

12th Annual Otolaryngology Literature Update

Otology I

Habib G. Rizk, M.D., MSc

Associate Professor

Director, Vestibular Program

Department of Otolaryngology - Head & Neck Surgery

Medical University of South Carolina

rizkh@musc.edu

Habib G. Rizk, M.D., MSc grew up in Beirut-Lebanon. He attended the French Faculty of Medicine-Saint Joseph University in Beirut Lebanon and pursued an Otolaryngology – Head & Neck Surgery residency at Hôtel-Dieu de France Hospital in Beirut followed by a one-year Otologic Medicine and Surgery Fellowship under the mentorship of Dr. Michael Teixido and a two-year Neurotology fellowship at the Medical University of South Carolina.

Dr. Rizk's interests pertain to all areas of otology and neurotology with a specific focus on medical and surgical management of vestibular disorders. He is an associate professor in the MUSC department of Otolaryngology, Head & Neck Surgery, and is the Director of the Multidisciplinary Vestibular Program.

Dr. Rizk is currently the president of the Vestibular Disorders Association (VeDA). He is a member of the Bárány society and a fellow of the American Neurotology Society. He is also a member of the American Balance Society and of the Otology and Neurotology Education Committee of the American Academy of Otolaryngology-Head and Neck Surgery.

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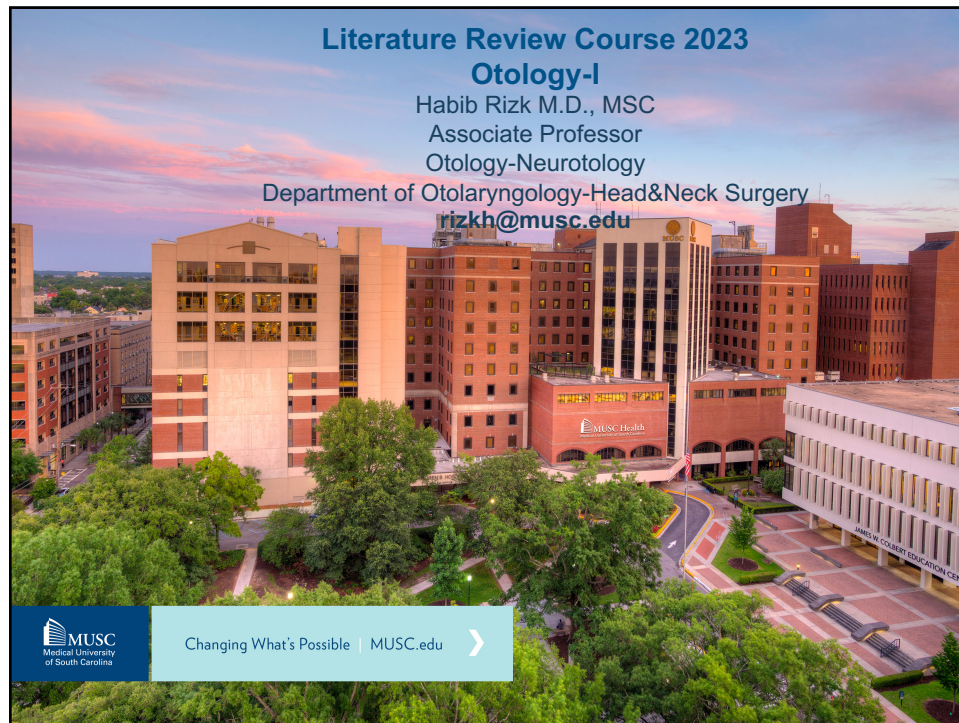
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Literature Review Course 2023

Otology-I

Habib Rizk M.D., MSC

Associate Professor

Otology-Neurotology

Department of Otolaryngology-Head&Neck Surgery

rizkh@musc.edu



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Barany Society articles

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Acute unilateral vestibulopathy/vestibular neuritis: Diagnostic criteria

Consensus document of the committee for the classification of vestibular disorders of the Bárány Society

Michael Strupp^{a,*}, Alexandre Bisdorff^b, Joseph Furman^c, Jeremy Hornibrook^d, Klaus Jahn^e,
Raphael Maire^f, David Newman-Toker^g and Måns Magnusson^h

^aDepartment of Neurology and German Center for Vertigo and Balance Disorders, Hospital of the Ludwig Maximilians University, Munich, Marchioninistrasse, Munich, Germany

^bClinique du Vertige, Centre Hospitalier Emile Mayrisch, Esch-sur-Alzette, Luxembourg

^cDepartment of Otolaryngology, Neurology, Bioengineering and Physical Therapy, University of Pittsburgh, Pittsburgh, Pennsylvania, USA

^dDepartments of Otolaryngology - Head and Neck Surgery, Christchurch Hospital, University of Canterbury and University of Otago, Christchurch, New Zealand

^eDepartment of Neurology, Schoen Clinic Bad Aibling, Bad Aibling, Germany and German Center for Vertigo and Balance Disorders, Ludwig-Maximilians University, Campus Grosshadern, Munich, Germany

^fDepartment of Otorhinolaryngology/Head & Neck Surgery, Lausanne University Hospital, Lausanne, Switzerland

^gOphthalmology, Otolaryngology and Emergency Medicine, The Johns Hopkins University School of Medicine, Johns Hopkins Hospital, Baltimore, MD, USA

^hDepartment of Otorhinolaryngology, Lund University, Lund, Sweden



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3.1. Diagnostic criteria for “Acute Unilateral Vestibulopathy”

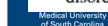
Each of the following criteria have to be fulfilled:

- A) Acute or subacute onset¹ of sustained² spinning or non-spinning vertigo³ (i.e., an acute vestibular syndrome) of moderate to severe intensity⁴ with symptoms lasting for at least 24 hours^{5,6}
- B) Spontaneous peripheral vestibular nystagmus⁷ i.e., a nystagmus with a trajectory appropriate to the semicircular canal afferents involved, generally horizontal-torsional, direction-fixed⁷, and enhanced by removal of visual fixation^{7,8}.
- C) Unambiguous evidence of reduced VOR function^{10,11,12} on the side opposite the direction of the fast phase of the spontaneous nystagmus
- D) No evidence for acute central neurological symptoms or acute audiological symptoms such as hearing loss or tinnitus¹³ or other otologic symptoms such as otalgia
- E) No acute central neurological signs, namely no central ocular motor or central vestibular signs¹⁴, in particular, no skew deviation¹⁵, no gaze-evoked nystagmus¹⁴, and no acute audiological signs¹⁶
- F) Not better accounted for by another disease or disorder

3.2. Diagnostic criteria for “Acute Unilateral Vestibulopathy in Evolution”

Each of the following criteria have to be fulfilled:

- A) Acute or subacute onset¹ of sustained² spinning or non-spinning vertigo³ (i.e., the acute vestibular syndrome) of moderate to severe⁴ intensity, with continuous symptoms for more than 3 hours, but that have not yet lasted for at least 24 hours⁶
- B) Spontaneous peripheral vestibular nystagmus⁷ which is direction-fixed⁷ and enhanced by removal of visual fixation^{7,8} with a trajectory appropriate to the semicircular canal afferents involved (generally horizontal-torsional)⁹
- C) Unambiguous evidence of reduced VOR function^{10,11,12} on the side opposite the direction of the fast phase of the spontaneous nystagmus.
- D) No evidence for acute central neurological symptoms or acute audiological symptoms such as hearing loss or tinnitus¹³ or other otologic symptoms such as otalgia
- E) No acute central neurological signs, namely no central ocular motor or central vestibular signs¹⁴, in particular, no skew deviation¹⁵, or gaze-evoked nystagmus¹⁴, or acute audiological signs.¹⁶
- F) Not better accounted for by another disease or disorder.



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3.3. Diagnostic criteria for “Probable Acute Unilateral Vestibulopathy”

- A) Acute or subacute onset¹ of sustained² spinning or non-spinning vertigo³ (i.e., an acute vestibular syndrome) of moderate to severe intensity⁴ with symptoms lasting for at least 24 hours⁵.
- B) Spontaneous peripheral vestibular nystagmus⁷ which is direction-fixed⁷ and enhanced by removal of visual fixation^{7,8} with a trajectory appropriate to the semicircular canal afferents involved (generally horizontal-torsional)⁹
- C) No clear evidence of reduced VOR function by bedside examination^{10,11,12} on the side opposite the direction of the fast phase of the spontaneous nystagmus.
- D) No evidence for acute central neurological symptoms or acute audiological symptoms such as hearing loss or tinnitus¹³.
- E) No acute central neurological signs, namely no central ocular motor or central vestibular signs¹⁴, in particular, no skew deviation¹⁵, no gaze-evoked nystagmus¹⁴, and no acute audiological signs.¹⁶
- F) Not better accounted for by another disease or disorder.

3.4. Diagnostic criteria for “History of acute unilateral vestibulopathy”

- A) History of acute or subacute¹ onset of sustained² spinning or non-spinning vertigo³ lasting at least 24 hours (i.e., an acute vestibular syndrome) and slowly decreasing in intensity over days.
- B) No history of simultaneous acute central neurological or audiological symptoms such as hearing loss or tinnitus¹³.
- C) Evidence of unilaterally reduced VOR function^{10,11,12,17}.
- D) No history of simultaneous acute central neurological or audiological signs¹³
- E) Not better accounted for by another disease or disorder.



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- 25% of patients may experience an episode of vertigo or dizziness lasting several hours within two days before the onset of the sustained vertigo
- If there is an episode of vertigo more than many days before the onset of the sustained vertigo consider meniere's disease vestibular migraine or TIA
- Vertigo can be spinning or non spinning and persists at rest
- Symptoms include, vertigo, head motion intolerance, oscillopsia, postural imbalance with fall toward the affected side
- Treatment with antivertiginous drugs or steroids can reduce symptoms
- If full recovery within 24h, then AUVP is unlikely
- VideoHIT is strongly recommended to make the diagnosis unequivocal



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- Double vision can be due to decompensation of strabismus but also in this case patient needs to be reevaluated for TIA
- Other neurologic signs: hemianopia, impaired sensation in face, body, limbs, dysarthria, dysphagia, impaired coordination
- Hearing loss, tinnitus, ear pain: reevaluate for Meniere's disease, vestibular migraine or TIA



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Acute central vestibular syndrome:

- Lesion in root entry zone of the vestibular nerve in the lateral medulla: multiple sclerosis, small lacunar strokes
- Small lacunar infarction of vestibular nuclei or dorsolateral pons affecting the cerebellar peduncle
- Small cerebellar infarction of the flocculus which can also cause a pathological head impulse testing
- Vestibular migraine is a difficult differential diagnosis if it is a first attack especially in the elderly



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Table 1	
Differential diagnoses for AUVP. Central and peripheral vestibular disorders (in alphabetical order)	
Diagnosis	Clinical characteristics
Central vestibular disorders	
Acute central vestibular syndrome	Acute onset and duration often similar to AUVP More often vascular risk factors Often accompanied by central neurological symptoms and signs HINTS-plus important for the differential diagnosis
Vestibular migraine	Acute or subacute onset of often > 24 hrs of symptoms Not always associated with headache Episodes often associated with spontaneous and/or positional nystagmus [155]
Peripheral vestibular disorders	
Cogan's syndrome	Double triad: – Vertigo, bilateral hearing loss/tinnitus, eye pain/ "red eyes" – Bilateral, often asymmetric peripheral vestibular deficits, bilateral hypoacusis, interstitial keratitis Symptoms or deficits often rapidly progress Mostly in young women
Cupulolithiasis of a horizontal semicircular canal	Clinical examination may reveal horizontal pseudo-spontaneous nystagmus, which changes direction during the lean-and-bow test [35] and shows apogeotropic positional nystagmus during positional manoeuvres [154].
Herpes zoster oticus (Ramsay Hunt syndrome)	Initially burning ear pain and blisters, vertigo, hearing disorders and facial paresis; the symptoms can begin before the skin rash or even without a skin rash (Zoster sine herpette) Can lead to complete AUVP, including skew deviation [4] Often contrast enhancement of the affected cranial nerves on MRI
Isolated acute unilateral utricular or saccular vestibulopathy	Acute onset of postural imbalance which can be diagnosed by ocular and cervical VEMP; repeated testing is recommended to confirm the diagnosis
Labyrinthitis	Associated with ear pain, reduced hearing and/or tinnitus. The course of the disease can be acute, subacute or slowly progressive.
Menière's disease	Can begin with major vestibular and only minor audiological symptoms and is also associated with a nystagmus. The differential diagnosis is difficult and can only be made during the course of the disease (see diagnostic criteria).
Recurrent vestibulopathy	First attack is similar to AUVP, duration often shorter than in AUVP. However, if symptoms re-occur, this differential diagnosis as well as vestibular migraine should be considered; its etiology is still not clear [43].
Vestibular schwannoma	Often a slowly progressive course of the disease and associated with impairment of hearing and/or tinnitus. Often diagnosed in patients who have an asymmetric impairment of hearing by means of contrast-enhanced MRI. Vestibular symptoms may occur only in the later stage of the disease. In rare cases, it may also be associated with attacks of vertigo.
Combined central and peripheral disorders	
AICA infarction	Can affect the labyrinth, cerebellum and/or brainstem (74)
Susac syndrome	Can rarely begin as an acute vestibular syndrome. During the course of the disease, there is a

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Epidemiology of patients with dizziness over a 3-year period, requiring utilization of the emergency medical serviced system: A pre- and post-COVID pandemic comparative study using the population-based ORION registry

Koshi Ota^{a,d,*}, Daisuke Nishioka^b, Yusuke Katayama^d, Tetsuhisa Kitamura^d, Jun Masui^c, Kanna Ota^a, Masahiko Nitta^{a,d}, Tetsuya Matsuoka^d and Akira Takasu^a

^aDepartment of Emergency Medicine, Osaka Medical and Pharmaceutical University, Osaka, Japan

^bResearch and Development Center, Osaka Medical and Pharmaceutical University, Osaka, Japan

^cOsaka Prefectural Government, Osaka, Japan

^dThe Working Group to Analyze the Emergency Medical Care System in Osaka Prefecture, Osaka, Japan



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Background

Dizziness accounts for 2-4% ED visits

20% of those visits lead to hospital admissions

In the US 4 million patients present to the ED in a year.

After the COVID-19 was declared a pandemic there was reduction in EMS services of 10%

Objective of the study: clarify the epidemiology of emergency dizziness in Japan and assessing influence of covid-10 on the patients with dizziness



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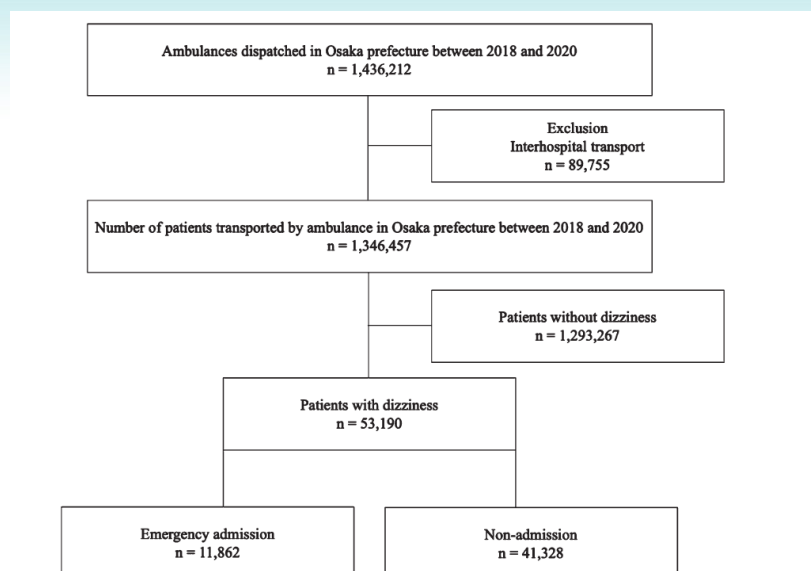
Material and Methods

Retrospective study from January 2018 to December 2020

ICD codes used included dizziness, epidemic vertigo, meniere's disease, bppv, vestibular neuronitis, other peripheral vertigo, vertigo of central origin, disorders of vestibular function, other vertiginous disorders



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Outcomes studied

Identify proportion of each disease entity associated with dizziness and the respective disposition in the ed for the 3 year period

Elucidate the broader influence of covid-19 pandemic on acute dizziness including its prevalence and hospital course



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Results

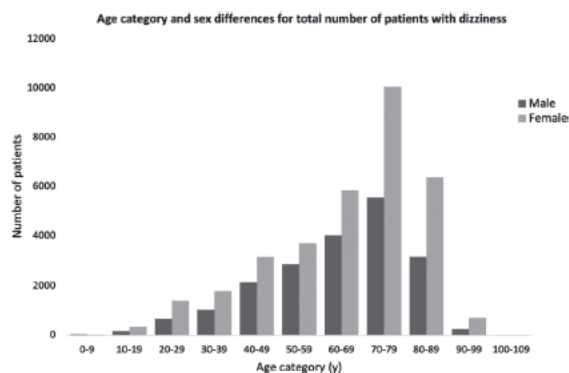


Fig. 2. Age category and sex differences for total number of patients with dizziness. Blue: male, Red: female. X axis was ten-year age categories. Y axis was number of patients. Female patients were more common than male patients in all ten-year age categories. The age strata of patients in their seventies showed the greatest frequency and number of dizziness patients.



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Table 1
Demographic characteristics of transported patients

Year	2018	2019	2020	Total	P value
Number of patients	462,773	468,697	414,987	1,346,457	<0.001
Age, median (IQR)	69.0(38)	70.0(38)	71.0(35)		<0.001
Sex (male), %	234,542 (50.7)	236,661 (50.5)	210,334 (50.7)	681,537 (50.6)	0.111
Age, median (IQR)	67.0 (38)	67.0 (38)	69.0 (34)		<0.001
Children, %	35,314 (7.6)	37,547 (8.0)	24,697 (6.0)	97,558 (7.3)	<0.001
Age, median (IQR)	3.0 (7)	3.0 (7)	4.0 (7)		<0.001
Adults, %	166,402 (36.0)	164,722 (35.1)	143,740 (34.6)	474,864 (35.3)	<0.001
Age, median (IQR)	43.0 (26)	44.0 (26)	45.0 (26)		<0.001
Elderly patients, %	261,057 (56.4)	266,428 (56.8)	246,550 (59.4)	774,035 (57.5)	<0.001
Age, median (IQR)	80.0 (12)	80.0 (12)	80.0 (12)		<0.001
Total number with dizziness, %	18,396 (3.98)	18,649 (3.98)	16,145 (3.89)	53,190 (3.95)	0.058
Dizziness and giddiness, %	9,570 (2.07)	9,613 (2.05)	7,892 (1.9)	27,075 (2.01)	<0.001
Epidemic vertigo, %	270 (0.06)	121 (0.03)	47 (0.01)	438 (0.03)	<0.001
Ménière's disease, %	749 (0.16)	704 (0.15)	596 (0.14)	2,049 (0.15)	0.083
Benign paroxysmal vertigo, %	1,354 (0.29)	1,455 (0.31)	1,442 (0.35)	4,251 (0.32)	<0.001
Vestibular neuritis, %	92 (0.02)	119 (0.03)	130 (0.03)	341 (0.03)	0.003
Other peripheral vertigo, %	2,949 (0.64)	3,177 (0.68)	2,890 (0.7)	9,016 (0.67)	0.002
Vertigo of central origin, %	510 (0.11)	475 (0.1)	450 (0.11)	1,435 (0.11)	0.384
Other disorders of vestibular function, %	32 (0.01)	52 (0.01)	54 (0.01)	138 (0.01)	0.015
Disorders of vestibular function, unspecified, %	2,787 (0.6)	2,881 (0.61)	2,483 (0.6)	8,151 (0.61)	0.579
Vertiginous syndromes in diseases classified elsewhere, %	83 (0.02)	52 (0.01)	161 (0.04)	296 (0.02)	<0.001

Children, 0–14 years; Adults, 15–64 years; Elderly patients, ≥65 years. Infant, 0 years; Toddler, 1–4 years; Childhood, 5–9 years; Adolescent, 10–14 years. Determined by the χ^2 test for categorical variables and Kruskal-Wallis test for continuous variables. Abbreviation: IQR, interquartile range.



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Results

1,436,212 patients were transported to the emergency room:
1,346,457 patients were enrolled in this study

About 4% were transported to for dizziness

R42 Dizziness and giddiness was most common diagnostic code
with different numbers lower numbers in 2020

Vestibular neuronitis increased in both absolute number and
prevalence in 2020 compared with the other years

22.3% were admitted without difference per year



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Results

All dizziness diseases were significantly higher for admission to the ED

Highest OR of admission was seen for vestibular neuronitis and vertigo of central origin



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Discussion

COVID-19 pandemic was associated with an increased OR for emergency admission in all transported patients but not increased admission in patients transported for dizziness

Vestibular neuronitis had higher incidence of admission compared to vertigo of central origins which includes VM and CVAs

Young patients with bppv and neuronitis increased in 2020 and stress may be related to both pathologies (tenuous explanation)



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Limitations

Retrospective observational study

Medical history, medications and health status could not be analyzed because information was unavailable

COVID-19 outbreak started April 2020 so capping the data to December 2020 may underrepresent the impact of the outbreak

Details of the hospital course as well as the results in the ED were unavailable



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JAMA Otolaryngology-Head & Neck Surgery | Original Investigation

Assessment of the Cost Burden of Episodic Recurrent Vestibular Vertigo in the US

Seth S. Jeong, BA; Kit N. Simpson, DrPH; Jada M. Johnson, MS; Habib G. Rizk, MD



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Background

2020 study: total annual expenditures for patients with dizziness or vertigo was 48 billion dollars in the US (Direct costs)

2014 study from Belgium showed that half of patients referred for dizziness reported absenteeism, 12% reported complete disability



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Material and Methods

Marketscan commercial database in the year 2018

Looking at patients with BPPV, MD and VM (approximated by dual diagnosis of dizziness and migraine on the same encounter)

Age 0-64 years

Compared the episodic vertigo groups to a control group



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Table 1. Overall Characteristics of the Study Populations

Characteristic	No. (%)			
	Ménière disease (n = 5783)	Vestibular migraine (n = 3526)	Benign paroxysmal positional vertigo (n = 43 901)	Normal comparisons (n = 34 738) ^a
Age, mean (SD), y	50.4 (10.5)	39.1 (12.3)	48.2 (11.6)	42.0 (13.5)
Sex				
Female	3552 (61.4)	2903 (82.3)	29 534 (67.3)	18 833 (54.2)
Male	2231 (38.6)	623 (17.7)	14 367 (32.7)	15 905 (45.8)
Charlson Comorbidity Index score				
0	5713 (98.8)	3472 (98.5)	43 326 (98.7)	34 169 (98.4)
1	38 (0.7)	30 (0.9)	304 (0.7)	272 (0.8)
≥2	32 (0.5)	24 (0.6)	271 (0.6)	297 (0.8)
Patients with hospital admissions	272 (4.7)	214 (6.1)	1773 (4.0)	1510 (4.3)
Hospital days, mean (SD)	4.6 (6.9)	5.2 (8.6)	4.9 (8.7)	5.0 (9.5)

^a Randomly selected patients with no diagnosis codes for dizziness.



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Table 2. Mean Cost of Payment to Clinicians per Person in Dollars

Payment	Ménière disease	Vestibular migraine	Benign paroxysmal positional vertigo	Normal comparisons
Annual payment ^a				
No.	5783	3526	43 901	34 738
Mean (95% CI), \$	11 036 (10 641-11 445)	10 894 (10 397-11 414)	9507 (9382-9633)	7069 (6965-7175)
Adjusted annual payment ^b				
No.	5783	3526	43 901	34 738
Mean (95% CI), \$	9579 (9250-9920)	11 371 (10 872-11 894)	8247 (8143-8354)	6160 (6071-6250)
Hospital payment				
No.	272	214	1773	1510
Mean (95% CI), \$	36 672 (32 745-41 071)	29 345 (25 826-33 342)	38 225 (36 566-39 960)	35 638 (33 965-37 394)
Outpatient payment				
No.	5756	3506	43 641	34 455
Mean (95% CI), \$	7437 (7186-7698)	7363 (7046-7695)	6117 (6041-6194)	3946 (3891-4002)
Prescription payment				
No.	5090	2996	37 520	27 134
Mean (95% CI), \$	2168 (2064-2278)	2109 (1977-2249)	2202 (2162-2242)	2028 (1985-2072)
Scan payment for patients with scans ^c				
No.	968	1283	6686	890
Mean (95% CI), \$	1329 (1252-1411)	1161 (1103-1223)	1178 (1151-1205)	1106 (1040-1178)

^a Hospital payment plus outpatient payments plus scan payments.

^b Adjusted for age, sex, and comorbidities; true difference between different diagnosis; and removed costs associated with patients' personal

characteristics.

^c Inpatient scans and outpatient scans.



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Table 3. Total Clinician Payments in Millions of Dollars and Incremental Increase in Cost of Illness for the Conditions in Study and to the US as a Whole

Payment	Ménière disease	Vestibular migraine	Benign paroxysmal positional vertigo	Normal comparisons
Total payments in 2018 (based on adjusted cost), \$ (millions) ^a	55.4	40.1	362.1	214.0
Extrapolated total payment in the US				
Prevalence, % ^b	0.2	2.7	1.6	NA
No. (millions) ^c	0.66	8.9	5.3	NA
Yearly payment (based on adjusted cost), \$ (billions)	6.3	101.2	43.7	NA
Incremental increase in payment to clinicians compared with normal population, \$	3419	5211	2087	NA
Extrapolated total cost of payments for the US population, \$ (billions) ^a	2.3	46.4	11.0	NA

Abbreviation: NA, not applicable.

^a Calculated based on adjusted annual cost and total number for each diagnosis.

^b Based on literature by von Brevern et al.,⁶ Forrester et al.,⁸ and Alexander

and Harris.²⁰

^c Calculated based on the total US population reported by the US Census Bureau in 2020.



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Discussion

- Payment costs 1.34-1.85 increased in those vestibular disorders
- 5% 1-year prevalence of vestibular vertigo
- Prevalence of MD, VM and BPPV is 0.2%, 2.7% and 1.6%: 1-year prevalence of 4.5%
- Imaging costs were one of the main causes of inflated expenditures: 7-8 times higher
- VM patients had twice the number of scans than other groups



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Discussion

Study by Adams et al showed that vestibular test claims showed higher utilization in southern and eastern costs and overlap with our own study of increased expenditures

Vestibular test claims may also be contributing to inflated costs

Another cause for inflated costs is the fact that those areas are known as the stroke belt

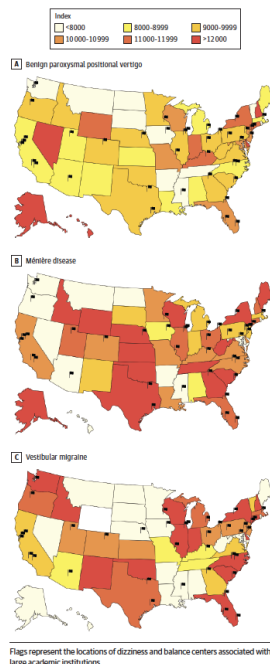
Indirect costs were not calculate in this study



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Figure. Heat Map of the Total Cost of Benign Paroxysmal Positional Vertigo, Ménière Disease, and Vestibular Migraine



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eTable. Comparison of episodic Vestibular Disorders to Other Chronic Diseases

	Episodic Vestibular Disorder (Our Study)	Diabetes ¹	Arthritis ²	Migraine ³	Asthma ⁴
Estimated Prevalence in millions in 2020 (% of US population)	14.9 (4.5%)	34.2 (10.5%)	58.5 (23.7)	52.4 (15.9)	22.6 (7.3) in 2013
Direct costs (in billions)	151.2	237	139.8	28.2	50
Indirect costs (in billions)	-	90	163.7	7.8	31.9
Total Cost (in billions)	-	327	303.5	36	81.9

¹ Treviño González JL, Soto-Galindo GA, Moreno Sales R, Morales Del Ángel JA. Sudden sensorineural hearing loss in atypical Cogan's syndrome: A case report. *Ann Med Surg (Lond)*. 2018;30:50-53.

² Murphy LB, Cisternas MG, Pasta DJ, Helmick CG, Yelin EH. Medical Expenditures and Earnings Losses Among US Adults With Arthritis in 2013. *Arthritis Care & Research*. 2018;70(6):869-876.

³ Bonafede M, Sapra S, Shah N, Tepper S, Cappell K, Desai P. Direct and Indirect Healthcare Resource Utilization and Costs Among Migraine Patients in the United States. *Headache*. 2018;58(5):700-714.

⁴ Nurmaganbetov T, Kuwahara R, Garbe P. The Economic Burden of Asthma in the United States, 2008-2013. *Annals of the American Thoracic Society*. 2018;15(3):348-356.



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Conclusions and limitations

Episodic vestibular vertigo does not have stereotypical presentation

Common comorbidities of multiple vestibular disorders

PT sessions, mistaken diagnosis, psychiatric comorbidities are often associated with inflated costs

Limitations include: VM patients were not typical Barany society VM but the VM group is likely underestimated rather than overestimated

Another limitation was the inability to quantify inpatient scan results especially if not well documented in discharge summaries
We could be underestimating the number of scans incurred by those patients who were hospitalized



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OPEN

The Effects of Hearing Loss on Balance: A Critical Review

Mark G. Carpenter^{1,4} and Jennifer L. Campos^{2,3,4}

- Hearing is important to help localize, monitor and respond to objects and events in our environments and to perceive our own movements through space
- Important to explore impact of hearing loss on mobility related outcomes
- Many studies are showing relationship between hearing loss, poor balance, mobility problems and falls:
- 1.4x increased odds ratio of falling for every 10dB increase in hearing loss (Lin and Ferrucci et al.)



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Studies are still not conclusive but some studies did report significant effects of reduced hearing on whole body static postural control

Three types of studies:

- Normal hearing patients with sound suppression
- Hearing loss patients with hearing aids on and off
- Cochlear implant patients (before/after and CI on/off)

Current evidence of relationship is weak in the context of static balance

Hearing may become more important when other sensory inputs are poor and/or when task demands are high



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Original Study

Is Sudden Sensorineural Hearing Loss an Otologic Emergency? Evidence-Based Cutoff for Optimal Treatment Initiation for Sudden Unilateral Sensorineural Hearing Loss: A Case Series and Meta-Analyses

Linor Klein, Ophir Handzel, Shahaf Shilo, Yahav Oron, Rani Abu Eta,
Nidal Muhanna, and Omer J. Ungar

*Department of Otolaryngology-Head and Neck Surgery and Maxillofacial Surgery, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel,
Affiliated to the Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel*

Objectives: To study the need for defining unilateral idiopathic sudden sensorineural hearing loss (ISSNHL) as an otologic emergency and establish an evidence-based cutoff for treatment initiation for optimal outcome.

Methods: A systematic literature search of "MEDLINE" via "PubMed," "Embase," and "Web of Science" and original case series comparing the outcome of steroidal treatment for ISSNHL as a function of delays of patient presentation, of diagnosis, and of treatment initiation. Total delay was defined as days from ISSNHL onset to first steroidal dose and divided into up to 3 days, up to 7 days, up to 14 days, and >14 days.

Results: The literature search identified 1,469 ears and our original case series contributed 154 ears suitable for study inclusion, resulting in 1,623 ears for statistical analysis. An odds ratio (OR) of 0.42 (95% confidence interval [CI], 0.25–0.71) was calculated for recovery if treatment had been initiated within the third

day since the sudden occurrence of a unilateral hearing loss compared with treatment initiation on or after the fourth day ($P = 40.1\%$). The calculated OR for recovery was 0.35 (95% CI, 0.26–0.47) when treatment was initiated during the first 7 days after the sudden hearing loss onset compared with a delay of 8 days or more ($P = 52.1\%$). The OR was 0.31 (95% CI, 0.21–0.46) when treatment was initiated during the first 14 days after the event compared with a longer delay ($P = 0.0\%$).

Conclusion: Unilateral ISSNHL should be considered a medical emergency. Initiating treatment before 3 days have elapsed since the event portends the best outcome.

Level of Evidence: Level I.

Key words: Emergency—Idiopathic—Sudden deafness—Prognosis—Sudden sensorineural hearing loss.

Otol Neurotol 44:216–222, 2023.



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ISSNHL is most commonly defined as an SNHL of at least 30dB in three or more consecutive speech frequencies occurring within three days preceding presentation

Incidence 27-60/100000 people per year

Chance of regaining hearing is inversely related to the time elapsed between onset and initiation of treatment (typically steroids)

Some patients do recover spontaneously.

No clear-cut cutoff for time to treatment.



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Material and Methods

Retrospective analysis of all adults with ISSNHL between 2012 and 2022

- Audiogram was obtained within hours of presentation
- Systemic oral prednisone 1 mg/kg/day for 7-0 days followed by salvage treatment
- Improvement of hearing defined by return of PTA within 10 dB to the unaffected ear's thresholds or to normal range
- Salvage treatment: 6 consecutive daily injections of DXM

Systematic review using PRISMA guidelines



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Results Original Case series

- 154 patients
- Median age 54 years 53.9% were male
- Median age of delays to patient presentation 8 days
- Median age to diagnosis and treatment : 1 day and 0 days



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- Treatment was initiated within the first three days in 23/154 and hearing recovered in 14/23 (60.9%) The 131 patients where treatment was initiated after three days 50 recovered (38.2%)
- 76/154 presented within 7 days from hearing loss onset and hearing recovered in 42 of them (55.3%) 78 presented after day 8 and only 24 recovered (30.8%)
- 108/154 patients presented in the first 14 days and 53 recovered (49.1%) 46 patients presented after 14 days and only 11 recovered (23.9%)
- Overall recovery rate was 64/154 or 41.6%



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Results Systematic review

17 studies were ultimately selected after an initial yield of 1861 studies:
9 from Asia, Six from USA two from Europe
Ten retrospective case series, six prospective nonrandomized trials and one RCT

15 studies used oral steroids alone or followed by IT steroid and two studies used IT steroids

Objective recovery of hearing was not identical in all studies

Total N: 1266 patients Average age 40-69

Diabetes and hypertension were the only reported systemic comorbidities: 13 to 32%

Vertigo and tinnitus only reported associated symptoms upon presentation



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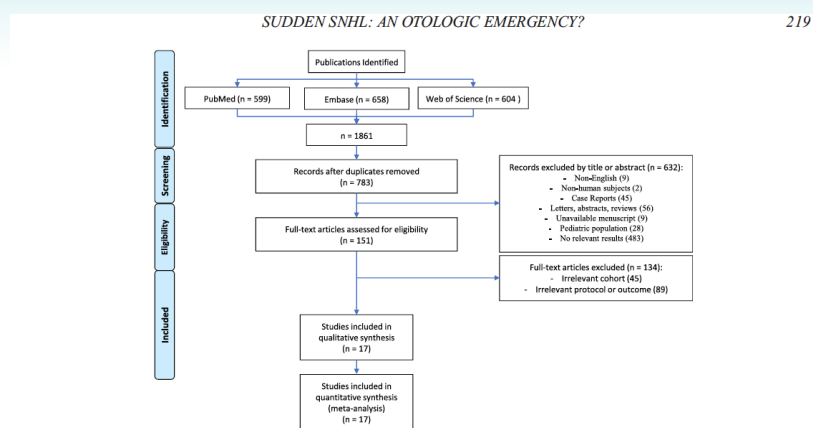


FIG. 1. PRISMA flow diagram. Presentation of the literature search methodology and article selection. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.



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TABLE 1. Characteristics of enrolled studies

#	Author(s)	Year	Country	Design	Setting	Therapeutic Protocol	Recovery Definition
1	Battaglia et al.	2014	United States	PT	Multicenter	Oral high-dose prednisone + IT DEX	AAO-HNSF guidelines
2	Battista	2005	United States	PT	Hospital	Oral high-dose prednisone + IT DEX	Complete: PTA within 10 dB of baseline. Partial: 50%
3	Jia et al.	2019	China	RCV	Hospital	IT DEX + IV batroxobin	Siegel's criteria
4	Huafeng et al.	2019	China	RCV	Hospital	IV corticosteroids	Hearing gain of at least 10 dB
5	Jeyakumar et al.	2006	United States	RCV	Hospital	Oral high-dose prednisone	10 dB decrease in PTA or a 15% improvement in SDS
6	Tsai et al.	2011	Taiwan	RCV	Hospital	IT-DEX	Hearing improvement equal to a decrease of 10 dB or more in the average PTA hearing threshold across three frequencies (0.5, 1, and 2 kHz)
7	Tong et al.	2021	China	RCT	Hospital	Oral high-dose prednisone + HBO	Hearing within 15 dB of baseline
8	Vijayendra et al.	2012	India	PT	Hospital	IV corticosteroids + valacyclovir + aspirin	Complete: PTA within 10 dB of baseline. Partial: 50%
9	Perez Ferreira Neto et al.	2021	Brazil	RCV	Hospital	Oral high-dose prednisone	Partial recovery was defined in two ways based on whether the degree of initial hearing loss after the event of SSNHL rendered the ear nonserviceable (PTA 50 dB or WRS 50%)
10	Zadeh et al.	2003	United States	RCV	Hospital	Systemic corticosteroids	Return of half the difference between the affected and unaffected ear
11	Wang et al.	2019	China	RCV	Hospital	Systemic corticosteroids + vasodilators + HBO	Siegel's criteria—any improvement
12	Terzi et al.	2016	Turkey	RCV	Clinic	systemic steroids + betahistine + piracetam	Siegel's criteria—any improvement
13	Rafique and Farrukh	2013	Pakistan	PT	Multicenter	IV corticosteroids + dextran	Complete: PTA within 10 dB of baseline. Partial: 50%
14	Kantora et al.	2021	India	PT	Multicenter	Oral high-dose prednisone/IT DEX	Hearing gain of at least 10 dB
15	Yildirim et al.	2015	Turkey	RCV	Clinic	Systemic corticosteroids + HBO + piracetam	Hearing gain of at least 10 dB
16	Gupta et al.	2016	India	PT	Hospital	Systemic corticosteroids + pentoxifylline	Complete: PTA within 10 dB of baseline. Partial: 50%
17	Anyah et al.	2017	United States	RCV	Hospital	Systemic corticosteroids	Wilson's criteria

RCV, retrospective chart review; RCT, randomized controlled trial; PT, prospective trial; IT, intratympanic; DEX, dexamethasone; AAO-HNS, American Academy of Otolaryngology–Head and Neck Surgery Foundation; HBO, hyperbaric oxygen; IV, intravenous; PTA, pure tone average; SDS, speech discrimination score; WRS, word recognition score.



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Authors pooled the systematic review patients and their own case series over ten years for a total of 1420 ears

OR of 0.42 was calculated for recovery if treatment had been initiated before the third day This means the recovery rate is reduced by 2.4 fold if treatment is initiated after three days

OR of 0.35 if treatment is initiated after day 7 menaing a reduction of recovery of 2.9 fold

OR of 0.31 if treatment is initiated within 14 days

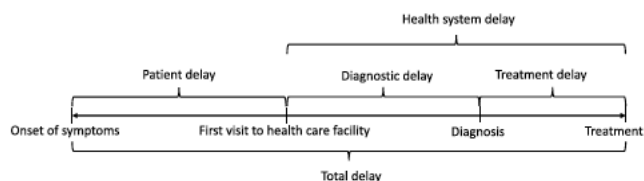


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Discussion

- Factors of poor prognosis: time to treatment, patient's age, audiogram shape hearing loss severity, hypertension, diabetes, accompanying vertigo
- Reasons for delays below can be patient dependent but also unavailability of audiogram
- Most patients present within 48-96 hours



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Discussion and Limitations

- Study is in favor of classifying sudden sensorineural hearing loss as an otologic emergency given stark reduction in pooled recovery rates as time to treatment increases
- Limitations: variable definitions of recovery, bias in the fact that some patients improve spontaneously and those we are seeing may be the ones who have a poorer prognosis to start with. The ones who present early and get treatment early may actually have spontaneous remission anyway...

Vestibular mapping assessment in idiopathic sudden sensorineural hearing loss

Hee Won Seo, Jae Ho Chung, Hayoung Byun, and Seung Hwan Lee



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Background

- Studies in the past have linked vertigo to poorer outcome
- Posterior semicircular canal involvement has also been linked to poorer outcomes (proximity of posterior scc and cochlea)
- Objective of the study: identify pathophysiologic patterns of vestibular end organ impairment in ISSNHL and analyze their clinical implications as prognostic factors for ISSNHL.



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Material and Methods

- Retrospective review: 2016-2020
- 147 patients
- AAOHNS definition of ISSNHL hearing loss of 30dB or more at 3 consecutive frequencies within three days
- Vestibular testing was performed within 1 day of ISSNHL
- Diagnosis took place within two weeks of the onset of hearing loss
- Uniform treatment: oral prednisone 1mg/kg (maximum 60mg) for seven days followed by seven day taper. IT salvage after one week (four times in a 2 week period)
- All patients underwent 3D FIESTA MRI
- Patients underwent vHIT, cVEMP and oVEMP



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Assessment of outcomes

Recovery of hearing based on AAOHNS guidelines:

- Complete recovery: return of hearing within 10 dB of the unaffected ear and recovery of WRS to 5-10%
- If hearing improvement was less than 10dB then it was listed as no recovery Partial recovery was an improvement of more than 10dB but not within 10dB of the unaffected ear



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Results

Out of 147 patients 11 were excluded due to subsequent diagnosis of MD and one excluded due to discovery of acoustic tumor
 Remaining patients 135 Mean age 54(13.8) and 43% were male
 29.6% had hypertension, 25.2% had diabetes and 5.2% had cardiovascular disease

40% had associated vertigo, 63.7% had tinnitus, 67.4% had ear fullness

Average time between onset and treatment was 4 days

Mean initial hearing loss threshold was 69.6dB

Most patients had a flat audiogram (72.6%)

Most frequently affected vestibular organ was the utricle (56%), followed by the saccule (43.7%) and posterior SCC(22.2%)

80% received IT salvage injections



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Results Treatment Outcomes

- 47.4% had complete recovery
- 71/135 had partial or no recovery
- Univariate analysis showed that : age, presence of vertigo, initial hearing thresholds, treatment methods, impairment of the posterior SCC, Saccular and utricle were associated with complete recovery
- Multivariate analysis only showed that initial hearing thresholds and impairment of posterior SCC were associated with complete recovery



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Patterns of vestibular end organ impairment

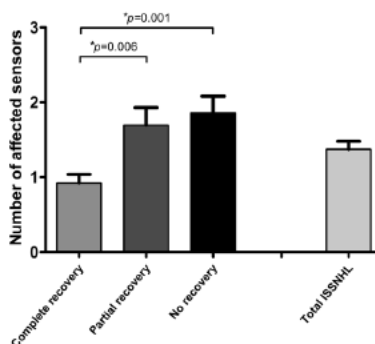


Fig. 1. Bar plot illustrating the numbers of affected sensors according to hearing recovery. Each bar represents the standard error of the mean. Statistically significant differences are reported as * $p < 0.05$.



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Patterns of vestibular end organ impairment

- Among all patients: preservation of all five sensors was most frequent (29%) followed by isolated utricular dysfunction 19% Combined impairment of posterior scc utricle and saccule accounts for 9%
- Complete recovery group: 40.6% had intact sensors Any utricular or saccular damage was identified in 40.6% and 34.4%
- Partial recovery group 22% all five sensors preserved. Impairments of posterior scc, utricle or saccule were observed in 36%, 63.9% and 50% respectively
- More utricular and posterior scc dysfunction in partial recovery group
- In the no recovery group: utricular dysfunction was most frequent 23% Dysfunction of posterior scc (34%) and utricular dysfunction 77% was more frequent than in complete recovery group



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Patterns of vestibular end organ impairment

- Presence of vertigo is associated with less recovery
- Vertigo does not correlate with vestibular dysfunction

TABLE 3. Results of vestibular function tests according to presence of vertigo

Variables	ISSNHL With Vertigo N = 54	ISSNHL Without Vertigo N = 81	<i>p</i>
Affected sensors			
Horizontal SCC	8 (14.8%)	2 (2.5%)	0.007
Anterior SCC	7 (13.0%)	3 (3.7%)	0.044
Posterior SCC	20 (37.0%)	10 (12.3%)	0.001
Utricle	33 (61.1%)	43 (53.1%)	0.357
Sacculle	29 (53.7%)	30 (37.0%)	0.056
Number of affected sensors	1.80 ± 1.43	1.09 ± 1.02	0.002

Statistically significant (*p* < 0.05) values are highlighted in bold.
ISSNHL, idiopathic sudden sensorineural hearing loss; SCC, semicircular canal.



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Statistically significant (*p* < 0.05) values are highlighted in bold.
ISSNHL, idiopathic sudden sensorineural hearing loss; SCC, semicircular canal.



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Discussion and conclusions

- Posterior SCC function preserved more often in complete recovery group
- Initial hearing thresholds and posterior scc impairment are associated with poorer prognosis
- Number of affected sensors was higher in partial/no recovery group
- Impairment does not follow innervation and vascularization patterns
- only 6.7% had low frequency snhl
- 40% of patients had vertigo 71% had at least one vestibular organ impairment
- ISSNHL with vertigo had frequently damaged scc function and the number of affected sensors was higher: is that the same disease as ISSNHL wo vertigo?
- 56% with abnormal vestibular function tests and 33% of the dysfunctional posterior scc did not have vertigo: subclinical vestibular impairment?

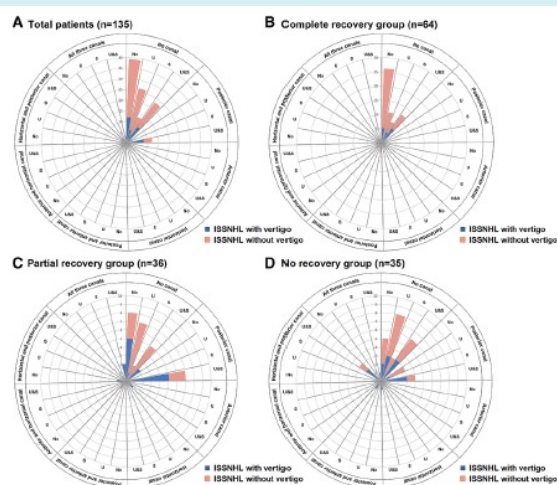


Fig. 2. Polar histogram plots illustrating the numbers of different combinations of vestibular end organs impaired according to hearing recovery. In the bar plots, the red color is the proportion of ISSNHL patients without vertigo, and the blue color is the proportion of ISSNHL patients with vertigo. Impairment of semicircular canals is indicated in the outer circle, and the status of otolith organs is indicated in the inner circle. With intact otolith organs (No), isolated utricular (U) or saccular (S) impairment, or both utricular and saccular impairment (U&S). ISSNHL, idiopathic sudden sensorineural hearing loss.



Conclusions and Limitations

Posterior scc function can be a prognostic marker to decide on high dose steroid therapy in patients with many comorbidities

Limitations: retrospective, binary classification of vestibular impairment, lack of comparison group

MD was not completely ruled out because of lack of long term followup

Vestibular function tests were not rechecked after steroid treatment even in those with initial vertigo since the symptom of vertigo improved in most patients



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Vestibular and Auditory Manifestations of Migraine

Tania Benjamin, MD¹, Danielle Gillard, MD¹, Mehdi Abouzari, MD, PhD², Hamid R. Djalilian, MD^{2,3}, Jeffrey D. Sharon, MD¹

¹University of California, San Francisco (UCSF) Department of Otolaryngology – Head and Neck Surgery, San Francisco, CA, USA

²University of California, Irvine (UCI) Department of Otolaryngology, Irvine, CA, USA

³University of California, Irvine (UCI) Department of Biomedical Engineering, Irvine, CA, USA

- Tinnitus more prevalent in different types of migraine
- Possibly related to activation of trigeminal nerve and central hypersensitivity
- Patients with migraine have a 3-fold increase in likelihood of having tinnitus
- Association is stronger in young patients with migraine with aura
- Hyperacusis is a well described association of chronic migraine and is described as phonophobia in migraine literature



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Cochlear Migraine?

First described in 2018

Recurrent or fluctuating unilateral sensorineural hearing loss without vertigo or mild dizziness along with aural fullness. Minor criteria include aura before hearing loss, concurrent tinnitus, family history of migraine related disorders, history of migraine or chronic headaches or unilateral neck stiffness, photophobia or phonophobia, motion sickness, visual motion intolerance and barometric pressure sensitivity

Patients with migraine have lowering of OAE and central auditory dysfunction on ABR



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Hearing Loss?

Subjective hearing change during VM attacks is common

Migraine is independently associated with increased likelihood of subjective tinnitus and hearing loss

25% of adults with migraine versus 16.6% without migraine would have hearing loss

A recent metaanalysis concluded that a history of migraine is a risk factor for sudden sensorineural hearing loss (hazard ratio 1.84)

Some studies looked at migraine treatment in addition to steroid treatment for sudden hearing loss and had encouraging results



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Aural Fullness?

54% of patients with aural fullness met HIS criteria for migraine and responded to migraine preventive treatment

Migraine symptoms included visual motion sensitivity, head motion sensitivity, sinus/facial pressure, phonophobia

Aural fullness in patients without ETD and normal imaging studies is most likely related to migraine



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Otalgia?

Patients with classic migraine are more likely to report ear pain than patients with other types of headaches

Patients with otalgia are more likely to report headaches than patients without otalgia

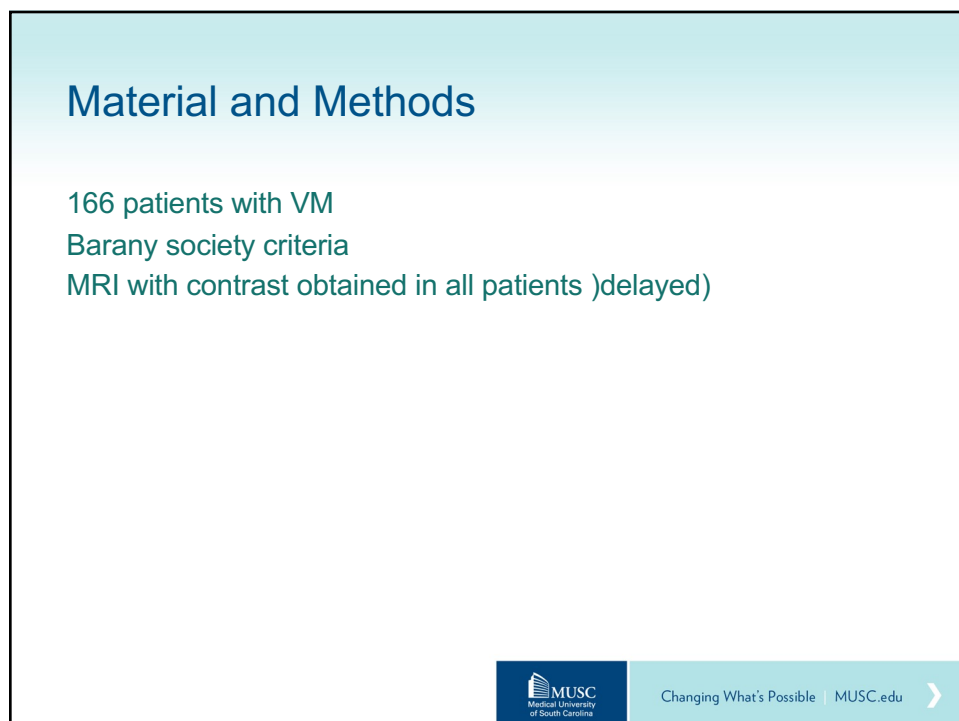
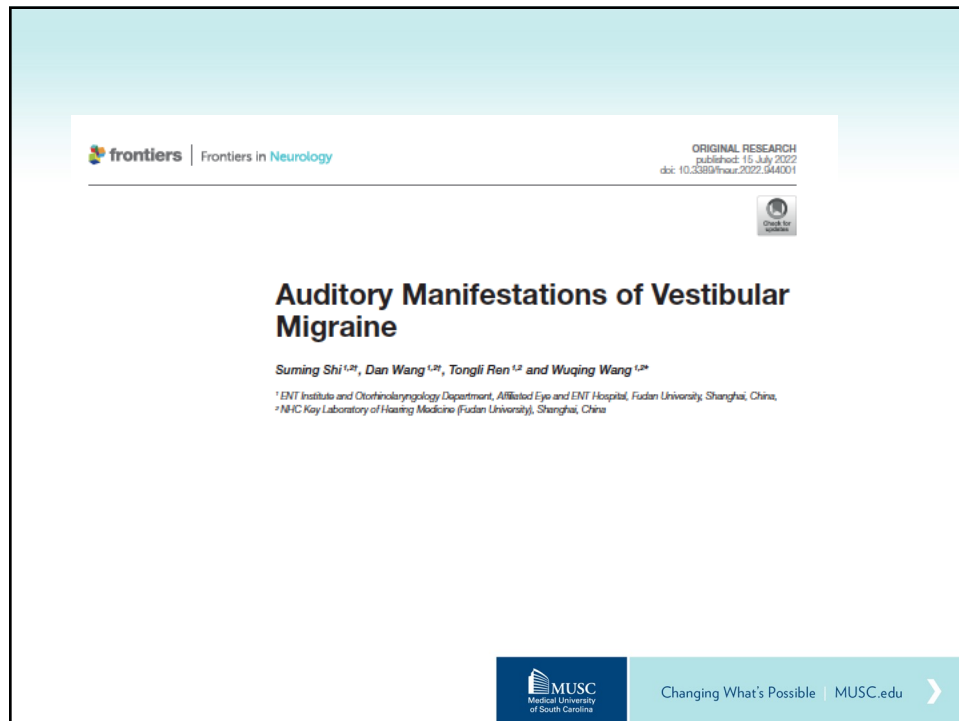
In a retrospective review of patients with otalgia without other cause in a single ENT practice, more than half had a prior history of headaches and 65% met HIS criteria for migraine with or without aura

Otalgia can also be seen in VM



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Results

Mean age 42.5
Onset age 35
Disease course 8 months

122/166 diagnosed with vm, 42 WITH PROBABLE vm
21% had hearing loss, 8% had otalgia, 51.8% had tinnitus, 41% had aural fullness, 32% had phonophobia

VM with hearing loss tend to be younger Average disease duration longer
Higher incidence of tinnitus in this subgroup as well as aural fullness

Duration of vestibular attacks tend to be shorter in the hearing loss group



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Discussion

Majority of hearing loss during attack is unilateral
Hearing loss does not progress contrary to MD
Theories for hearing loss include vasospasm in cochlea, inflammation and neurotransmitter involved in migraine pathogenesis affect inner and central auditory system, genetic deficiency of ion channels

Central sensitization: tinnitus, otalgia and aural fullness



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Limitations

Only auditory tests performed were PTA
 Vestibular function was not analyzed
 Migraine and MD can be a comorbidity



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Auris Nasus Larynx 50 (2023) 235–240

Contents lists available at ScienceDirect



Auris Nasus Larynx

journal homepage: www.elsevier.com/locate/anl



Correlating atmospheric pressure and temperature with Meniere attack



Yi-Jia Chen^a, Ya-Hui Wang^b, Yi-Ho Young^{c,*}

^a Department of Otolaryngology, Catholic Cardinal Tien Hospital, Fu-Jen Catholic University, New Taipei, Taiwan

^b Medical Research Center, Catholic Cardinal Tien Hospital, Fu-Jen Catholic University, New Taipei, Taiwan

^c Department of Otolaryngology, National Taiwan University Hospital, 1, Chang-Te St., Taipei, Taiwan



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Background

Risk of MD attack when atmospheric pressure is below 1013 hectopascal is 1.3 times higher than at higher atmospheric pressure levels



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Material and Methods

Patients from 2015-2017 presenting to a neurotology clinic
N=283 (2015), 351 (2016) and 319 (2017)

Mean age 50

Gender ratio 2:1

All patients had otoscopy, audiometry, ovemp, cvemp and bithermal caloric tests

Meteorological parameters including atmospheric pressure, temperature, relative humidity and rainfall from annual report of the central weather bureau in Taiwan



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Results

No monthly difference in number of monthly cases and mean monthly incidence of meniere's disease attack

There was significant difference in seasonal incidence of attacks

There were more attacks during the summer season

Study was conducted in Taiwan which is in a subtropical-tropical region

Higher severity attacks were also noted during the typhoon seasons

Y.-J. Chen, Y.-H. Wang and Y.-H. Young/*Auris Nasus Larynx* 50 (2023) 235–240

Table 3. Seasonal incidence of Meniere attack in relation to overall neurological cases

Years	Spring (4-6)	Summer (7-9)	Autumn (10-12)	Winter (1-3)	p value
2015	66 (11.8%)	86 (15.6%)	77 (14.1%)	54 (10.6%)	
2016	78 (15.0%)	104 (19.8%)	95 (17.6%)	74 (14.5%)	
2017	85 (17.5%)	90 (17.0%)	81 (16.3%)	63 (13.4%)	
mean $\pm$ SD	76 $\pm$ 10 (14.8 $\pm$ 2.8%) ^a	93 $\pm$ 9 (17.5 $\pm$ 2.2%) ^b	84 $\pm$ 9 ^b (16.0 $\pm$ 1.8%) ^c	64 $\pm$ 10 (12.8 $\pm$ 2.0%) ^{a,b,c}	0.006 0.035

p value: one-way ANOVA test.

^a $p > 0.05$.

^b $p = 0.004$, Bonferroni-adjusted t test.

^c $p > 0.05$.

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Correlation between meniere's disease attacks and meteorological parameters

Meniere attack correlated with atmospheric pressure and atmospheric pressure negatively correlated with the temperature

No correlation with relative humidity and rainfall

Summer season had a 15% higher risk of meniere's disease attacks than autumn season

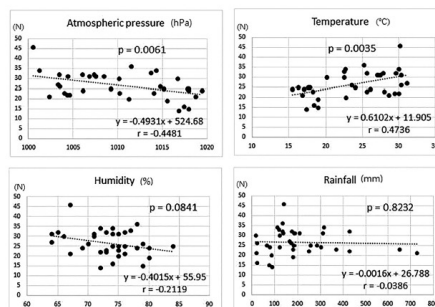


Fig. 1. Correlations between the onset of Meniere attacks and meteorological parameters. The onset of Meniere attacks correlates significantly with the atmospheric pressure and temperature, but not with the relative humidity or rainfall.

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Discussion

Reduction in atmospheric pressure leads to reduction of middle ear cavity function. Middle ear pressure then equalizes with perilymphatic pressure through the RW

Pressure gradient is transmitted through Reissner's membrane
This leads to increased endolymphatic pressure and hydrops



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<https://doi.org/10.1007/s00405-022-07505-5>

REVIEW ARTICLE



Risk factors for Meniere disease: a systematic review and meta-analysis

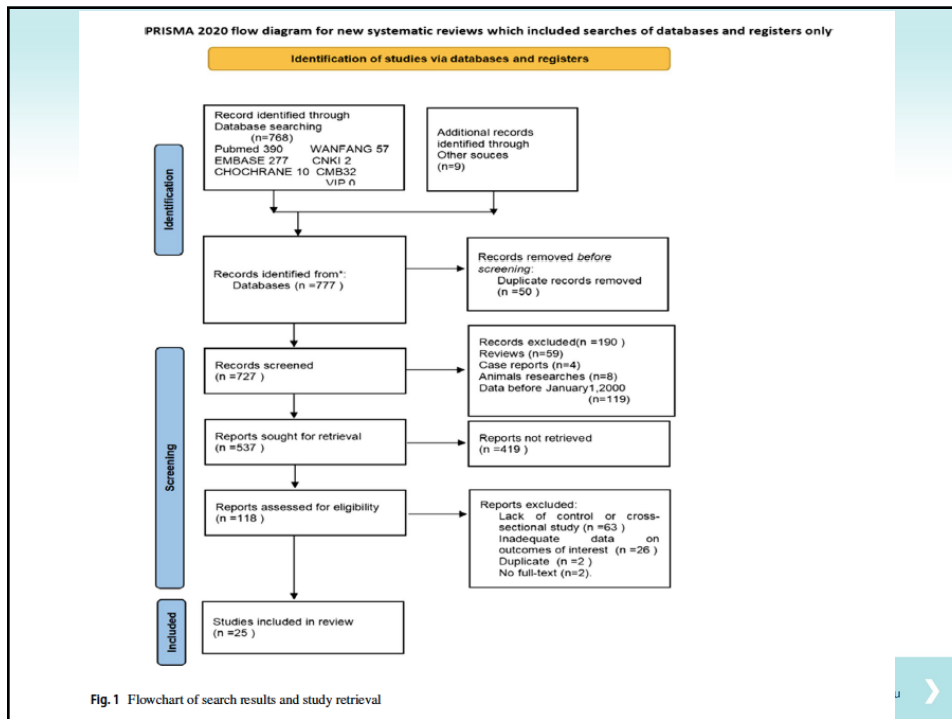
Chunmei Hu^{1,2} · Wenjie Yang³ · Weili Kong² · Jilang Fan¹ · Gang He¹ · Yun Zheng² · Jianjun Ren² · Chuan Dong¹

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25 studies that enrolled 1,471,944 participants

High to moderate methodological evidence that age and sleep disorders are risk factors for MD

OSA is associated with higher incidence of vertigo and female and middle aged patients with OSA had higher incidence of MD:

Inner ear may be extremely sensitive to hypoxia

Effect of gender was not obvious in this metanalysis

Heredity, autoimmunity and allergy were also more difficult to determine in this specific study

Limitations

Potential overlap with vm that would be underrecognized in the pooling of those studies

Some risk factors may not have been studied because of limited number of studies available

Sensitivity analysis and publication bias are also potential limitations



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Thank you for your attention

Feel free to email me any question at rizkh@musc.edu

Or call me on my phone 2154590435



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