Otologic Migraine

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Disclosures

- Beyondtinnitus software/app, Co-founder
- Novus therapeutics, advisory board
- Cactus Medical, Co-founder

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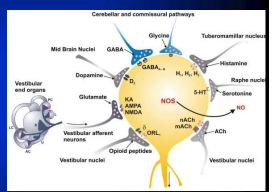
Pathophysiology

- Baseline hypersensitivity of brain
- NT involved: glut, 5-HT, hist, CGRP, etc.
- Spreading cortical depression with activation of CN V →
  - Headache
  - ?Δs to the inner ear, central vestibular effect



Soto, Neuropharmacol, 2010

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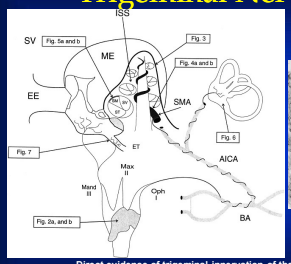
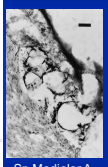
Trigeminal Nerve and Ear

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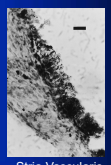
Stria Vascularis

Direct evidence of trigeminal innervation of the cochlear blood vessels.
Vass Z', Shore SE, Nuttall AL, Miller JM. Neuroscience. 1998 May;84(2):559-67.

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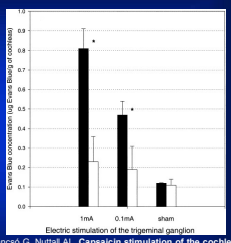
Trigeminal Nerve Stimulation

- Trigeminal nerve stimulation caused fluid extravasation in cochlea within 60 minutes
- Theoretically can cause ELH, MD, BPV, etc.



Vass Z[1], Steyger PS, Hordichok AJ, Trune DR, Jancsó G, Nuttall AL. **Capsaicin stimulation of the cochlea and electric stimulation of the trigeminal ganglion mediate vascular permeability in cochlear and vertebro-basilar arteries: a potential cause of inner ear dysfunction in headache.**
Neuroscience. 2001;103(1):189-201.

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Incidence

- Migraine in general population: 13-25%
  - 27-42% get vertigo → 3-5% of general population gets VM
  - "Meniere's" prevalence of 0.2%
  - 36% of VM patients get vertigo during headache-free intervals
  - Many symptoms of atypical migraine involve ear

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Atypical Migraine

- 60% of patients have atypical sxs and do not fulfill IHS criteria
- Neck spasm/stiffness (esp unilateral)
- "Sinus" HA, Pain behind eyes, "Hurts to move eyes", "Stress"/"Caffeine" HA, head pressure
- "Sinusitis from A/C" or "weather changes"
- Dizzy with weather changes, too much sound
- "I've had 4 sinus surgeries but still get sinus pain"
- "Pain improved after FESS for 6 months"

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Migraine Triggers

- Stress
  - Psychological (e.g., anxiety, conflict at work/home, death of relative, etc.) or physical (e.g., back pain, URI, other illness)
- Hormonal changes
  - Menstrual cycle, menopause, HRT, OCP, and testosterone supplement

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Migraine Triggers

- Changes in sleep
  - Too much sleep (over sleeping or napping)
  - Too little sleep, interrupted sleep (>1 awakenings/night, OSA)
  - Shifting sleep schedule (e.g., having a different sleep schedule on the weekends vs. weekdays, shift-work, or jet-lag sleep)
- Head trauma, intracranial surgery
- Surgery/dental work

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Migraine Triggers

- Diet
  - Skipping meals, dehydration
  - Certain foods (aged or NT-like – histamine, glutamate, tyramine)
    - Caffeine, Chocolate, nuts (peanuts, esp), Alcohol (esp red wine), cheeses (aged or fermented): Fresh breads and yeast products, Aged, canned, cured, smoked, or processed meats, MSG, Pickled, preserved or marinated foods, Aspartame, Vegetables: beans, lima; Fruit: Avocados, figs, raisins. Bananas tyamine and citrus fruit histamine. Overly ripened fruits

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Migraine Triggers

- Intense stimulations
  - Bright lights
  - Loud sound (similar to PLF and Sup Canal Dehiscence)
  - Intense, repeated, or certain head motion
  - Visual motion (e.g., scrolling on computer screen, movie theaters, 3-D movies, scrolling and reading on phone, walking and reading on phone, etc.)
  - Weather changes (primarily related to atmospheric pressure changes) – "I can tell when storm is coming", low pressure (travel to mountains)
  - Intense smells
  - Heat (ambient), cold (on face)
  - Intense exercise

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Vestibular Migraine

- Think of Migraine:
  - Photophobia or phonophobia
    - Sunlight, innocuous noise (e.g., traffic, stereo, cell phone)
  - Sensitivity to motion in visual fields
    - Scrolling computer screen, sports game on TV, Supermarket dizziness, windshield wipers, 3-D movies, ceiling fan
  - Childhood or Adult-onset motion sickness
    - Cannot sit in the back seat, cruise/boat problems
  - Space and motion discomfort
  - Excessive nausea

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Migraine Associated Symptoms

- Think of Migraine:
  - Otalgia or aural pressure once other causes ruled out
  - Associated with headache, wind, dizziness (Teixido O&N 2011)
  - Aural pressure does not resolve w Valsalva, myringotomy (not SCD) (Moshtaghi, …, Djalilian O&N 2018)
  - "Sinus" headaches with repeated normal CT's or lack of response to Tx (Schreiber Arch Int Med 2004)
  - Low frequency or fluctuating HL (Hwang, et al, Lin & Djalilian JAMA Oto 2018)
  - If you think Meniere's, it's likely migraine (Ghavami, Djalilian, Laryngoscope 2015)

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Think of Migraine

- Feel dizzy with loud noise, but no SCD or PLF
- Recurrent BPV not responding to Epley (MRI -)
- If pt vertiginous and MRI negative (and not BPV)
- Dix-Hallpike causes dizziness but no nystagmus
- Severe nausea/vomiting after Epley
- Immediate nystagmus on Dix-Hallpike

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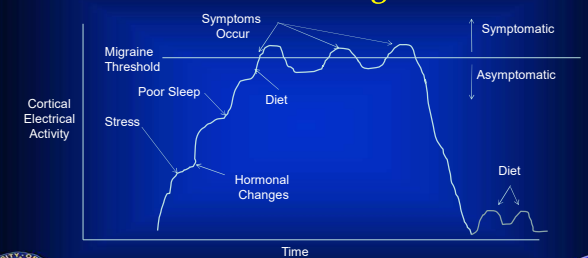
Intermittent Migraine



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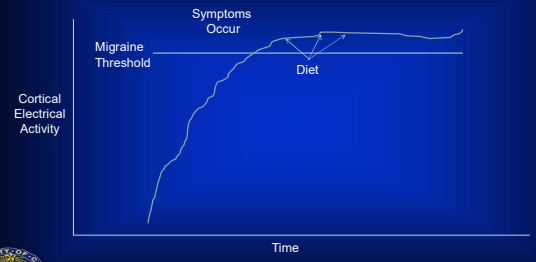
Continuous Migraine Sx's



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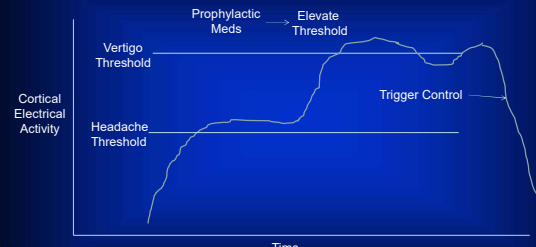
Multiple Migraine Thresholds



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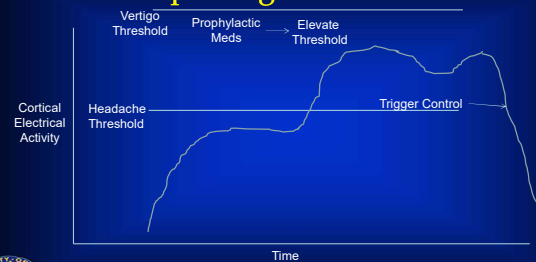
Multiple Migraine Thresholds



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A Historical Recount: Discovering Menière's Disease and Its Association With Migraine Headaches

*Omid Moshtaghi, *Ronald Sahyouni, *Harrison W. Lin, *Yaser Ghavami, and *†Hamid R. Djalilian

- Examined Meniere's original 4 papers in French
- ''… cerebral states, called migraine, give place in the end to similar attacks and the deafness which arises in these circumstances would seem to us inevitably to be related to a disease of the same nature.''
- "…we believe that it can be asserted that many so-called migraines are only the index of a morbid process leading infallibly to deafness.''

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Reference	No.	Treatment	Improved Item or Symptom	Score System	Response Rate to Treatment (%)
Kato et al[34]	159	ESD	QOL	MDQOL	87
Hu and Parnes[38]	30	ESD	QOL	MDQOL	80
Convert et al[39]	90	ESD	QOL	MDQOL	81
Durland et al[40]	19	ESD	Vertigo		95
Barrs et al[41]	21	ITS	Vertigo		52
Dodson et al[42]	22	ITS	Vertigo		55
Cohen-Kerem et al[43] (meta-analysis of 15 studies)	627	ITG	Vertigo		74.7 (class A) 92.7 (class A of B)
Perez et al[44]	71	ITG	Vertigo		83
Wu and Minor[45]	34	ITG	Vertigo		90
Banerjee and Johnson[46]	21	ITG	QOL	GBI	81
Paradis et al[47]	67	ITG (37) ESD (30)	QOL	MDQOL	ITG (54) ESD (75)
Glasscock and Miller[48]	31	VNS	Vertigo		94
Pappas and Pappas[49]	41	VNS	Vertigo		90
Brookes[50]	62	VNS	Vertigo		93
Fukuhara et al[51]	28	VNS	Vertigo		78.3
Colletti et al[52]	48	VNS (24) ITG (24)	Vertigo		VNS (96) ITG (75)
Hillman et al[53]	64	VNS (39) ITG (25)	Vertigo		VNS (95) ITG (80)
Current study	25	Migraine treatment	QOL	MDQOL	92

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Migraine Features in Patients With Meniere's Disease

Yaser Ghavami, MD; Hossein Mahboubi, MD, MPH; Amy Y. Yau, MD; Marlon Maducdoc, BS; Hamid R. Djalilian, MD

- Looked at a cohort of 28 definite MD pts
- 68% of pts with MD had migraine HA's
- Other 32% had FHx of Migr, migr features or 3 sensitivities (light, sound, motion, vis motion, weather, smells)

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Management of Mal de Debarquement Syndrome as Vestibular Migraines

Yaser Ghavami, MD; Yarah M. Haidar, MD; Kasra N. Ziai, MD; Omid Moshtaghi, BS; Jay Bhatt, MD; Harrison W. Lin, MD; Hamid R. Djalilian, MD

- 15 MDDS pts tx'd w migraine protocol
- Historical control group 17 tx'd w PT
- Females (73%) and a mean age of 51
- Tx VAS: 7.6 → 1.8, Ctrl: 7.4 → 6.8
- F/u mean 14 mo

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Evaluating Quality of Life in Patients With Meniere's Disease Treated as Migraine

Yaser Ghavami, MD[1], Yarah M. Haidar, MD[1], Omid Moshtaghi, MD[1], Harrison W. Lin, MD[1], and Hamid R. Djalilian, MD[1,2]

- Cohort of 26 def MD prospectively evaluated
- Treated w migraine protocol – stepwise protocol nortriptyline/verapamil then topiramate
- MDQOL survey initially and in follow up
- 92% improved – mean 8 episodes/mo pre, 0.6 post
- MD pts respond well to migraine protocol
- Response ≈ equivalent to vest n. section

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MDDS

Clinical Feature	All Patients With MdDS Frequency, N = 32	%	Patients Treated With Migraine Prophylactic Medications Frequency, N = 15	%	Patients Treated With Physical Therapy and VR Frequency, N = 17	%	Treatment Versus Control P value*
Sensitivity							
Visual motion sensitivity	16	50%	9	60%	7	41%	0.48
Light sensitivity	15	47 %	7	47%	8	47%	0.85
Sound sensitivity	13	41%	7	47%	6	35%	0.87
Head motion sensitivity	20	63%	10	67%	10	59%	0.79
Smells sensitivity	10	31%	4	27%	6	35%	0.43
Weather change sensitivity	7	22%	2	13%	5	29%	0.49
Medication sensitivity	5	16%	2	13%	3	18%	0.63
Motion sickness	23	72%	10	67%	13	77%	0.35
Mental confusion (head fog)	17	53%	9	60%	8	47%	0.12
Family History							
Family history of migraine	8	25%	3	20%	5	29%	0.56
Family history of Meniere disease	0	0	0	0	0	0	0.92
Family history of motion sickness	1	3%	1	7%	0	0	0.05
History of using medication for migraine	7	22%	3	20%	4	24%	0.73
Sinus pain, facial pressure, or headache when exposed to wind or air conditioner	23	72%	13	87%	10	59%	0.01
Pain in scalp or face from touching	5	16%	1	7%	4	24%	0.03
History of getting headache when eating ice cream	18	56%	9	60%	9	53%	0.81
History of sinus headaches	23	72%	13	87%	10	59%	0.04
Neck stiffness	12	38%	8	53%	4	24%	0.06
Fulfilled International Headache Society criteria for migraine headache	23	72%	11	73%	12	71%	0.9

MdDS = mal de debarquement syndrome; VR = vestibular rehabilitation.

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Migraine and Hyperacusis

- 18 pts hyperacusis, tx w migraine protocol
- 17 historical controls tx'd w progressive broad band noise sound therapy
- No sound therapy used in migraine tx group
- Modified Khalfa Score (Normal < 27)
- Tx: 32.6 → 22.2
- Control: 33.9 → 27.6

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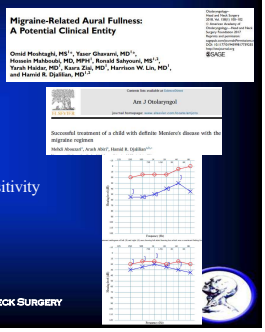
Other Migraine Work

- Migraine aural pressure
  - 11 pts – 6/11 (54%) w migraine headaches
  - VAS 7.2 → 1.5 (p<0.001)
  - 91% had visual motion sensitivity
- Pediatric dizziness
  - If MRI negative, migraine
- 5 pts with persistent post-stapedectomy vertigo
  - 3 had migraine headache hx, 2 had pressure sensitivity
  - Blood patch ineffective, CT neg for long prosth
  - Tx'd w migraine prophylaxis and all improved



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Migraine and Hearing Loss

- Kim. 45,114 migraine vs 180,456 controls. Auris Nasus Larynx. 2019
  - Migraine pts 50% more likely to get sudden HL
- Chu. 10,280 migraine vs 41,120 controls. Cephalalgia 2013
  - Migraine cohort 80% higher chance of developing sudden HL
- Migraine and sudden SNHL. (Jenkins HA, Coker NJ. Arch Oto HNS 1987)
  - Case report of recurrent sudden HL with migraine HA

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Cochlear Migraine

- Recurrent HL (usually LF)
- No dizziness
  - FH migraine
  - Headache, neck stiffness hx
  - Motion intolerance
  - Sensitive to pressure changes

The Role of Migraine in Hearing and Balance Symptoms

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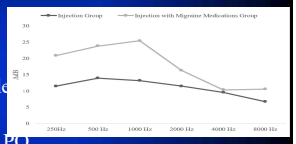
Sudden Hearing Loss

- Treatment of sudden HL (Laryngoscope, in press)
  - PO and IT steroids 47 pts
  - Adjuvant migraine prophylaxis 46 pts
- Significantly improved LF outcome w adjuvant migraine meds (N+T±V) and le # of injections (Abouzari…Djalilian AAO 2019)
- On avg 10 dB better improvement over PO and IT steroids



Average Improvement per Frequency

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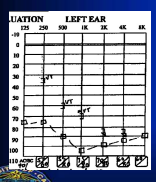
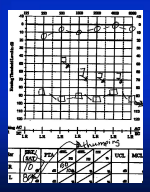
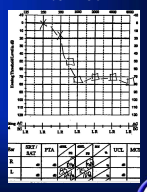
Sudden HL

3/26/19	4/8/19	5/16/19
(IT+PO steroids)	Started N+T	N75/T150







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Treatment of Migraine

- Lifestyle changes
- Strict adherence to diet
- Elimination diet to find problem
- Do not skip meals, drink lots of water during day until 3 hr b/f bed
- Sleep same schedule, check sleep study if anatomy/hx warrants
- Regular exercise and meditation
- Vitamin B2 200 bid, Magnesium (oxide or glycinate) 400 bid

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Treatment of Migraine

- Medication
  - Abortive agents
    - Triptans, Ergots – not useful for otologic migraine
  - Symptom agents
    - Analgesics
    - Antiemetics, anticholinergics
  - Prevention
    - Most effective for MRV

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Abortives

- Triptans, generally do not help vertigo
  - Imitrex 50 x 1, repeat in 2 hrs
  - Very effective for headache (not if coronary artery disease)
- Prednisone ½ to 1 mg/kg x 5-7d no taper or 7 d with taper
  - Can be used if pt must get immediate relief

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Prophylaxis

- More important and more effective
- Vestibular migraine generally does not responds to vestibular suppressant medications, e.g., meclizine, though some pts who are histamine sensitive benefit
- Often helps to treat underlying sensory amplifications
- Vest suppressants used only for trips, etc.

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Prophylaxis of Migraine

- Mechanism of action not understood
- All work ~ 70-80% of time
- They all take weeks-months to work – until the desired dose reached
- All have to be titrated gradually to desired dose
- Lots of art in managing medications

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TCA -Nortriptyline

- Tricyclic antidepressant group
- Mechanism unclear -Central antihistamine, norepinephrine, serotonin
  - Can cause somnolence (give qhs)
  - Depending on sensitivity, can start at 5 mg (liquid), 10, or 25mg qhs
  - Nortriptyline 25mg qhs increase q2-3wks by 25 to max of 75, if not improved
  - Consult cardiologist if arrhythmia history
  - Best agent for patients with poor sleep or associated anxiety/depression
    - If they're crying in the office, nortriptyline is the way to go
  - Alt is amitriptyline which causes a bit more somnolence – dosing same
  - Beyond 75 mg check EKG for QTc
  - When not to use: already on high dose x-depressants, unk arrhythmia hx

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SSRI - Paroxetine

- Best choice for patients who need an antidepressant but have cardiac issues, multiple rhythm-affecting agents
- Anti-migraine mechanism unclear
- Can cause somnolence or wakefulness, first start qhs on wknd
- Start at 5 mg qhs increase q2wks to 10-20-30 if needed
- When not to use: high dose x-depressants

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Calcium Channel Blockers - Verapamil

- Mechanism – unclear
  - Perhaps relates to genetics (calcium channel gene) or ?vasoactive
- Verapamil dose 120mg increase by 60 q2wks to max of 240 SR (can also do 40 qhs then 40 bid to start)
- Takes 1-2 weeks to work
- Verapamil SR (24 hr) 120-180-240 q2wk or start at 40-80mg qhs
- When not to use: SBP < 95 or HR <60 – or start at 20 or 40mg
- Alternative: Candesartan 4-8-16-32 – does not lower HR

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Anticonvulsants

- May raise threshold for cortical spreading depression
  - Topirimate (Topamax) 25-50-75-100-125-150 q1w
  - Gabapentin (Neurontin) 100-100tid-200tid-300tid q 2wk
  - Good choice for pts w multiple cardiac meds/issues
  - Alternative: acetazolamide (Diamox) 250qd-bid-tid-500 bid

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Beta Blockers

- Any beta blocker can work
  - Propranolol 80mg LA, increase by 40 in 2 weeks if ineffective (80-120-160LA)
  - Metoprolol 50 XL
  - Atenolol 50-100/day
- Side effects
  - Fatigue, slow pulse, orthostatic hypotension
  - Best to not use in diabetics, asthmatics

Sanchez-Del-Rio et al. (2006)

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Treatment

- Protocol: notrtiptyline if sleep/anxiety issues, verapamil if HTN
- Increase to effective dose, may require combination of 2 meds
- Complete disappearance of symptoms will not always occur
- Once intermittent, find triggers in 6 hrs b/f symptoms
- For pts w cardiac meds, paroxetine and topamax
- Continue Tx for 3-6 months, then taper off
- Continue diet and lifestyle change

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Invasive/Surgical Treatment

- Tympanostomy tube
  - Pts with pressure-change induced symptoms (generally low pressure)
    - Dizziness with weather change (cloudy rainy), high altitude, flights
    - Unilateral if symptoms localize (e.g., pain)
    - 5 pts w purely pressure sensitive vertigo – resolved post-PET (under review)
- Intratympanic steroid
  - Pts who fail medical therapy
  - Up to 4 injections spaced 1-2 weeks apart
- ELS surgery…?

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Conclusions

- Migraine is the primary cause of vast majority of vertigo
- Think of migraine in ear pressure, otalgia, sudden hearing loss, recurrent acute or chronic "sinusitis"
- History is key, neck stiffness, motion sensitivity, etc.
- Concurrent HA (or any hx thereof) not necessary for dx
- Treat with lifestyle changes/supplements first, screen for OSA
- Learn prophylactic tx

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