Otologic Migraine:
Effects of Migraine on the Ear

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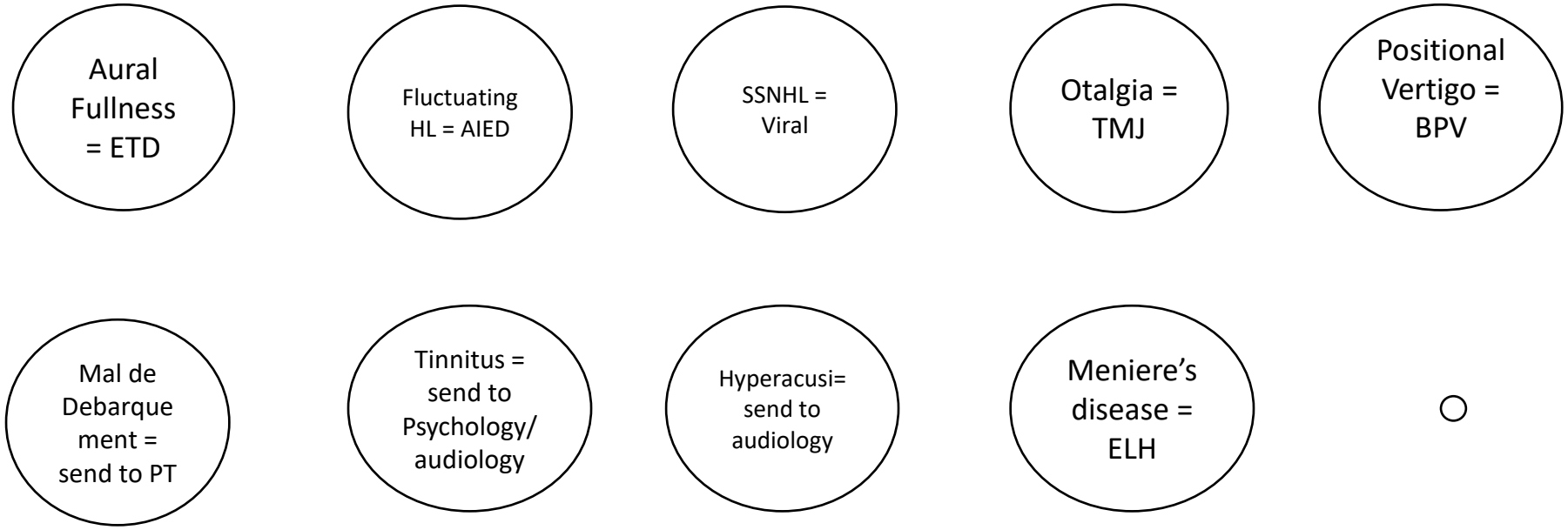
Disclosures

- Elinava Technologies and Mind:Set Technologies, Co-founder
- Cactus Medical, Co-founder
- NXT Biomedical, Consultant

This is How I Thought of Ear Disorders



This is How I Thought of Ear Disorders

Aural Fullness = ETD

Fluctuating HL = AIED

SSNHL = Viral

Otalgia = TMJ

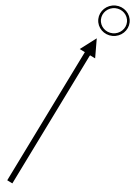
Positional Vertigo = BPV

Mal de Debarque ment = send to PT

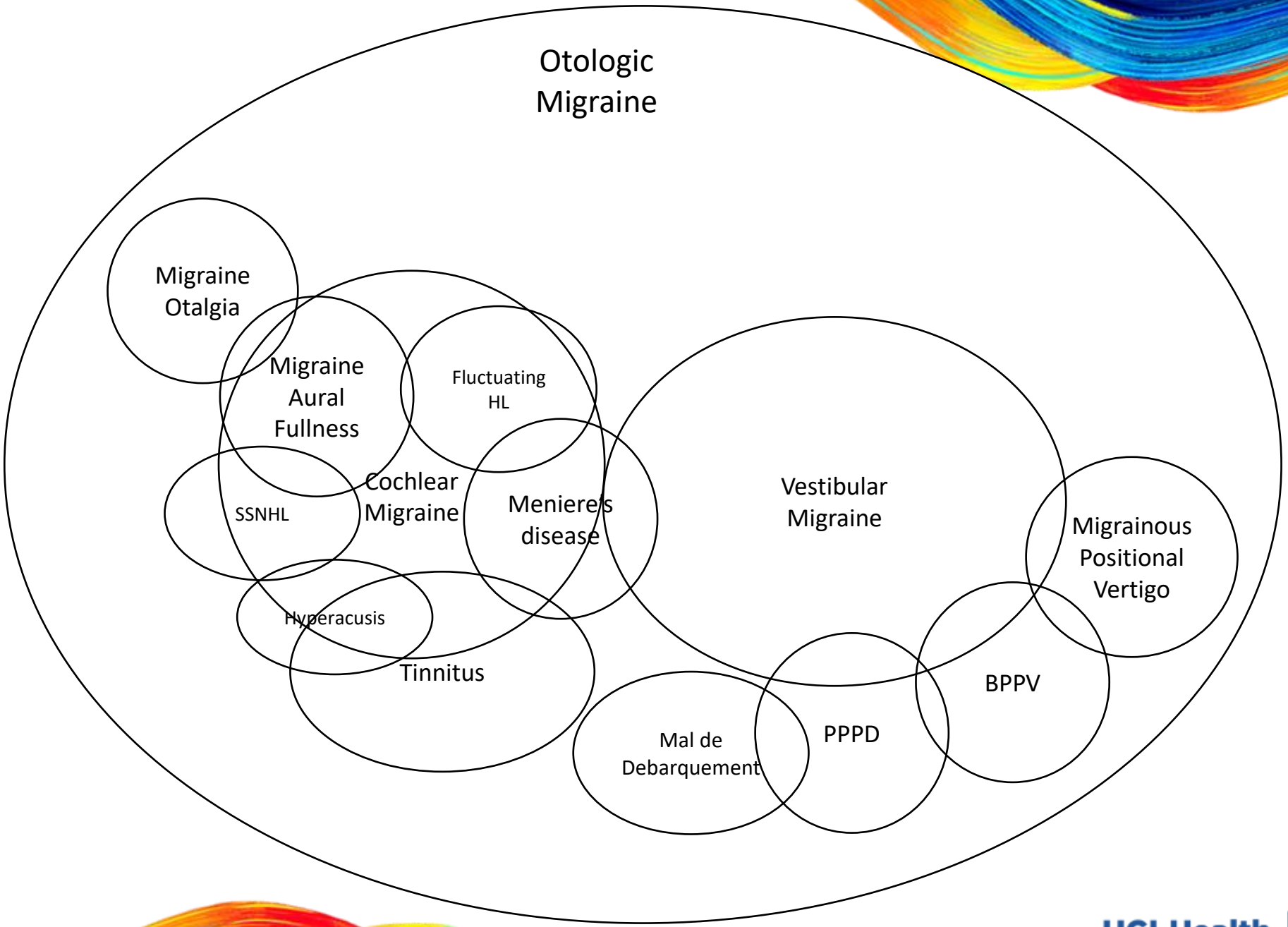
Tinnitus = send to Psychology/ audiology

Hyperacusi= send to audiology

Meniere's disease = ELH

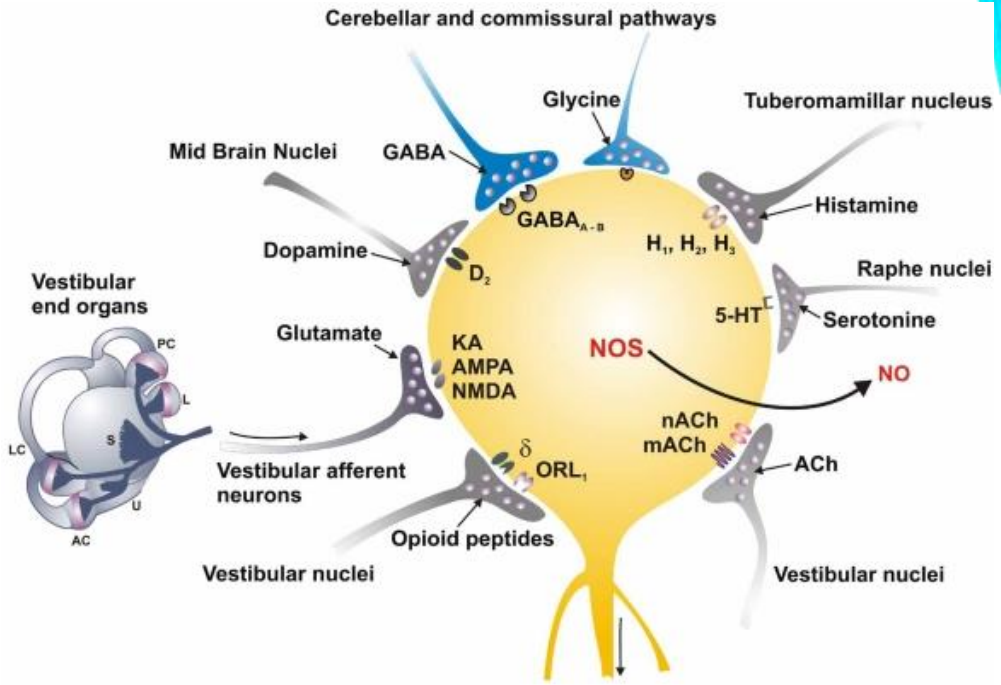


Migraine

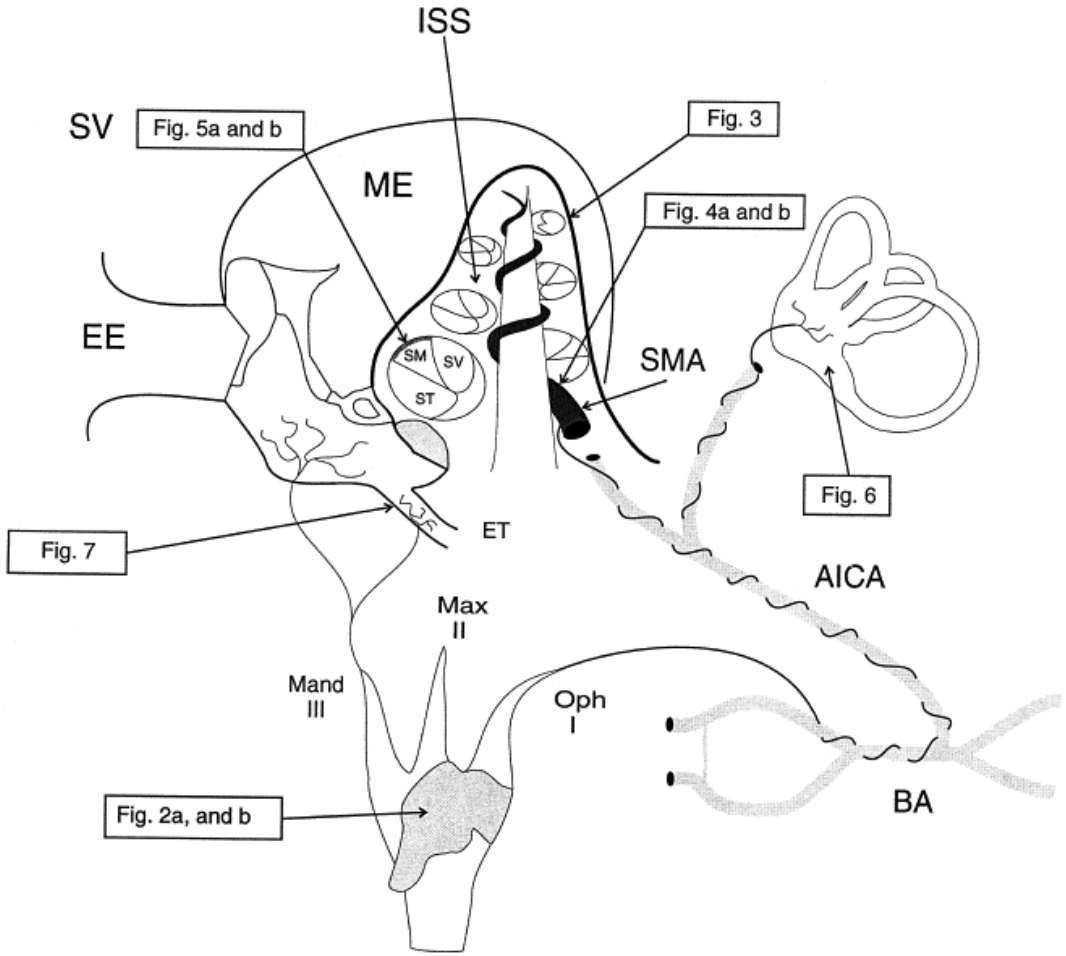

Otologic Migraine
Migraine Otalgia
Migraine Aural Fullness
Fluctuating HL
SSNHL
Cochlear Migraine
Meniere's disease
Vestibular Migraine
Migrainous Positional Vertigo
Hyperacusis
Tinnitus
BPPV
Mal de Debarquement
PPPD

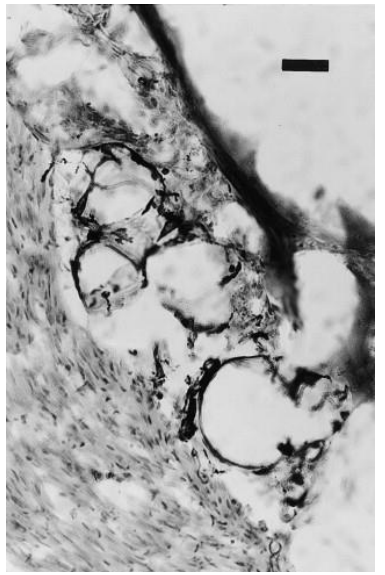
Pathophysiology

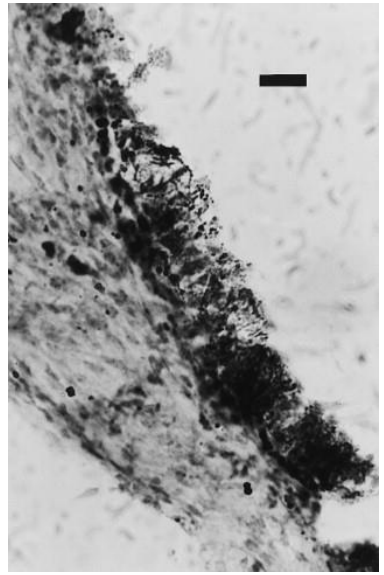
- Baseline hypersensitivity of brain
- NT involved: glut, 5-HT, hist, CGRP, etc.
- Spreading cortical depression with activation of CN V →
  - Headache
  - ?Δs to the inner ear, central vestibular effect



Trigeminal Nerve and Ear



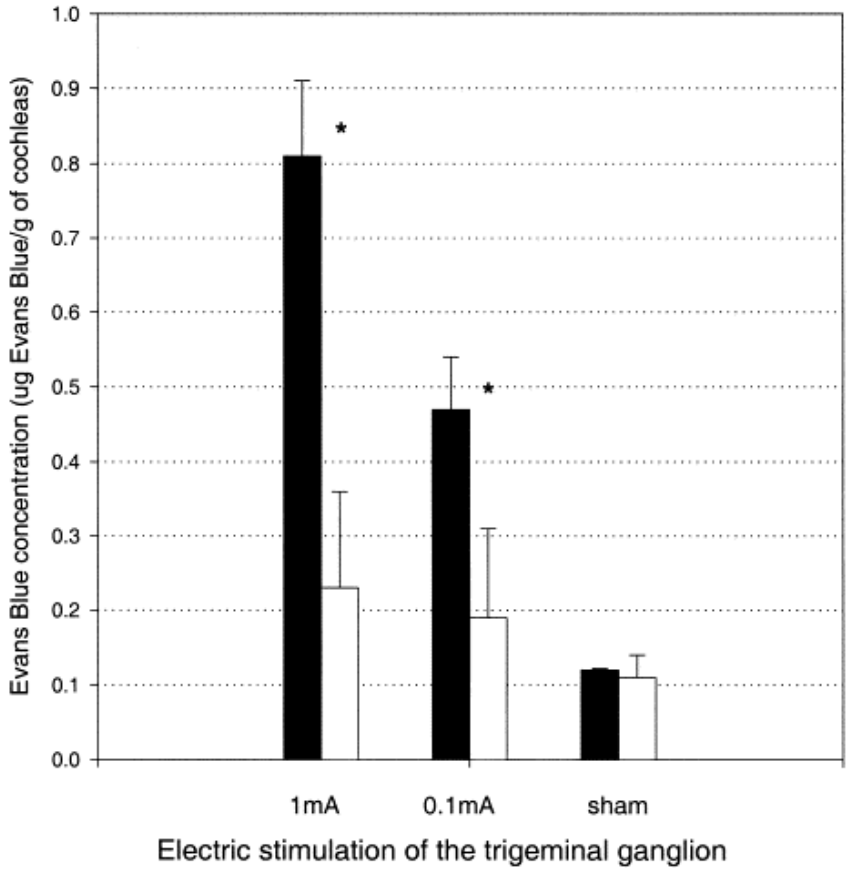




Direct evidence of trigeminal innervation of the cochlear blood vessels.
Vass Z[1], Shore SE, Nuttall AL, Miller JM. Neuroscience. 1998 May;84(2):559-67.

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.

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

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”

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

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

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: lima beans; Fruit: Avocados, figs, raisins. Bananas tyramine and citrus fruit histamine. Overly ripened fruits

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 or in ear)
  - Intense exercise

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

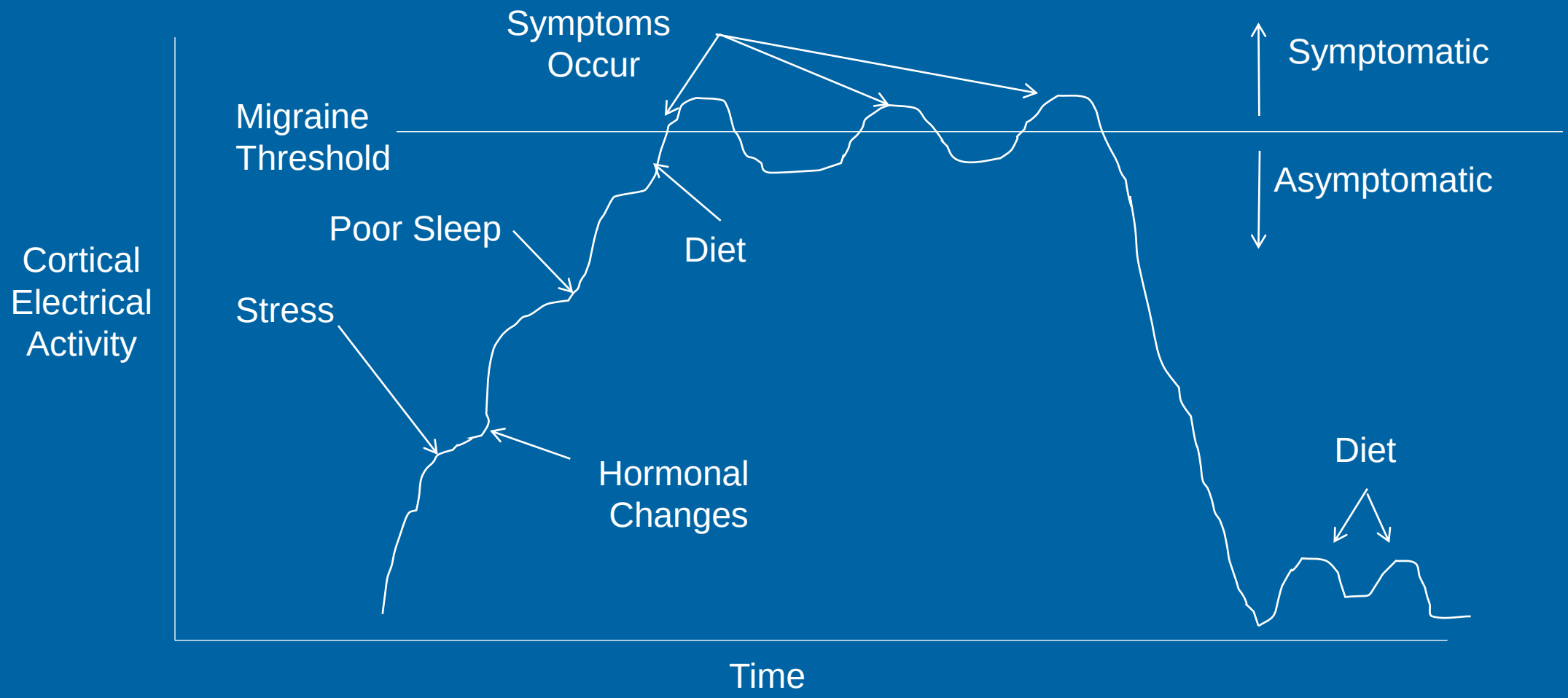
Migraine Associated Symptoms

- 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)

Think of Migraine

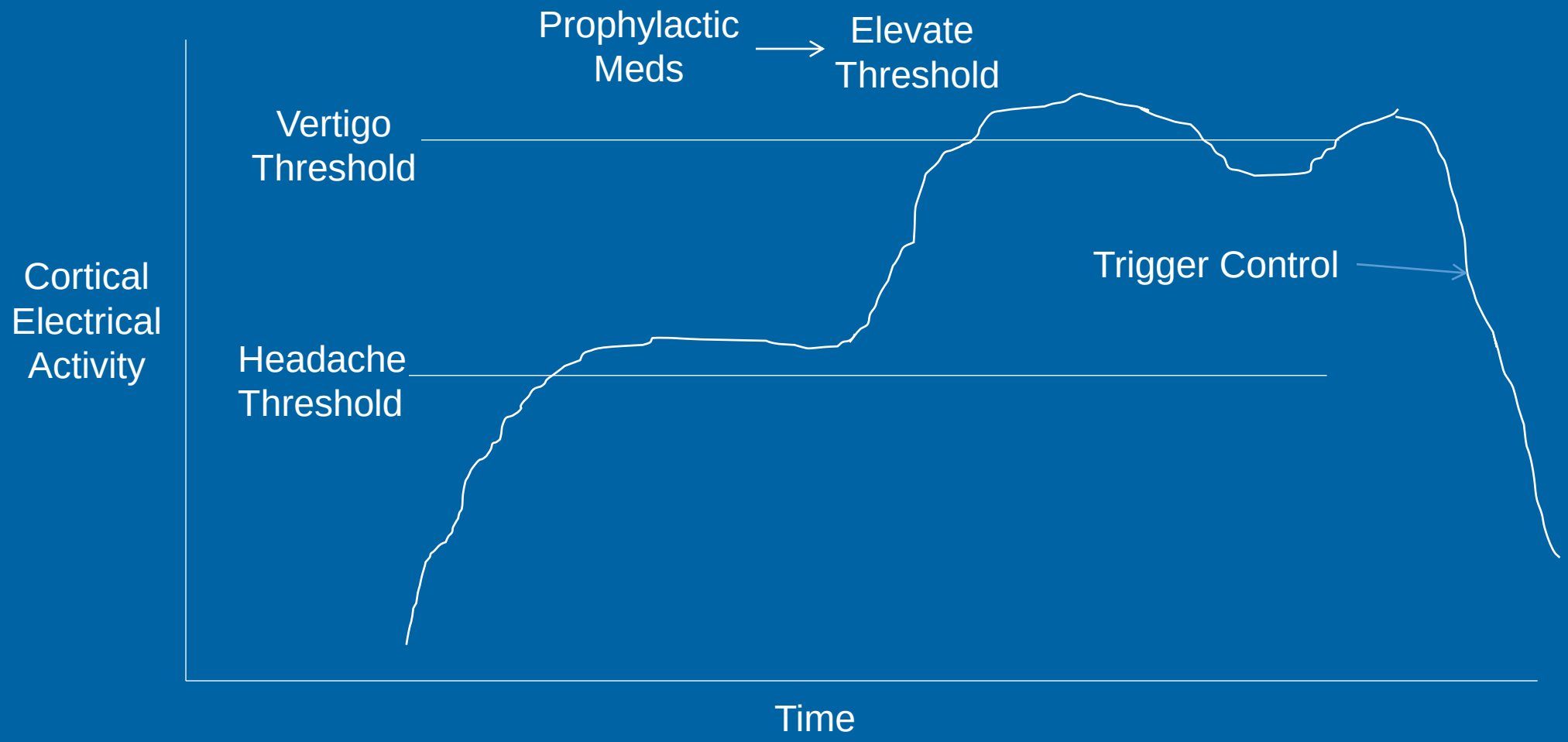
- Feel dizzy with loud noise, but no SCD or PLF
- Recurrent BPV not responding to Epley (MRI -)
- If pt vertiginous and MRI negative (and not BPV)
- Dix-Hallpike causes dizziness but no nystagmus
- Severe nausea/vomiting after Epley
- Immediate nystagmus on Dix-Hallpike

Intermittent Migraine

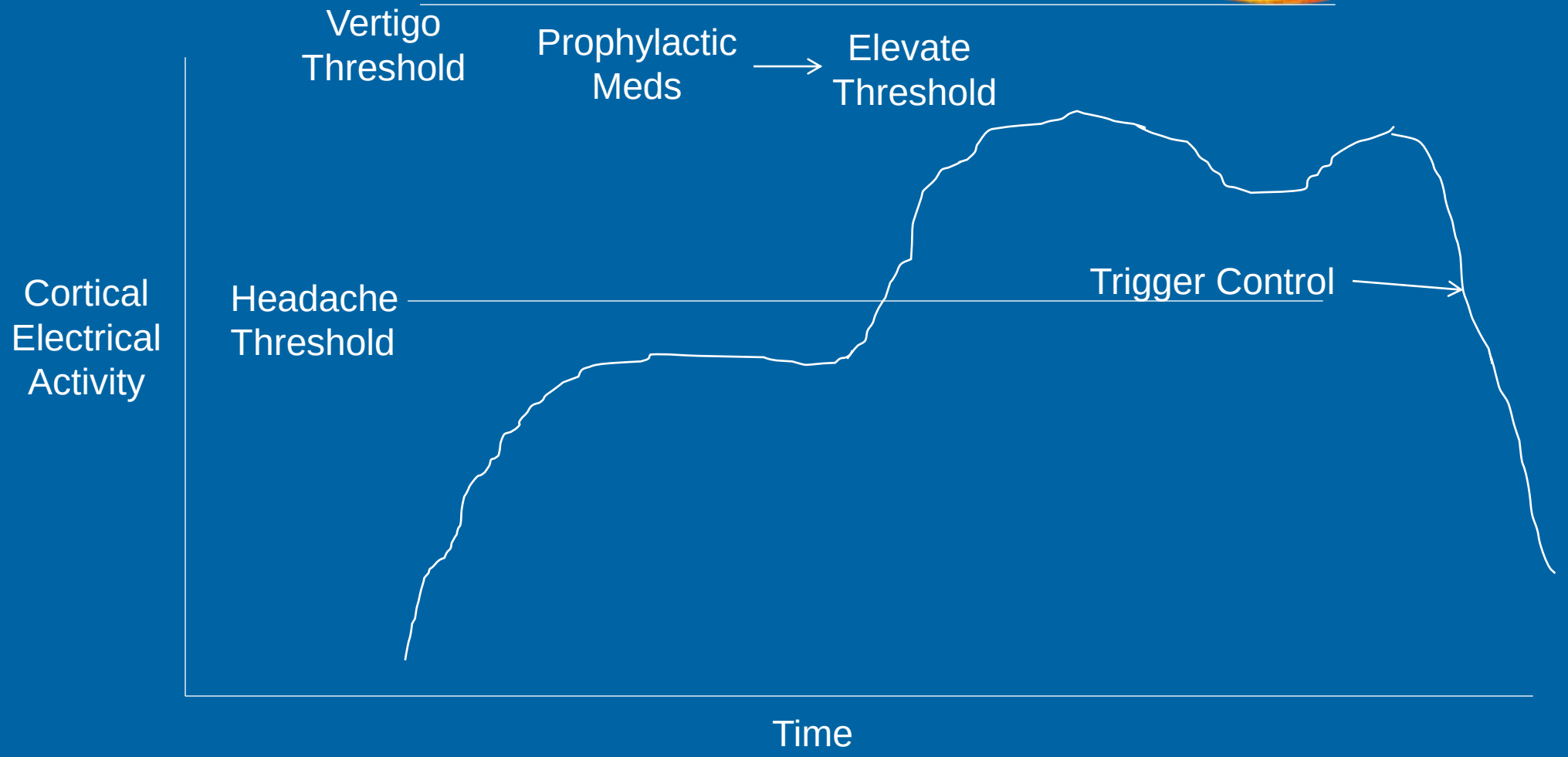


Continuous Migraine Symptoms

Prophylaxis vs Trigger Control



Multiple Migraine Thresholds



Migraine and Meniere's

The Laryngoscope

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)

Migraine and Meniere's

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

Annals of Otology, Rhinology & Laryngology
2018, Vol. 127(12) 877–887

DOI: 10.1177/0003489418799107
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SAGE

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

Reference	No.	Treatment	Improved Item or Symptom	Score System	Response Rate to Treatment (%)
Kato et al[14]	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

Migraine and MDDS

The Laryngoscope

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

MDDS

Clinical Feature	All Patients With MdDS		Patients Treated With Migraine Prophylactic Medications		Patients Treated With Physical Therapy and VR		Treatment Versus Contro
	Frequency, N = 32	%	Frequency, N = 15	%	Frequency, N = 17	%	*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

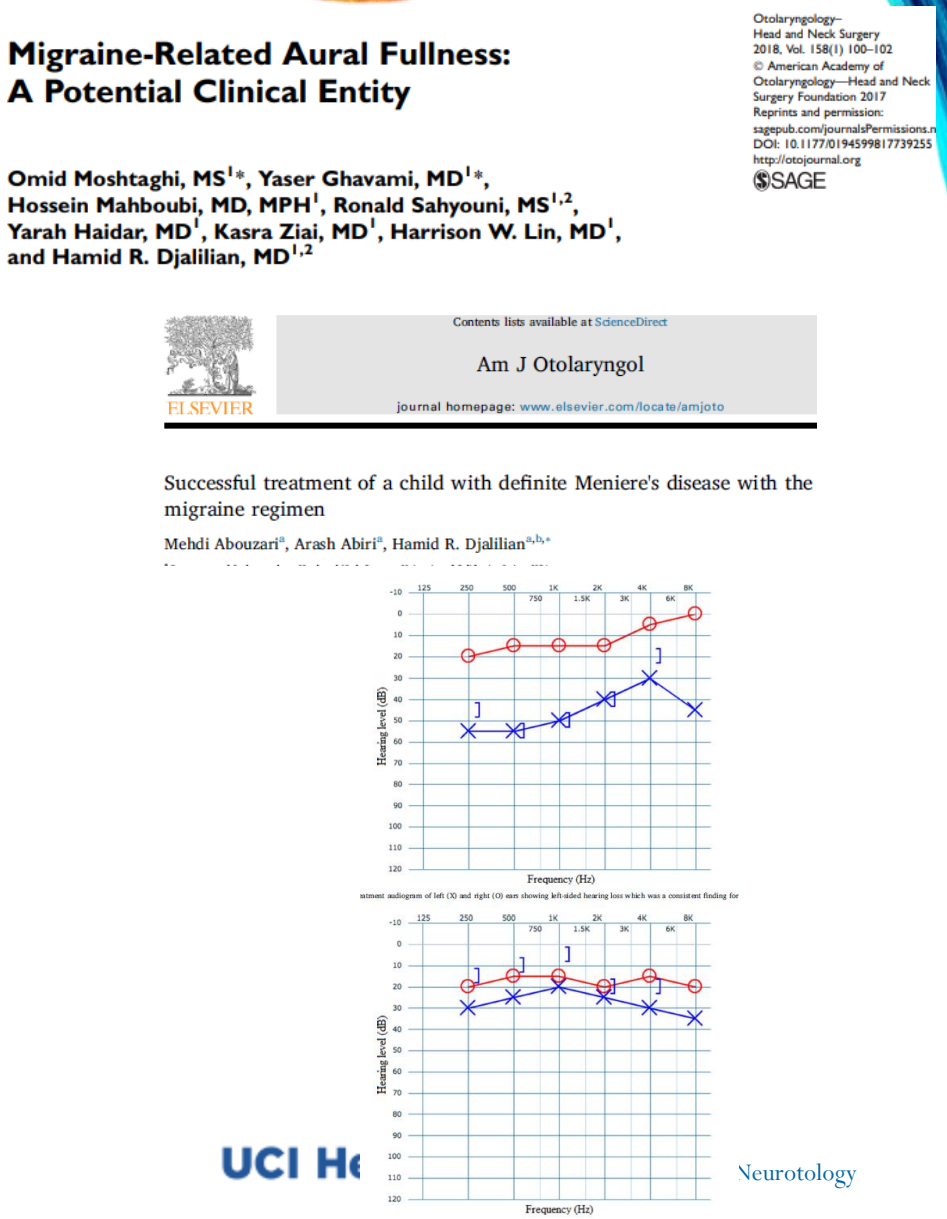
MdDS = mal de debarquement syndrome; VR = vestibular rehabilitation.

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

Other Forms of Otologic Migraine

- 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, exam normal, think 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/SCD
  - Tx'd w migraine prophylaxis and all resolved
- 9 pts with AN and episodic vertigo
  - 7 had migraine which resolved with medical treatment



Migraine-Related Aural Fullness: A Potential Clinical Entity

Omid Moshtaghi, MS[1]*, Yaser Ghavami, MD[1]*, Hossein Mahboubi, MD, MPH[1], Ronald Sahyouni, MS[1,2], Yarah Haidar, MD[1], Kasra Ziai, MD[1], Harrison W. Lin, MD[1], and Hamid R. Djalilian, MD[1,2]

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Successful treatment of a child with definite Meniere's disease with the migraine regimen

Mehdi Abouzari[a], Arash Abiri[a], Hamid R. Djalilian[a,b,*]

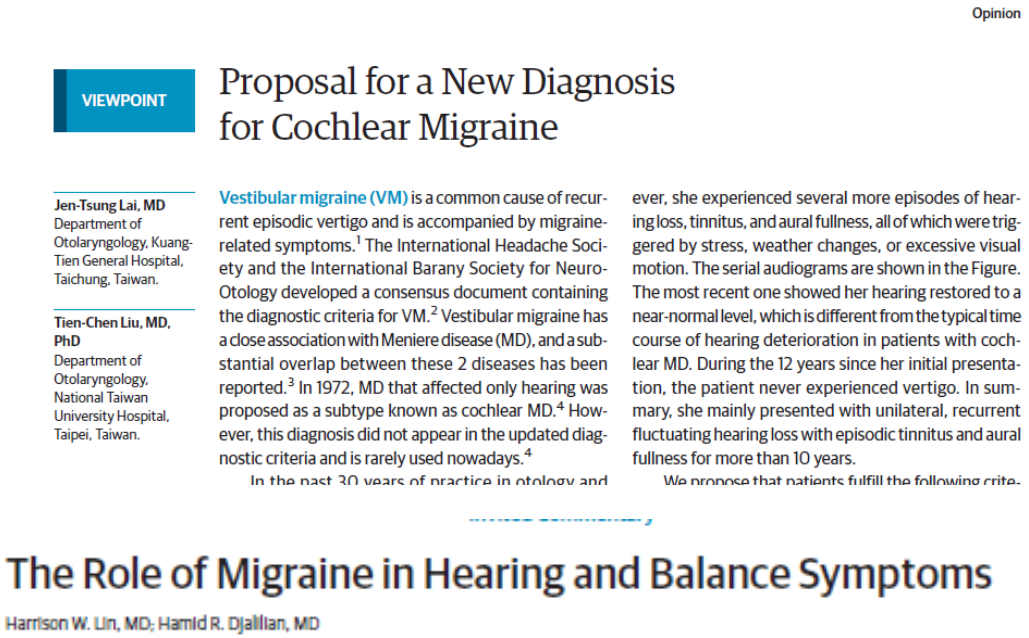
tatment audiogram of left (X) and right (O) ears showing left-sided hearing loss which was a consistent finding for

Migraine and Hearing Loss

- Kim. 45,114 migraine vs 180,456 controls.
  - 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

Cochlear Migraine

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



Opinion

VIEWPOINT

Proposal for a New Diagnosis for Cochlear Migraine

Jen-Tsung Lai, MD
Department of Otolaryngology, Kuang-Tien General Hospital, Taichung, Taiwan.

Tien-Chen Liu, MD, PhD
Department of Otolaryngology, National Taiwan University Hospital, Taipei, Taiwan.

Vestibular migraine (VM) is a common cause of recurrent episodic vertigo and is accompanied by migraine-related symptoms.[1] The International Headache Society and the International Barany Society for Neuro-Otology developed a consensus document containing the diagnostic criteria for VM.[2] Vestibular migraine has a close association with Meniere disease (MD), and a substantial overlap between these 2 diseases has been reported.[3] In 1972, MD that affected only hearing was proposed as a subtype known as cochlear MD.[4] However, this diagnosis did not appear in the updated diagnostic criteria and is rarely used nowadays.[4]

In the past 30 years of practice in otology and ever, she experienced several more episodes of hearing loss, tinnitus, and aural fullness, all of which were triggered by stress, weather changes, or excessive visual motion. The serial audiograms are shown in the Figure. The most recent one showed her hearing restored to a near-normal level, which is different from the typical time course of hearing deterioration in patients with cochlear MD. During the 12 years since her initial presentation, the patient never experienced vertigo. In summary, she mainly presented with unilateral, recurrent fluctuating hearing loss with episodic tinnitus and aural fullness for more than 10 years.

We propose that patients fulfill the following crite-

The Role of Migraine in Hearing and Balance Symptoms

Harrison W. Lin, MD; Hamid R. Djalilian, MD

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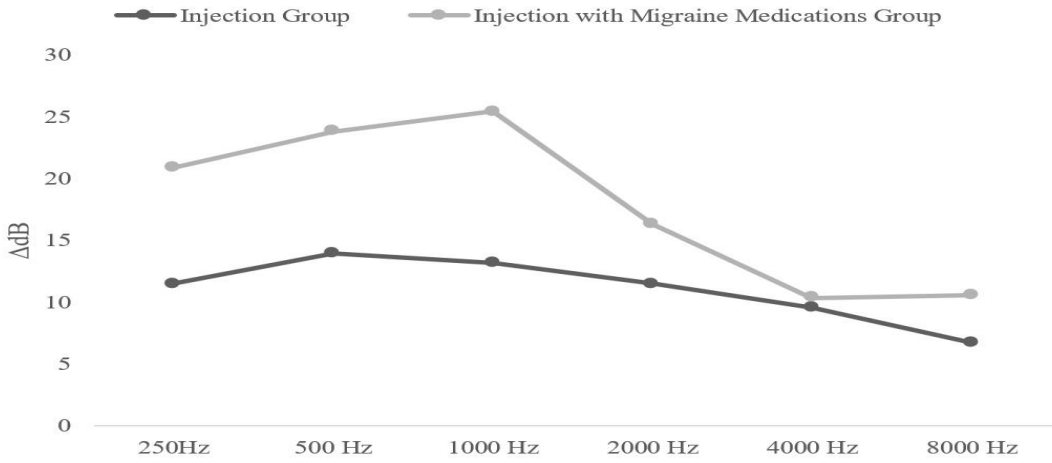
Sudden Hearing Loss

- Treatment of sudden HL
  - PO and IT steroids 47 pts
  - Adjuvant migraine prophylaxis 46 pts
- Significantly improved LF outcome w adjuvant migraine meds (N+T±V) and less # of injections (Abouzari…Djalilian. 2020 Apr 3. doi: 10.1002/lary.28618. Online ahead of print.
- On avg 10 dB better improvement over PO and IT steroids



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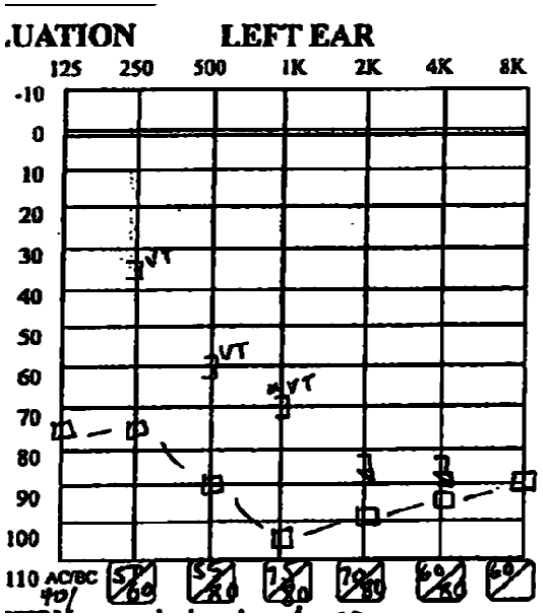
Sudden HL

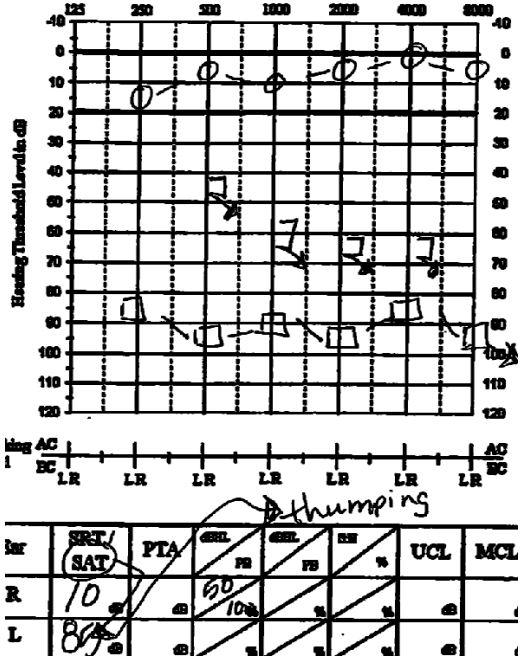
3/26/19

(IT+PO steroids)



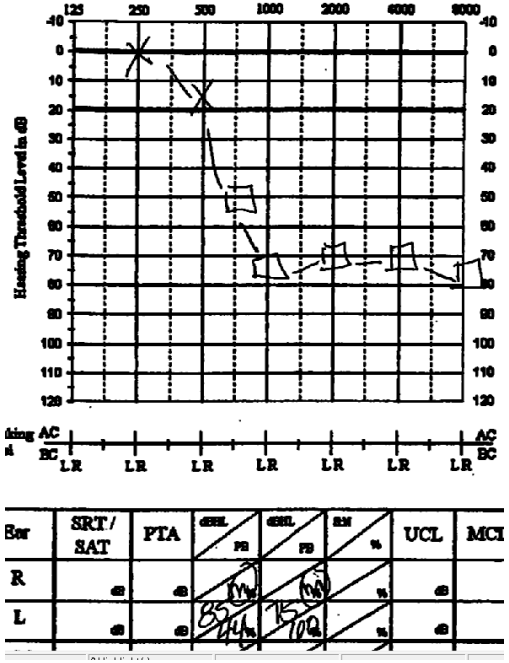
4/8/19

Started N+T



5/16/19

N75/T150



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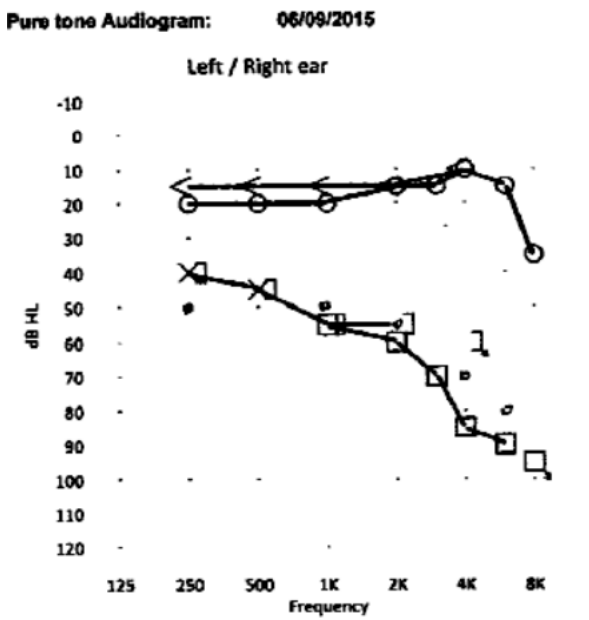
Chronic Sudden HL

- Goshtasbi…Djalilian (under review)
- 21 pts, onset of sudden HL mean 6.9 mo, median 4 mo
- Aural fullness in 52%, current HA in 29%
- Nortriptyline 25-50-75 + topiramate 25-50-75-100-125-150 /6 wks
- If not better 2 IT injections
- Return to baseline in 14%
- WD improvement of ≥15% was observed in 54%
  - Mean WD improvement of 35±20%
  - 7/21 (33%) went from non-serviceable to serviceable hearing

Chronic Sudden HL

6/9/15

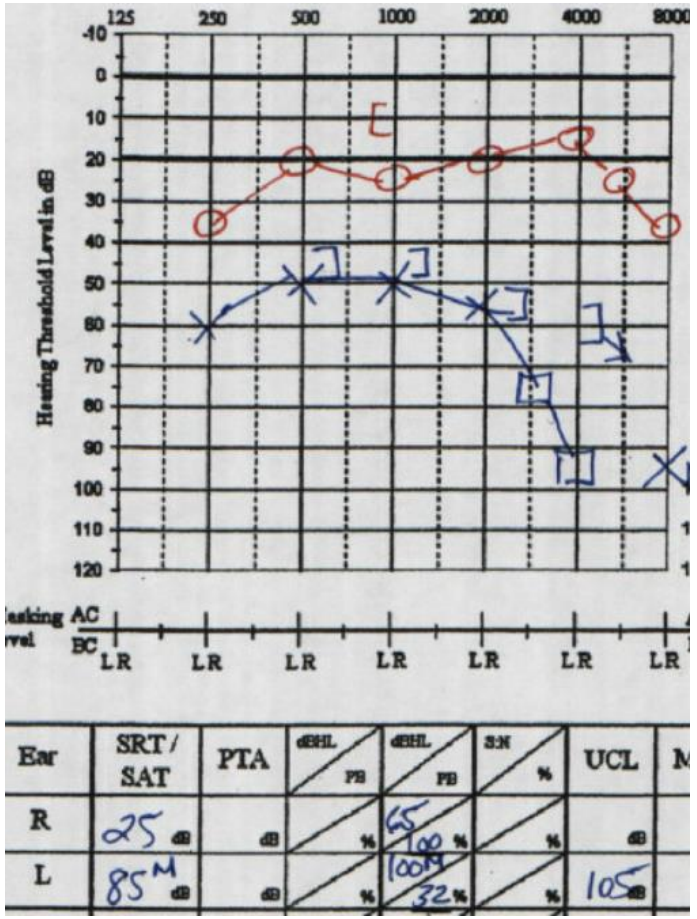


Notes:

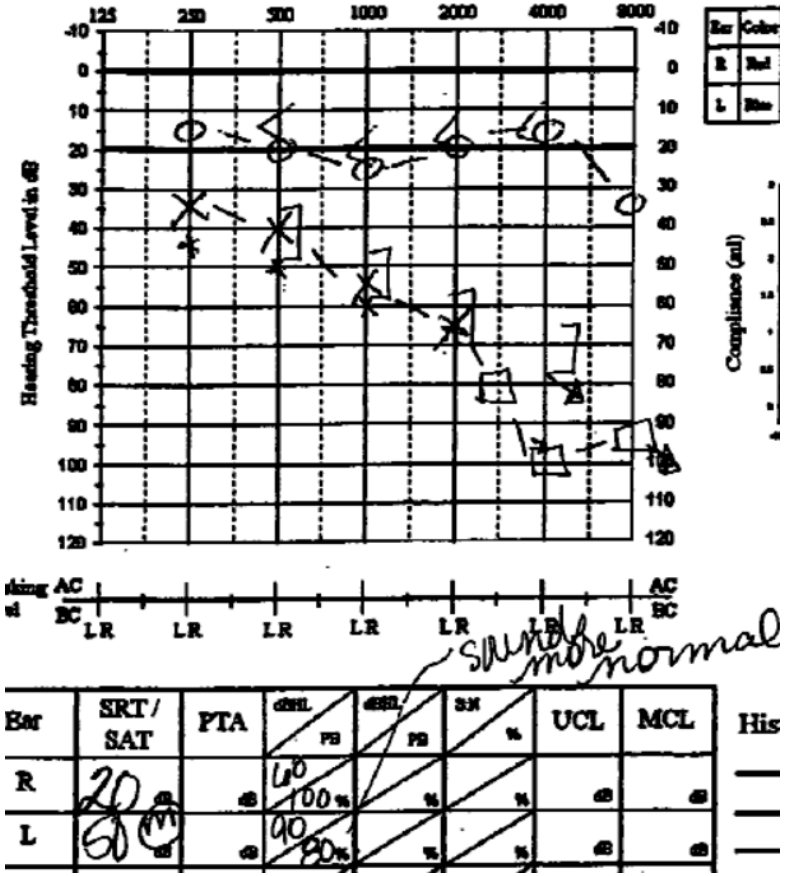
Speech Audiometry: 06/09/2015

	SRT	SD	SD-A
Left		32% at 85dB	
Mask		55dB	
Right	20dB	100% at 60dB	

9/7/15



1/14/16
N25/T50



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Treatment of Migraine

- Lifestyle changes
- Strict adherence to diet
- Elimination diet to find problem
- Don’t skip meals, drink lots of H2O during day until 3 hr b/f bed
- Sleep same schedule, check sleep study if anatomy/hx/wt warrants
- Regular exercise and meditation
- Vitamin B2 200 bid, Magnesium (oxide or glycinate) 400 bid

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

Prophylaxis

- More important and more effective
- Must be combined with trigger control
- Often helps to treat underlying sensory amplifications
- Vest suppressants used only for trips, etc.

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 up to desired dose and ramped down
- Lots of art in managing medications

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

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
- Alt: Venlafaxine

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

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

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

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

Reasons for Failure

- Starting at too high a dose – go back one step
- Escalating dose too quickly – escalate in ½ dose increments
- Escalating in too large a dose – escalate in 2 or 3 wk increments instead of 1wk
- Non-compliance by patient – ask pt how long they took it b/f stopping
- Not addressing underlying triggers (diet, sleep, etc.) – diet diary, sleep study
- Continued overstimulation – visual or head motion – reduce phone/videogame
- Major life stressor – consult psychiatry

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Conclusions

- Migraine is the primary cause of many forms of ear disease and 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

Otologic Migraine

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