right overgain with EA

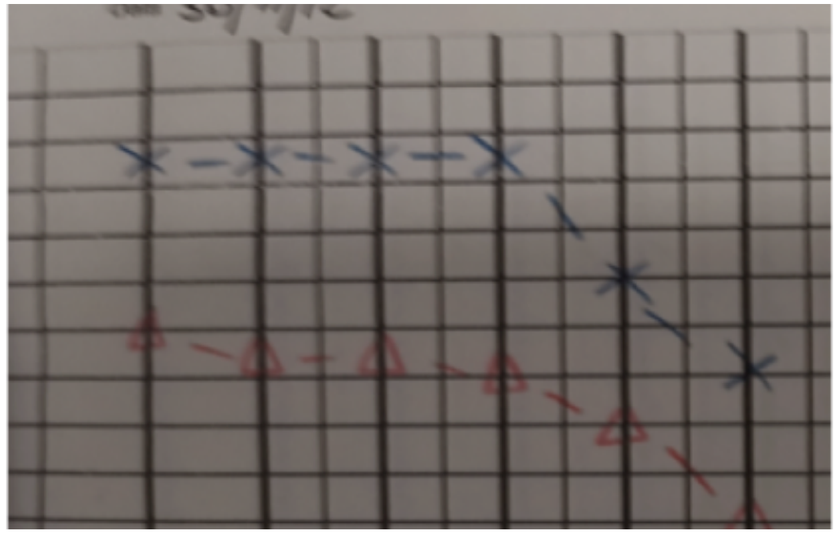
Case 2

- ECochG: SP/AP ratio **70**

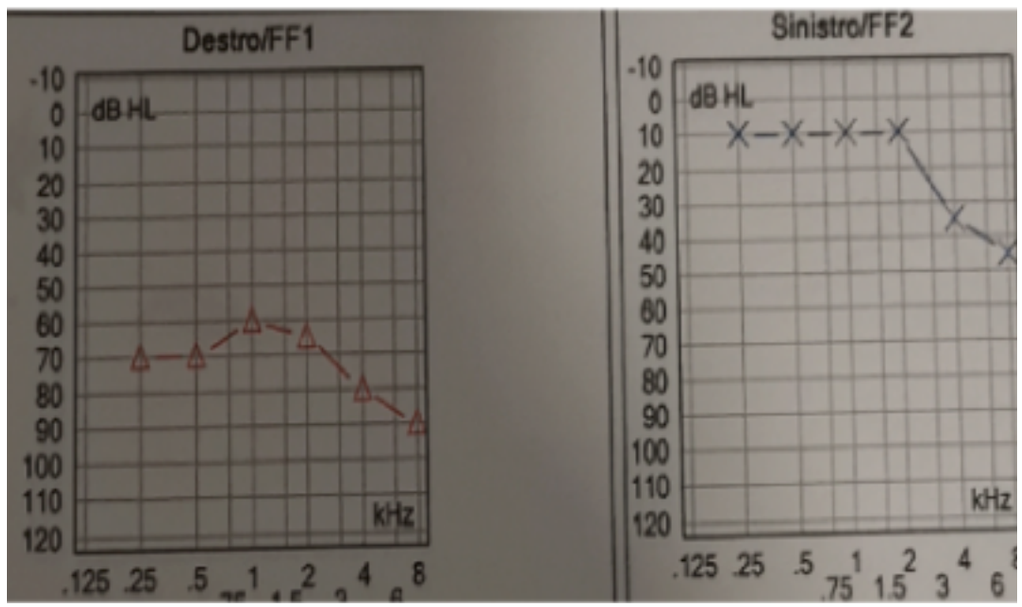
Case 3

- male 44 years-old
- familiar history of migraine (mother)
- Migraine headache since adolescence
- progressive Right hearing loss with intractable vertigo in 2012
- Right Intratympanic Gentamicin in 2016 with regression of symptoms and invariate hearing

- Normal VEMPs without asymmetry
- Normal vHIT



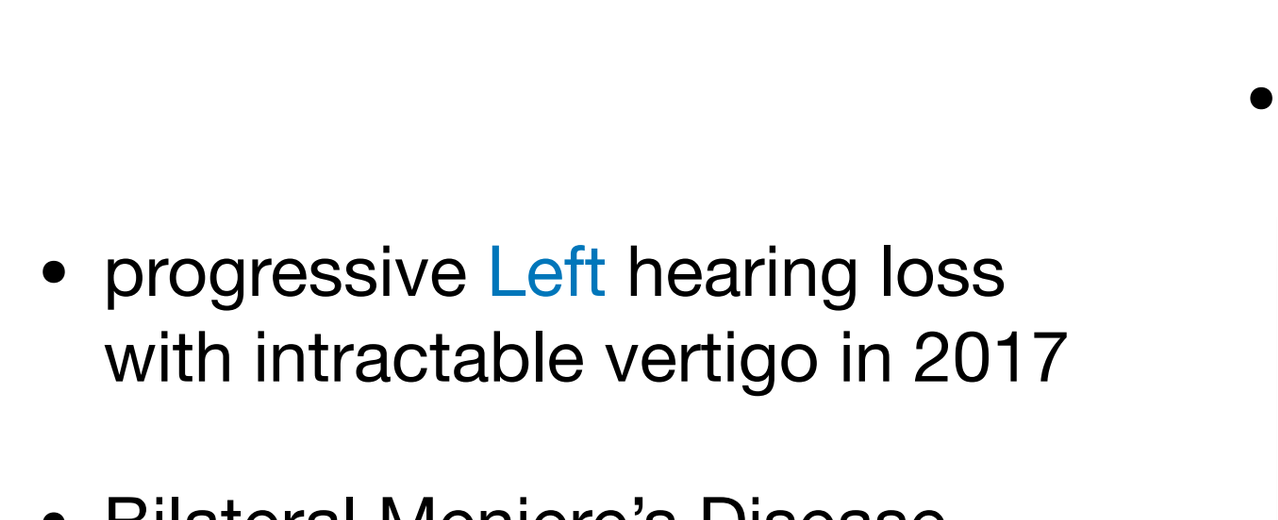
2012



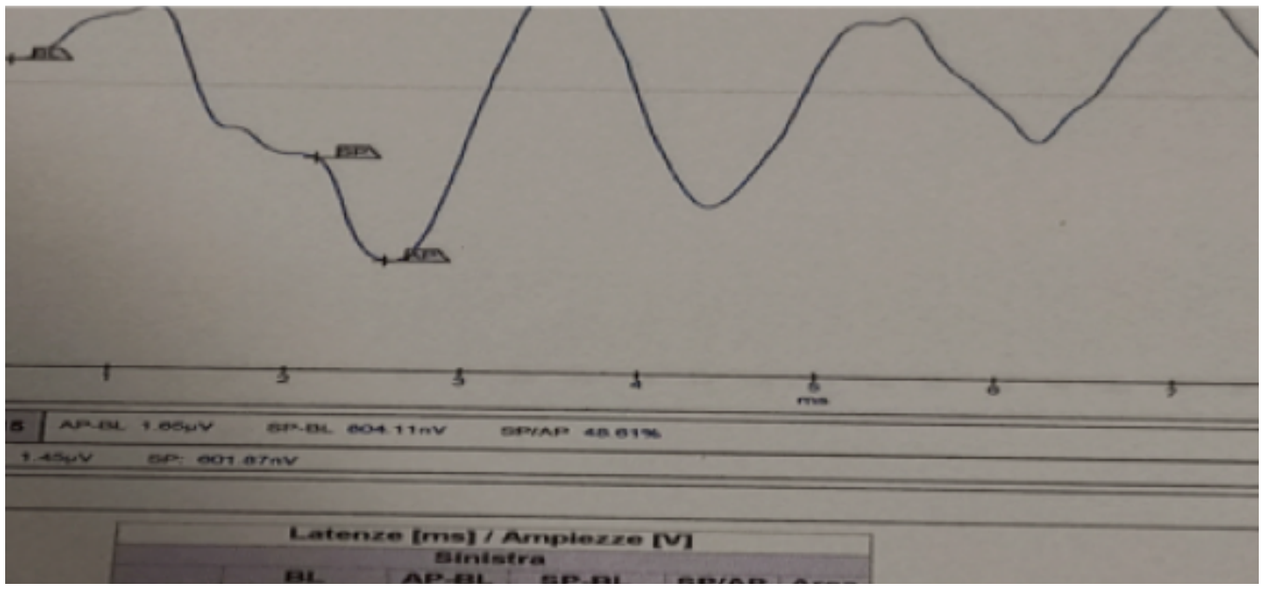
2016

Case 3

- progressive Left hearing loss with intractable vertigo in 2017
- Bilateral Meniere's Disease
- Responsive to medical treatment to date



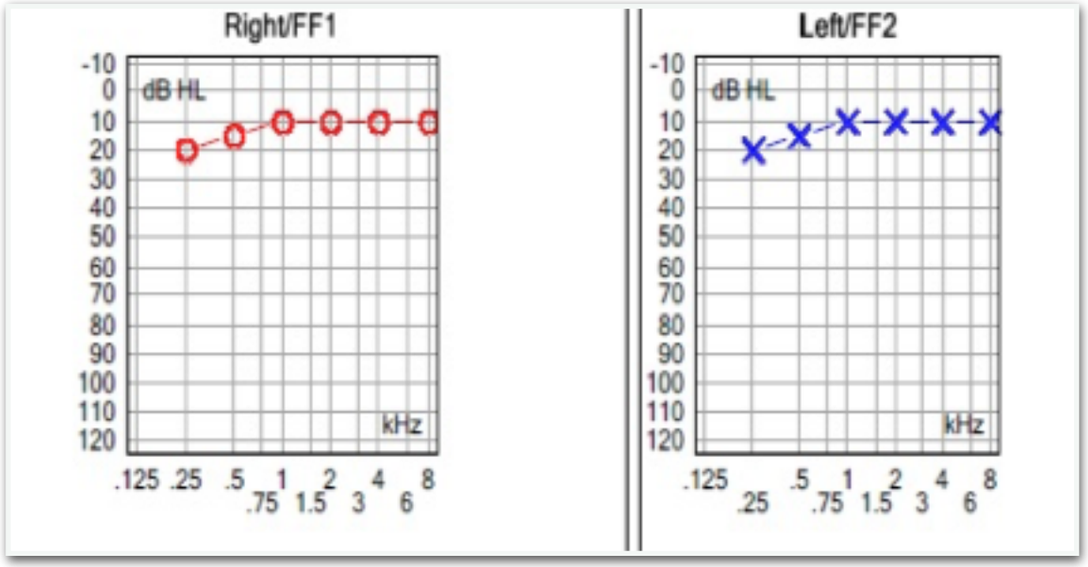
- Normal VEMPs without asymmetry
- Normal vHIT



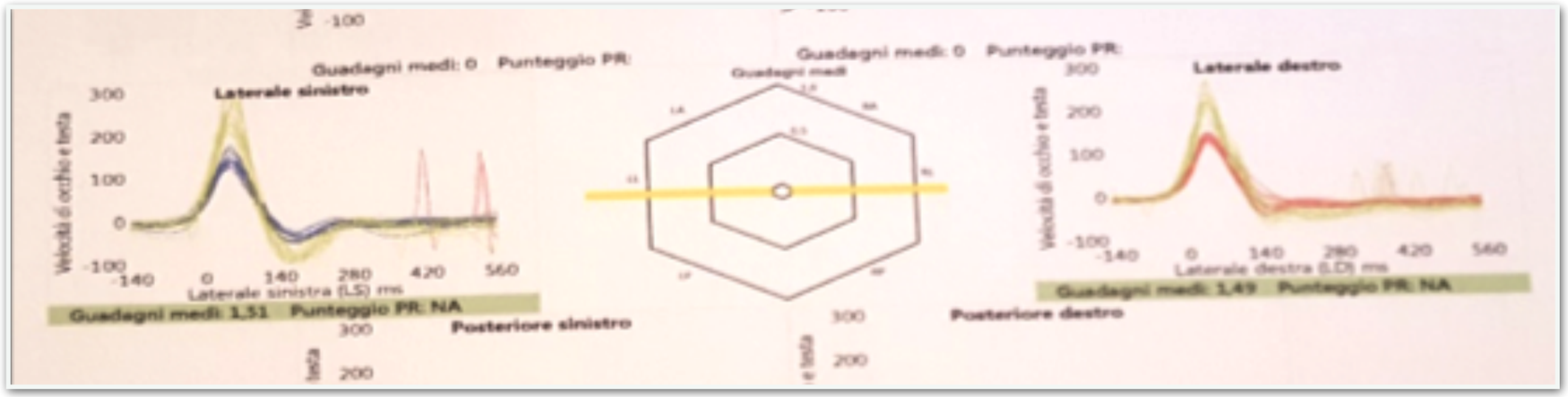
- ECochG: SP/AP ratio **55**

Case 4

- female 25 years-old
- familiar history of migraine (mother)
- Migraine headache with visual aura since 2 years
- symptoms worsening during menstrual cycle
- motion sickness
- postural dizziness

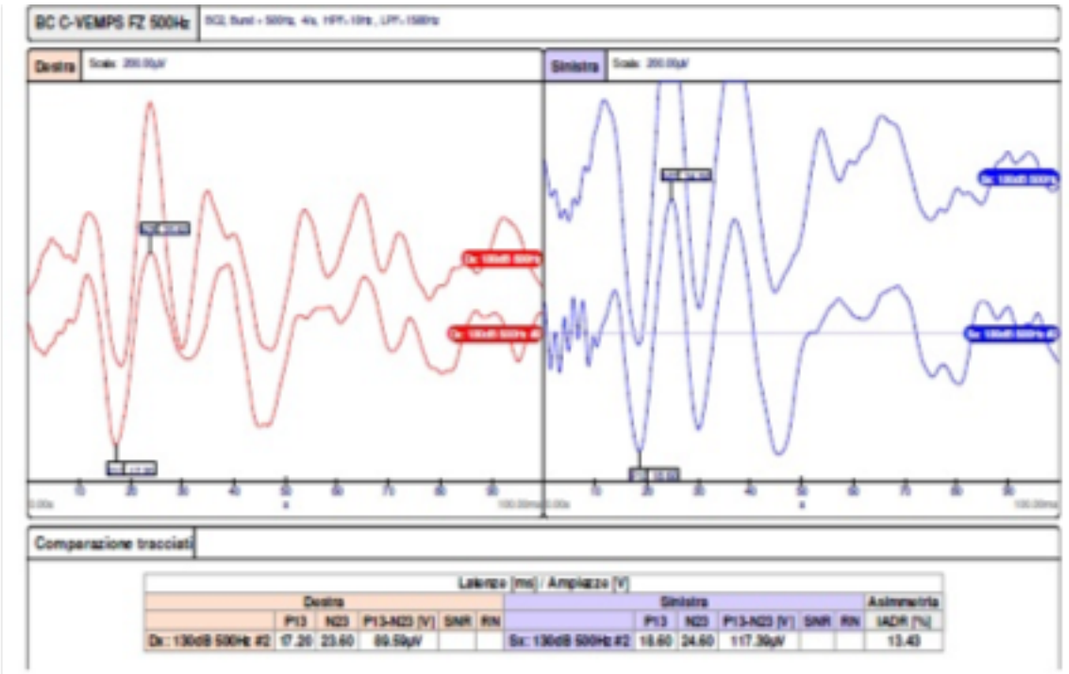


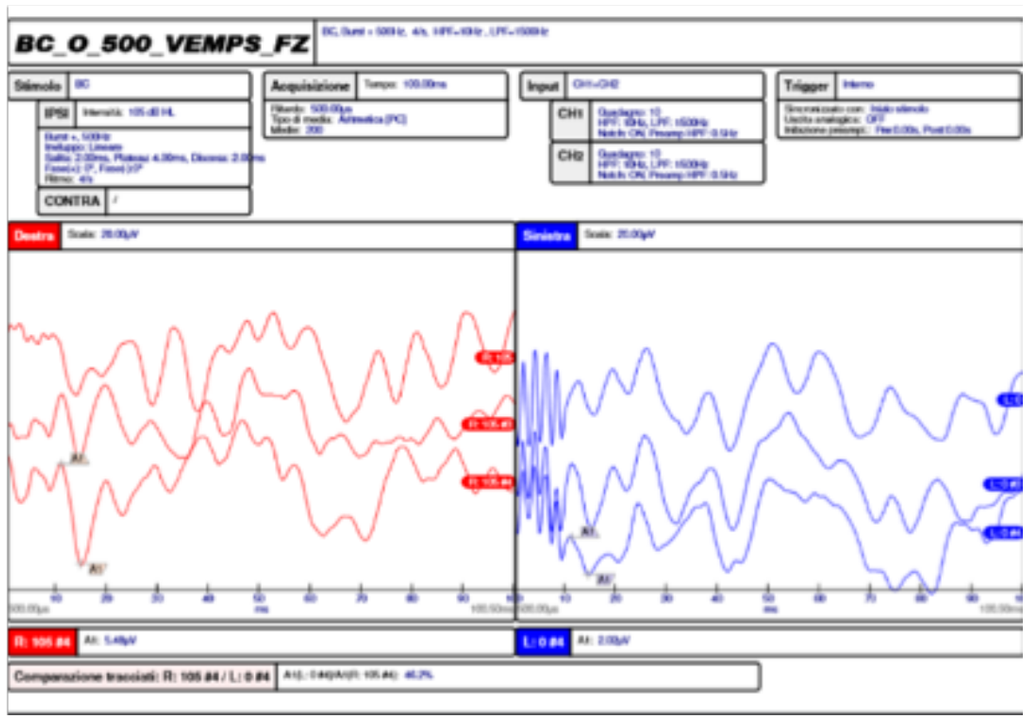
- Normal PTA
- vHIT bilateral overgain with right EA



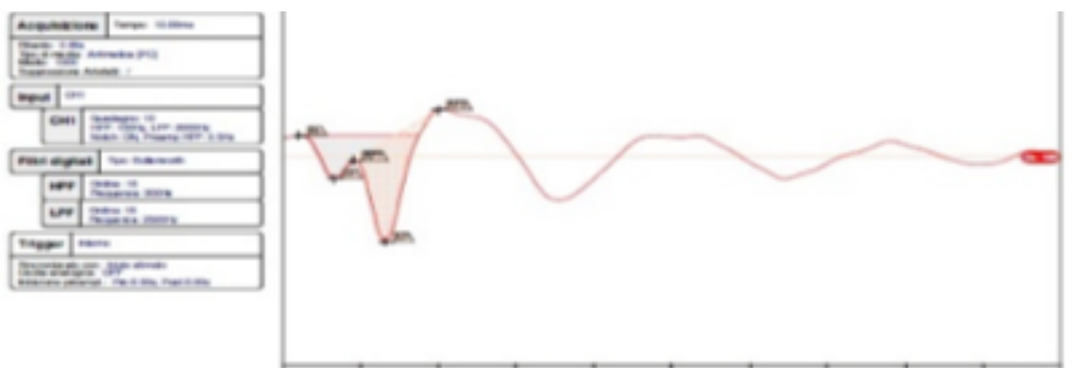
Case 4

- treatment with diet restriction (histamine) and triptan
- after one year of treatment vertigo spells (>30 minutes) with nausea and vomiting
- right tinnitus and fullness



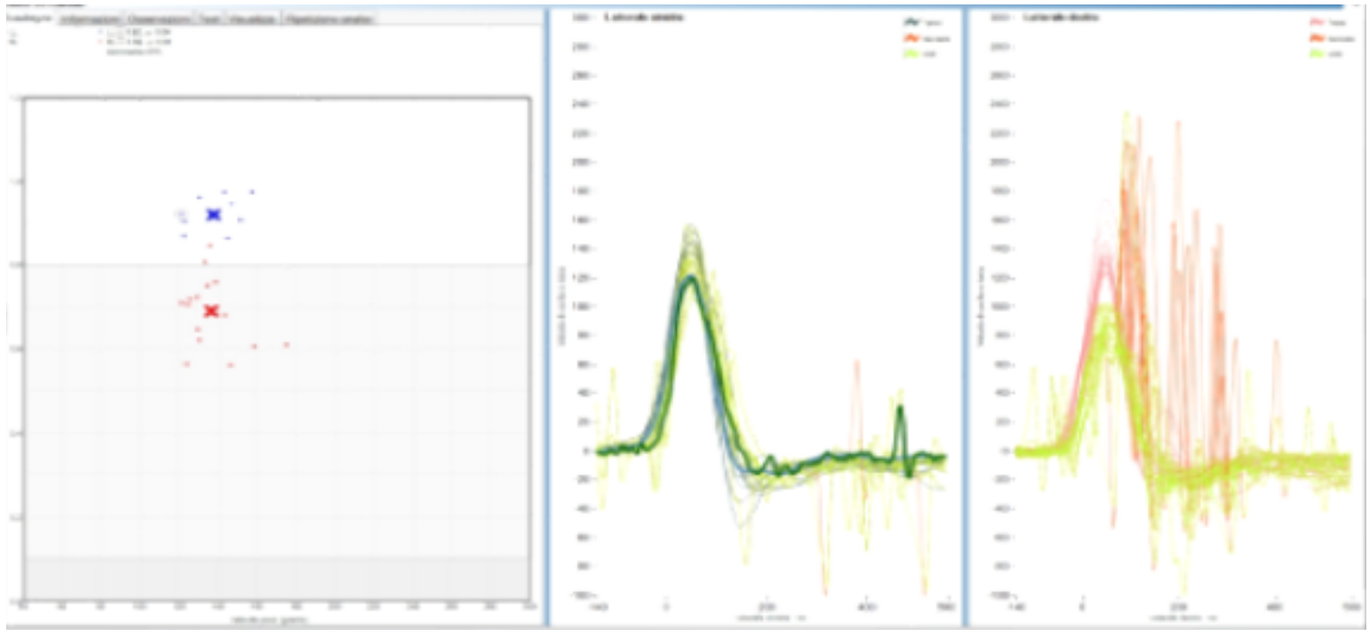


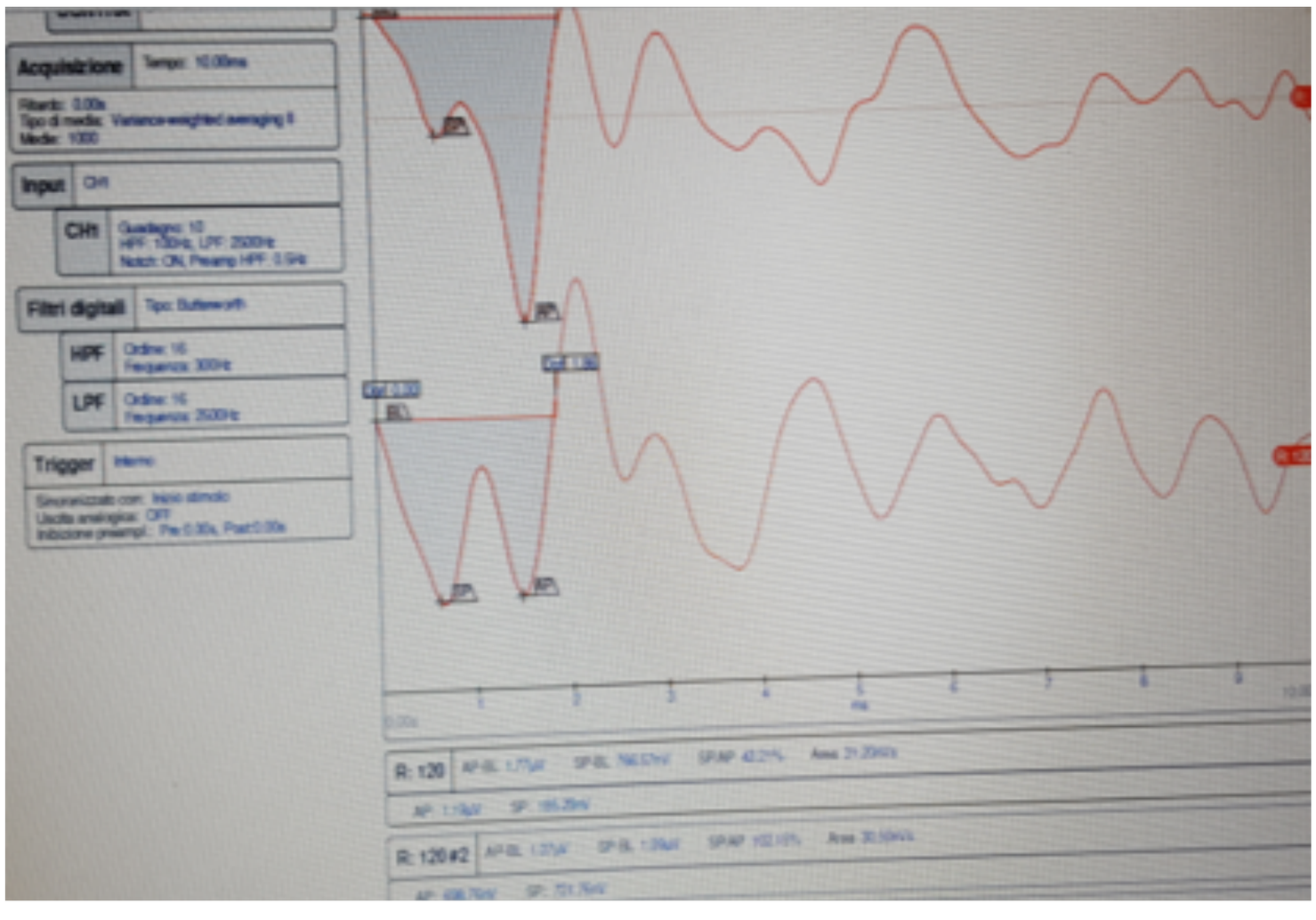
- Normal c-VEMPs
- Asymmetryc o-VEMPs **47%**
- ECochG SP/AP **45**



Case 4

- Sudden access to our clinic in acute phase of vertigo spell





First ECochG

20’ later

Conclusions

- An overlap between MD and VM is a clinical entity that may be considered as a separate disease
- MD patients may have migraine symptoms in their history
- VM patients may develop MD in their course of disease
- Efforts must be done to find the pathophysiologic bases of such disease
- A more strictly classification of both diseases should be reduce the numbers of “undefined” diagnosis
- A personalized treatment is desirable in patients with overlapping syndrome

Cathedral of Palermo, Sicily