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Tinnitus: Clinical Evaluation, Differential Diagnosis, and Therapeutic Options

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Disclosures

- **Presenter Disclosure**: Financial: Daniel Zeitler is an Otologist/Neurotologist at Virginia Mason Medical Center in Seattle, WA. He received an honorarium for this presentation. Non-financial: Daniel Zeitler has no relevant non-financial relationships to disclose.
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- Providers should always evaluate the limitations of diagnostic and screening tools, considering their potential for false results as well as any ethical implications.
- It is the responsibility of course participants to critically evaluate the evidence from multiple sources to guide professional practice.

Learning Outcomes

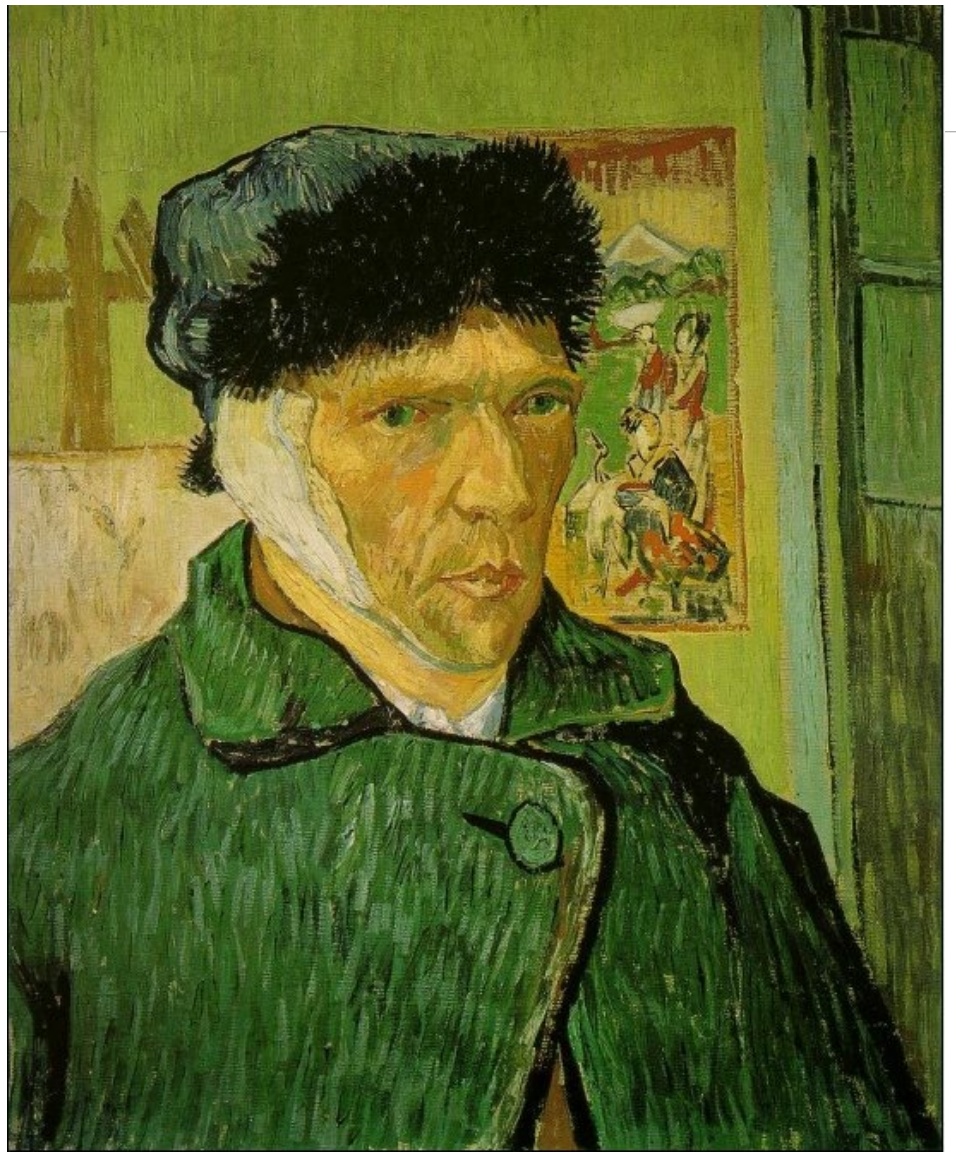
After this course, participants will be able to:

- Distinguish between subjective and objective tinnitus.
- List the essential components of a tinnitus evaluation.
- Classify tinnitus treatments as either recommended or not recommended by the American Academy of Otolaryngology—Head and Neck Surgery Foundation (AAO-HNSF).

“…my ears whistle and buzz day and night. I can say that I am living a wretched life.”

- Ludwig von Beethoven, 1801

Van Gogh



Tragic Consequences

52-year-old male stabs himself to death over tinnitus

- Sustained constant tinnitus after a rock concert
- Sought treatment from multiple provider and tried alternative remedies
- Couldn't sleep
- Desperate that it would never change
- Committed suicide 3 months after event

Dissatisfied patient shoots renowned ear specialist

- 68-year-old retired salesman seeking treatment by prominent University of Michigan ENT
- Dissatisfied with care after 3 years
- Shot physician during appointment

https://www.newsshopper.co.uk/news/9647848.robert-mcindoe-stabbed-himself-to-death-over-awful-tinnitus-from-them-crooked-vultures-gig/
https://www.upi.com/Archives/1992/06/26/Patient-arraigned-in-slaying-of-renowned-ear-specialist/2831709531200/

Background

- 30-40m Americans (4-15%) (underreported); 5-10m severe
- Prevalence highest 40–70-year-olds (8-20%) – presbycusis?
- Men > Women
- Unilateral vs. bilateral ear(s) vs. “in my head”
- No definition (≥ 5 minutes?; ≥ 5 minutes at least 1x/week?)
- Transition from symptom to disease?

Møller AR. *Prog Brain Res*. 2007. PMID 17956767

Quiz Hint

Classification

Subjective: the perception of sound that is only heard by the patient (most common)

Objective: sounds produced by para-auditory structures that are audible to an examiner (rare)

Pulsatile vs. ***Non-pulsatile*** Tinnitus

- Pulsatile tinnitus can be objective or subjective

Hazell, JW. Ann Otol Rhinol Laryngol Suppl. 1995; PMID 7668731

Subjective Tinnitus

Differential Diagnosis

- Head trauma
- Hearing loss/presbycusis
- Noise exposure
- Medications (aminoglycosides, furosemide, quinine, salicylates, lithium, platinum)
- CNS pathology (stroke, meningitis, encephalitis, schwannoma)
- Inner ear disorders (Meniere's Disease, labyrinthitis)
- Iatrogenic (otologic surgery)
- Infectious (AOM, COME)
- Vascular compression syndromes
- TMJ or muscle tension

Subjective Tinnitus

Similarities between tinnitus and central pain syndromes

- Absence of objective findings
- Can vary circumstantially
- Exaggerated response to normal stimulation (hyperpathia)
- “Kindling theory” (after-discharge activity in damaged neurons leads to ‘pace-maker phenomenon’)
- Alleviate symptoms rather than treat the illness

Jastreboff PJ. Neurosci Res. 1990; PMID 2175858

Pathogenesis

- Cause unknown in most patients
- Difficult to link cause and effect in others
- Unusually related to identifiable disorder
- Severe tinnitus likely due to functional abnormalities in auditory pathways
  - Morphogenic changes in cochlea, CN VIII, and/or nuclei
  - Neural plasticity (‘space vacancy’ theory)

‘Space Vacancy’ Theory (e.g., Phantom Sound Phenomenon)

- CNS response to input deprivation from auditory periphery
- Tonotopic mapping recapitulated from periphery to CNS
- Cochlear damage → lack of central input
- Altered tonotopic organization = neural plasticity
- Altered auditory cortex forms lesion projection zone (LPZ)
- Neurons in LPZ show 2 important changes:
  - Increased spontaneous firing rate (kindling theory)
  - Increased representation of bordering neurons (= loss of central inhibition)

Tinnitus and Affective Disorders

Nonclassical auditory pathway connects thalamic auditory nuclei to amygdala

Bypasses auditory cortex filtering

May explain affective disease associated with tinnitus (depression, anxiety)

Activation of amygdala in tinnitus patients

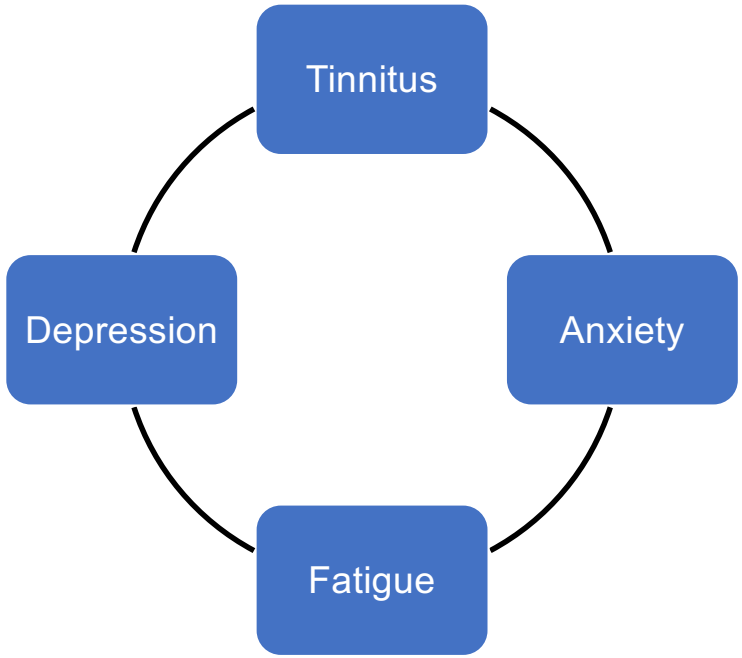
Supported by fMRI changes:

- Tinnitus + affective disorders = white matter fiber integrity in certain amygdala subregions compared to healthy controls

Huang Y. Human Brain Mapp, 2024; PMID 38798104

Tinnitus and Depression

- Up to 60% with tinnitus have/have had MDD (general population 6-25%)
- Prevalence of mood disorder higher
- Patients with depression rate tinnitus more severe
- Higher incidence of phobias, alcohol dependence, panic attacks, and sexual dysfunction



Folmer RL. Otolaryngol Head Neck Surg. 1999; PMID 10388877
Robinson SK. Hear Res. 2007; PMID 16973315

Subjective Tinnitus: Evaluation

Tinnitus Evaluation: History

- Careful medical history (otologic, noise exposure, CV, medications)
- Description of tinnitus
  - Onset
  - Quality, Pitch, Loudness
  - Laterality
  - Alleviating/aggravating factors
  - Comorbid complaints (vertigo, hearing loss, etc.)
  - TMJ
  - Concentration/sleep disruption
  - Risk factors (stress, caffeine, fatigue, etc.)

Evaluation

- No adequate quantifying measurement
  - Tinnitus Handicap Questionnaire, Tinnitus Handicap Index
  - Visual analog scale
  - Subjective scale (sleep disruption, concentration effects)
  - Audiometric intensity matching
    - 10/10 on loudness scale typically match to <10 dB

Quiz Hint

Tinnitus Evaluation: Exam

- Complete head and neck exam with microscopic otoscopy
- Audiometric evaluation
  - Pure tone thresholds, speech discrimination, tympanometry, ARTs
  - High frequency audiogram
- Laboratory tests low yield
- Imaging (MRI +C of IAC and posterior fossa)

Tunkell DE. Otolaryngol Head Neck Surg. 2014; PMID 25273878

Q3

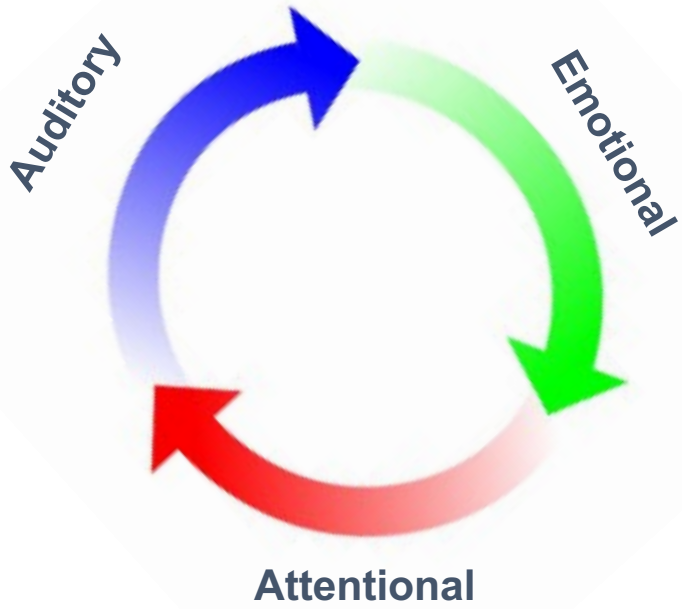
STATEMENT 3. IMAGING STUDIES: Clinicians should not obtain imaging studies of the head and neck in patients **with tinnitus, specifically to evaluate the tinnitus, unless** they have 1 or more of the following: tinnitus that localizes to 1 ear, pulsatile tinnitus, focal neurological abnormalities, or asymmetric hearing loss. *Strong recommendation against based on observational studies, with a preponderance of benefit over harm.*

Treatment: Counseling and Lifestyle

- Avoidance of caffeine, stimulants
- Smoking cessation
- Noise exposure
- Exercise and healthy diet (low Na+)
- Discuss stress, fatigue, anxiety, and depression
- Review medication list
- Reassurance (“25/50/25” rule)
- Hearing aids as indicated
- American Tinnitus Association (www.ata.org)

Treatment

- Auditory
  - Hearing instruments
  - Masking devices
  - Cochlear implantation
- Emotional
  - TRT, CBT
  - Neuromonics, Lenire
  - Counseling
- Attentional
  - Music



Lenire – Dual Mode Stimulation

- Combines audio and tongue stimulation (mild pulses)
- Clinically-trialed
- FDA-approved

Time	THI Score
Baseline	51.2
12 weeks	33.5
12 months	30.9

Tinnitus and Sound Enrichment

- Provides masking and relaxation
- Weakens tinnitus signal by reducing difference between tinnitus and background noise
- Sounds should be non-intrusive, pleasant and relaxing
  - Classical music
  - Ambient music (e.g., spa sounds)
  - Brown noise (vs. white noise) (e.g., rain, waterfall, crashing waves)
- Beneficial:
  - Hallam (1989) combined with TRT
  - Henry and Wilson (2001) combined with CBT

Tinnitus Retraining Therapy

- Aims to change functional connection between auditory and limbic system
- Primary goal is to habituate reactions
  1. Counseling: classify tinnitus as neutral stimuli
  2. Sound therapy: reduce the perceived strength of the stimuli
- Significant improvement by 3m, up to 80% maintain results at 1 yr.
- Neuromonics® – custom neural stimulus

Jastreboff PJ. *Otolaryngol Clin N Am.* 2003; PMID . 12856300
Phillips JS. *Cochrane Database Syst Rev*. 2010; PMID 20238353

Quiz Hint

Q2

STATEMENT 8. SOUND THERAPY: Clinicians may recommend sound therapy to patients with persistent, bothersome tinnitus. *Option based on RCTs with methodological concerns, with a balance between benefit and harm.*

STATEMENT 9. COGNITIVE-BEHVIORAL THERAPY (CBT): Clinicians should recommend CBT to patients with persistent, bothersome tinnitus. *Recommendation based on RCTs with methodological concerns, with a preponderance of benefit over harm.*

Tunkell DE. Otolaryngol Head Neck Surg. 2014; PMID 25273878

Tinnitus and Amplification

- Reduce CNS fatigue from hearing loss
- Increase neural activity and assist cortical reorganization
- Up to 50% reduction in tinnitus severity
- Cochrane: only HAs (34%) and music (30%) patient-reported to mitigate tinnitus (n=3400+)

Searchfield GD. Int J Audiol, 201o; PMID 20500032
Brennan-Jones CG. Int J Audiol. 2020; PMID 31361173
Schilder A. Otolaryngol Head Neck Surg. 2014; PMID 24748588

Cochlear Implantation for Tinnitus

- Bilateral SNHL and tinnitus
- 58% reduction loudness, 44% on THI
- Higher preoperative THI, VAS = greater decreases over time
- 80% have residual inhibition after switch-off
  - Supports involvement of central pathways
- SSD literature (90% reduction)

Baguley DM. Prog Brain Res 2007; PMID 17956799.
Wang Q. Comm Med, 2024; PMID 39702461
Rasmussen KD. Eur Arch Otorhinolaryngol. 2023; PMID 37099145
Deklerck AN. Brain Sci. 2023; PMID 37891851
Van de Heyning P. Ann Otol Rhinol Laryngol. 2008; PMID 18834065
Zeitler DM. Otol Neurotol; submitted for publication

brain sciences

MDPI

Systematic Review

Deep Brain Stimulation for Primary Refractory Tinnitus: A Systematic Review

Landon Basner [1,2], Jasper V. Smit [3,4], Daniel M. Zeitler [5], Seth R. Schwartz [5], Katie Krause [2], Aiyush Bansal [2] and Farrokh Farrokhi [2,*]

Patient	Age/Sex	Starting THI/TQ	Ending THI/TQ	THI/TQ Reduction	Time to THI/TQ Max Improvement	Site
Dijkstra 1	41 F	76 (THI)	20 (THI)	73.68%	9 mo	vALIC + NAc
Devos 1	54 M	54 (TQ)	16 (TQ)	70.37%	12 mo	MGB of thalamus
Cheung 2	38 F	76	56	26.32%	18 mo	Caudate nucleus
Cheung 3	58 M	54	32	40.74%	16 mo	Caudate nucleus
Cheung 4	58 M	34	18	47.06%	21 mo	Caudate nucleus
Cheung 10	37 F	74	2	97.29%	19 mo	Caudate nucleus
Cheung 12	62 M	82	58	29.27%	20 mo	Caudate nucleus

Transcranial Magnetic Stimulation (TMS)

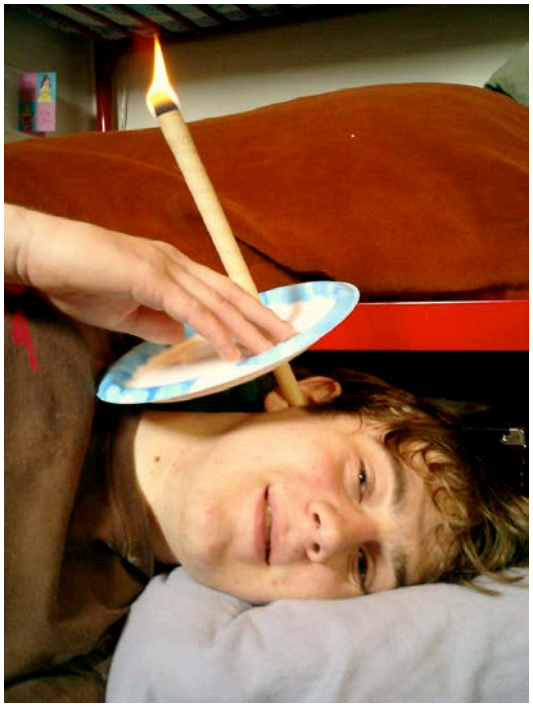
- Magnetic pulses delivered repetitively and rhythmically (brief, ms)
- Frequency-dependent effects on neural activity in superficial cortex
- Trials – LF pulses to temporal lobe 30 min QD x 3-10 days
- Side treated based on fMRI, left temporal lobe, or side opposite loudest percept
- RCTs: 5 trials, 233 patients, equivocal results, no adverse effects

STATEMENT 13. TRANSCRANIAL MAGNETIC STIMULATION (TMS): Clinicians should not recommend TMS for the routine treatment of patients with persistent, bothersome tinnitus. *Recommendation against based on inconclusive RCTs.*

Tunkell DE. Otolaryngol Head Neck Surg. 2014; PMID 25273878
Meng Z. Cochrane Database Sys Rev. 2011; PMID 21975776

Medical Therapy

Medical Therapy



Left image: Photo by Nataliya Vaitkevich: https://www.pexels.com/photo/flat-lay-photo-of-alternative-medicines-7615574/; Center: AI-generated;
Right: Bjørn Bulthuis from Langley, BC, Canada, CC BY-SA 2.0 <https://creativecommons.org/licenses/by-sa/2.0>, via Wikimedia Commons

Medical Therapy

- IV Lidocaine
  - Eliminates tinnitus in 50%, reduced in many
  - Mechanism of action unknown
  - Impractical: Short half life, serious side effects, IV
  - Oral antiarrhythmic (tocainide) = no effect
  - Anticonvulsant (carbamazepine) = no effect

Henry, JA. J Speech Lang Hear Res. 2005; PMID 16411806

Medical Therapy: Benzodiazepines

- Enhance GABA-ergic effects, cortical inhibition
- Decrease cortical habituation

- Johnson et al. (1993): Alprazolam vs. placebo
  - 76% study vs. 5% placebo improvement on VAS, reduced loudness matching
  - Dose required 1.0-1.5 mg/day
  - Risk of dependency

Johnson RM. Arch Otolaryngol Head Neck Surg. 1993; PMID 8343245

Medical Therapy: Tricyclics

- Nortriptyline
- 50-150 mg/day
- 67% (drug) vs. 40% (placebo)**
- Best predictors: sleep disturbance, female, absence of musculoskeletal disorders

** all patients showed improvement including placebo

Dobie RA. Am J Otol. 1993; PMID 8424470

STATEMENT 10. MEDICAL THERAPY: Clinicians should not routinely recommend antidepressants, anticonvulsants, anxiolytics, or intratympanic medications for a primary indication of treating persistent, bothersome tinnitus. *Recommendation against based on systematic reviews and RCTs with methodological concerns, with a preponderance of benefit over harm.*

Tunkell DE. Otolaryngol Head Neck Surg. 2014; PMID 25273878

Medical Therapy

- Other medications
  - Ginkgo: studies equivocal
  - Melatonin: effectiveness in tinnitus-related sleep disturbance
  - Baclofen
  - SSRIs
  - Diuretics
  - Calcium channel blockers
  - Niacin
  - Lipoflavanoids

Bottom line: medication no more effective for tinnitus than placebo

Tunkell DE. Otolaryngol Head Neck Surg. 2014; PMID 25273878

STATEMENT 11. DIETARY SUPPLEMENTS: Clinicians should not recommend Gingko biloba, melatonin, zinc, or other dietary supplements for treating patients with persistent, bothersome tinnitus.
Recommendation against based on RCTs and systematic reviews with methodological concerns, with a preponderance of benefit over harm.

Medical Therapy

Miscellaneous Therapy

- Acupuncture (4 blinded RCTs showed no benefit)
- Hypnosis
- Massage/craniosacral therapy
- Yoga + meditation
- Psychotherapy

STATEMENT 12. ACUPUNCTURE: No recommendation can be made regarding the effect of acupuncture in patients with persistent bothersome tinnitus. *No recommendation based on poor quality trials, no benefit, and minimal harm.*

Tunkell DE. Otolaryngol Head Neck Surg. 2014; PMID 25273878
Park J. Arch Otolaryngol Head Neck Surg. 2000; PMID 10772302

Pulsatile (Vascular) Tinnitus

Pulsatile Tinnitus

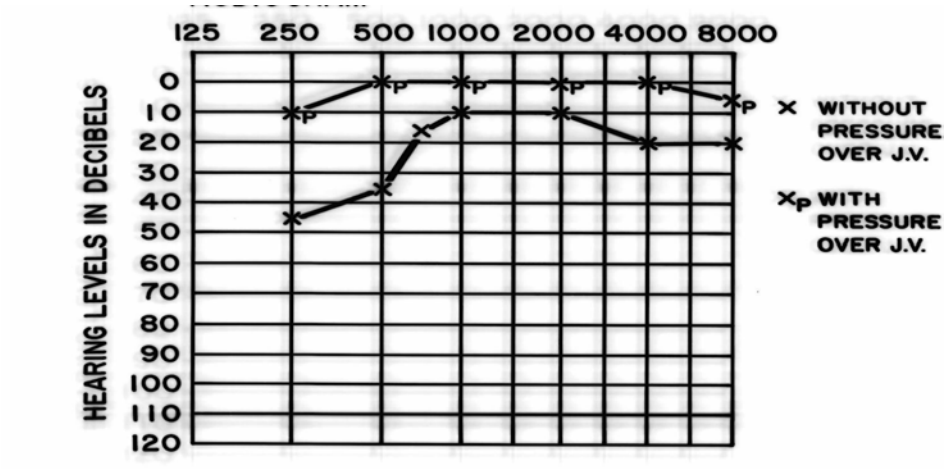
- Requirements:
  1. Source - structures in cranial vault and/or head and neck
  2. Functional cochlea
  3. Turbulent blood flow - increased volume or resistance
- Classification
  - Origin: Arterial vs. venous
  - Audibility: Objective vs. subjective

History

- Onset, duration
- Otologic (dizziness, aural fullness, hearing loss, otalgia/otorrhea)
- Contributing factors
- Headaches, visual disturbances
- Vascular risk (CAD, CVA, DM2, tobacco, HTN)
- Circulatory variables (pregnancy, thyroid, etc.)
- Trauma
- Ischemic (acute, facial/cervical pain, headache)

Langguth B. Prog Brain Res. 2007; PMID17956816

Objective Evaluation



- Microscopic otoscopy
  - Retrotympanic etiology?
- Careful auscultation (sound booth)
  - EAC, mastoid, neck, heart
  - Orbits (trauma)
  - With and without head rotation/digital pressure
- Audiogram – with/without JV compression if LF hearing loss

Differential Diagnosis of PT

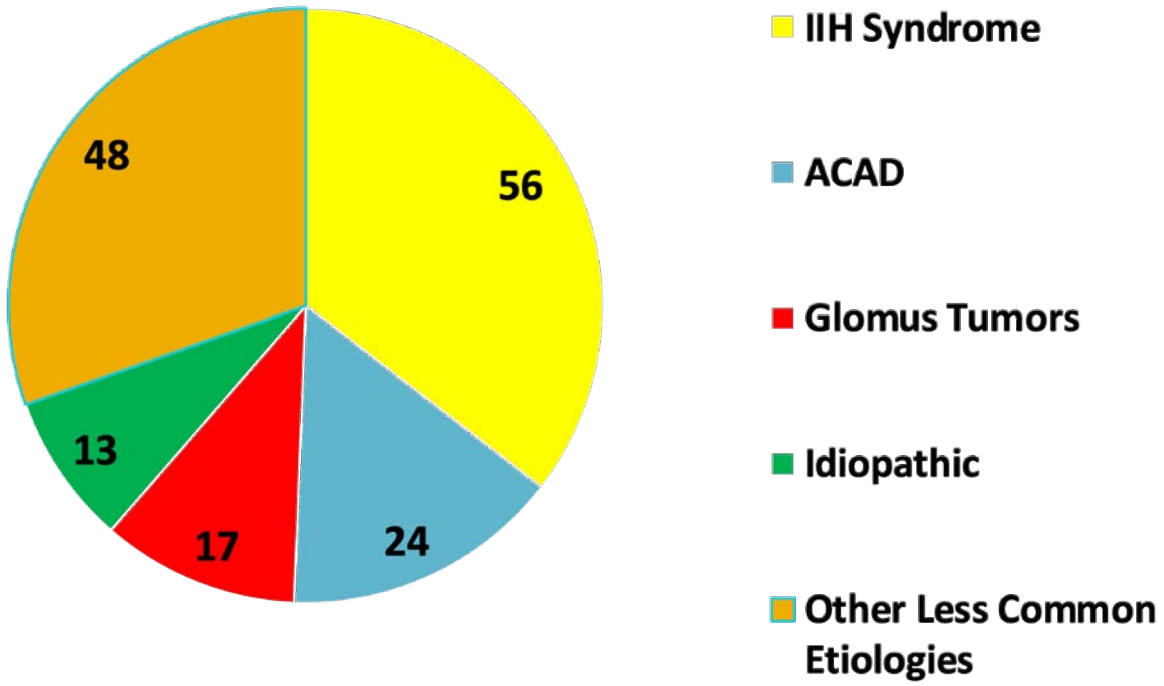
Middle ear conductive hearing loss
- Middle ear effusion
- Chronic otitis: TM or ossicular abnormalities
- Otosclerosis

Neoplasm
- Glomus tympanicum or jugulare
- Middle ear adenoma
- Geniculate ganglion hemangioma

Venous
- Benign intracranial hypertension (BIH)
- Sigmoid or jugular diverticulum
- High jugular bulb
- Transverse or sigmoid stenosis
- Condylar vein abnormalities

Arterial
- Atherosclerotic disease
  - Carotid (ipsilateral or contralateral)
  - Subclavian
- Dural arteriovenous fistulas
- Carotid-cavernous fistula
- Fibromuscular dysplasia of carotid artery
- Carotid artery dissection
- Aberrant internal carotid artery
- Hyperdynamic states (Anemia, thyrotoxicosis, pregnancy)
- Hypertension
- Internal auditory canal vascular loops

Most Common Causes of Pulsatile Tinnitus



Sismanis A. Am J Otol. 1998; PMID 9661757

Vascular Etiologies of Pulsatile Tinnitus

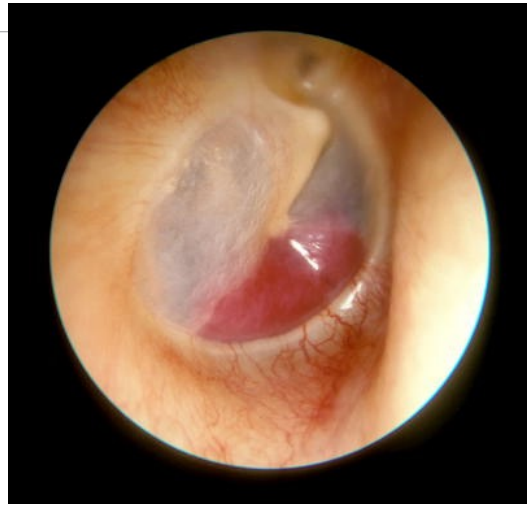
Quiz Hint

Atherosclerotic Carotid Artery Disease (ACAD)

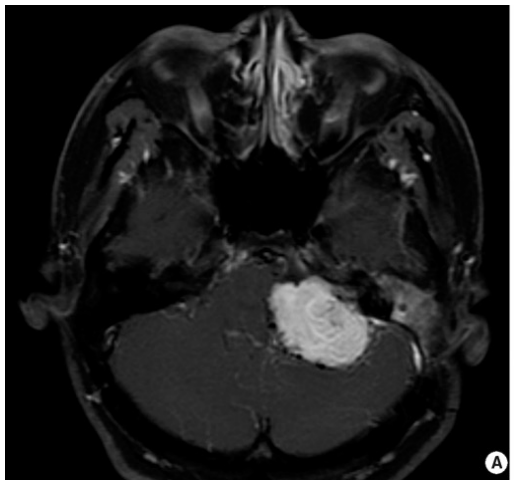
- Most common etiology > 50 yrs., especially with + risk factors
- Pulse synchronous arterial PT
- + neck bruit
- Duplex ultrasound (often only test necessary)
- Tx: carotid endarterectomy and angioplasty
    - often relieves PT

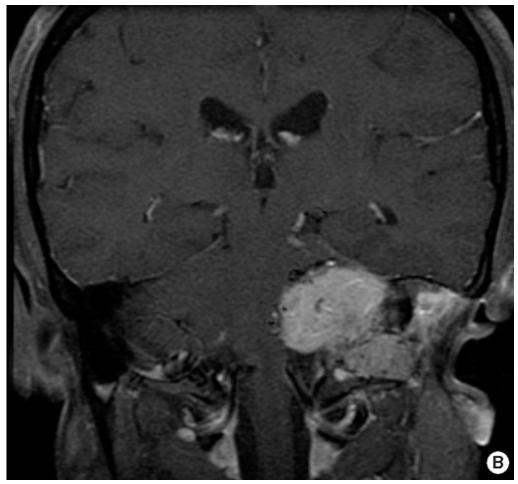
Sismanis A. Am J Otol. 1994; PMID 8579149
Emery DJ. Arch Otolarygol Head Neck Surg. 1998; PMID 9559697

Glomus Jugulotympanicum



- Most common tumor of middle ear
- Creates microvascular shunting
- Up to 98% present with PT
- CT angiogram





Green JD. Laryngoscope. 1994; PMID 8052074
Fayad JN. Otol Neurotol. 2010; PMID 19779386

Dural AV Fistulae

- 10-15% of intracranial AVF
- Transverse-sigmoid sinus most common (75%)
- PT common presenting symptom (>50%)
- 5-6th decade
- Overall annual bleeding risk 1.5%
- Mastoid bruit = AVF until proven otherwise

Peng T. J Clin Neurosci. 2014; PMID 24291477
Kobayshi A. Int J Stroke. 2014; PMID 25042991
Cohen SD. Laryngogscope. 2009; PMID 19172609

Dural AVF – Indications for Treatment

- Disabling PT
- Presence of radiologic high-risk (e.g., dilated veins)
- Neurological deficit(s)
- Intracranial hemorrhage

Dural AVFs – Management

- Combined coil occlusion of venous sinus and supplying arteries (treatment of choice)
- Stereotactic radiosurgery alone or combined w embolization +/- surgery
- Observation

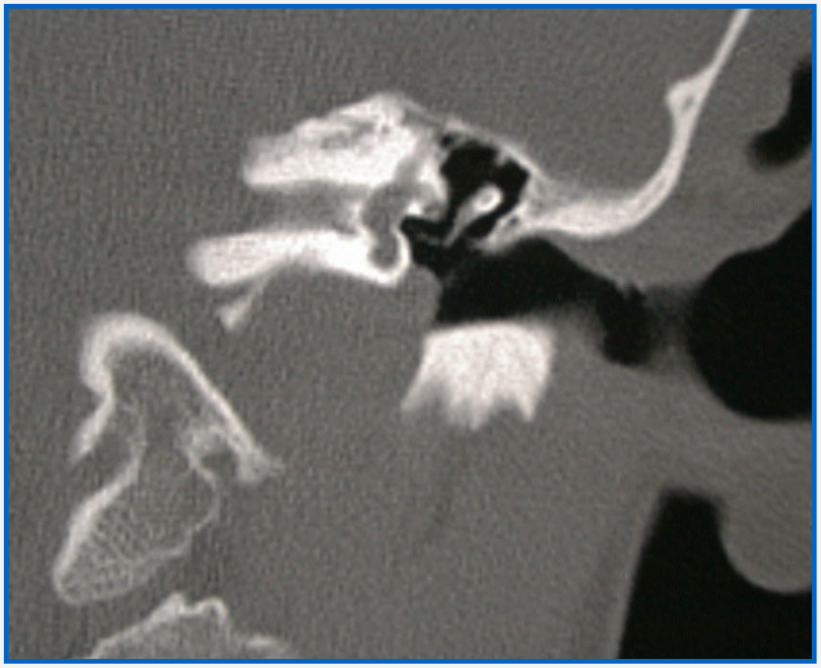
PT resolved in 92% of cases

Kirsch M. Neuroradiology. 2009; PMID 19352640
Loumiotis I. Neurosurg Rev. 2011; PMID 21584687

Jugular Bulb Diverticulae

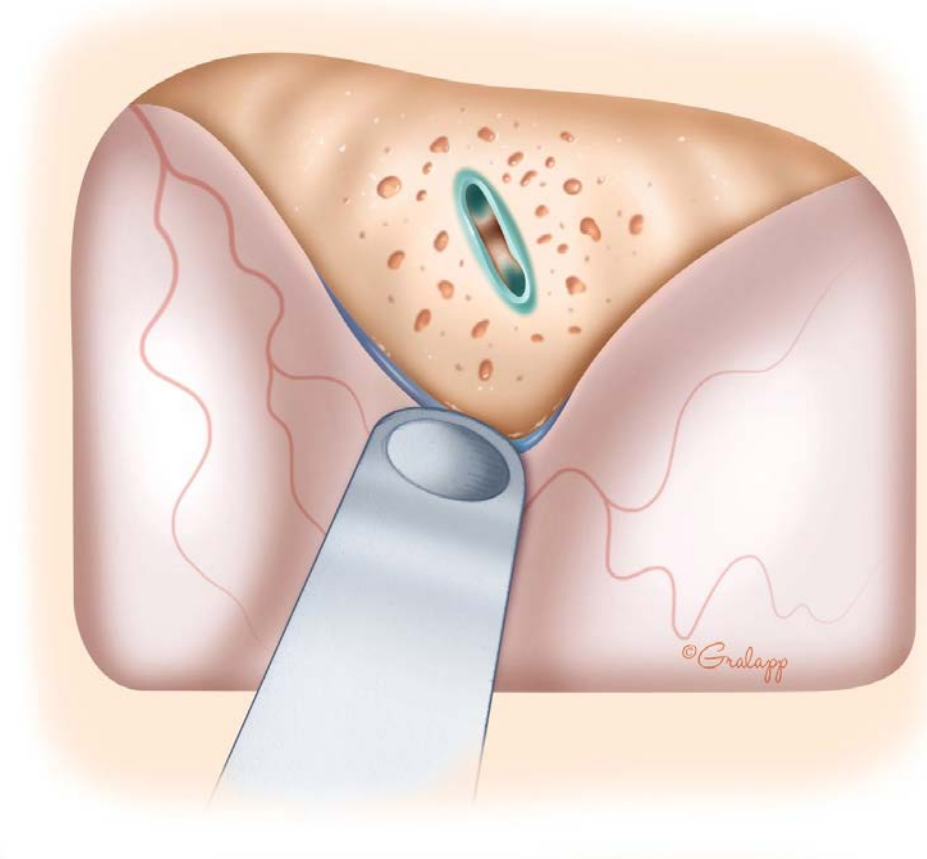
High jugular bulb

- PT, conductive HL
- retrotympanic mass
- can erode into cochlea, SNHL, vestibular issues



Friedmann DR. Otol Neurotol. 2011; PMID 21921860

Anatomic Etiologies for PT



Idiopathic Intracranial Hypertension (IIH)

- Obese females, women of color
- Hyperthyroid, Vitamin A/D deficiency, oral contraceptives
- Headaches, visual abnormalities, dizziness
- Absence of focal neurological signs (occ. VI, VII palsies)
- Otologic symptoms
  - 60-90% with PT
  - Pseudo-SNHL
  - CSF oto-/rhinorrhea
  - Dehiscence of tegmen and/or SSCD

Allen K. Otolaryngol Head Neck Surg. 2012; PMID 22886079
Sismanis A. Laryngoscope. 1994; PMID 8196443

PATHOPHYSIOLOGY

Obesity

↓

Increased intra-abdominal pressure

↓

Elevation of diaphragm

↓

Increased intrathoracic pressure

↓

Increased CNS venous pressure

↙ ↘

Increased resistance to CSF absorption

↓

Interstitial brain edema

Pulsatile tinnitus

1. Transmission of vascular pulsations via CSF to walls of venous sinuses creating turbulent flow
2. ELD transmits pressure from CSF to membranous labyrinth

Guiseffi v. Neurology. 1991; PMID 1992368
Sismanis A. Laryngoscope. 1987; PMID 3302575

Treatment

Meds

- Acetazolamide – effective up to 75%

LP Shunting

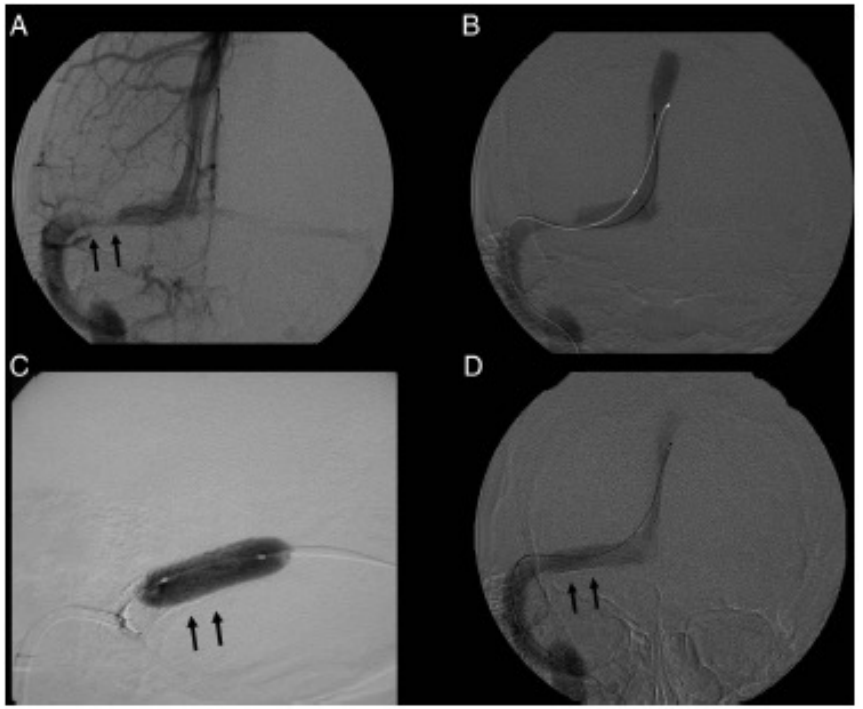
- Progressive visual loss, disabling tinnitus
- 82% improved, 29% resolved

Burgett RA. Neurology. 1998; PMID 9305333

Intravascular Sinus Stenting for IIH

Literature review

- 143 cases
- ✓99% technical success
- ✓88% improved headaches
- ✓87% improved vision
- ✓93% resolution of PT



Puffer RC. J Neurointerv Surg. 2013; PMID 22863980

Superior Semicircular Canal Dehiscence

- Microscopic evaluation of 1000 temporal bones/596 cadavers
- SSCD in 0.5% and 1.4% significant thinning over SSC

- No predilection for gender or race
- Kids=adults, adults more symptomatic

Free paper
Dehiscence or Thinning of Bone Overlying the Superior Semicircular Canal in a Temporal Bone Survey
Carey JO, Minor LB, Nager GT
JAMA Otolaryngology—Head & Neck Surgery
Vol 126, No 2,
February 2000
Available at:
https://jamanetwork.com/journals/jamaotolaryngology/fullarticle/404176

Anatomic Etiologies

Symptom	%
Autophony	97
Conductive hyperacusis (e.g. hear pulse, hear eye movements)	89
Sound-induced vertigo (i.e. Tullio phenomenon)	83
Tinnitus	81
Chronic disequilibrium	73
Pressure-induced vertigo (i.e., Hennebert sign)	68
Aural fullness or pressure in ear	62
Positional vertigo	42

Zhou G. Otol Neurotol. 2007; PMID 17955609

Diagnostic Criteria

(A) SYMPTOM

At least one symptom consistent with SCDS and attributable to 'third mobile window' pathophysiology including

1) hyperacusis to bone conducted sound
2) sound-induced vertigo and/or oscillopsia time-locked to the stimulus
3) pressure-induced vertigo and/or oscillopsia time-locked to the stimulus
4) pulsatile tinnitus

(B) PHYSIOLOGIC TESTING

At least one physiologic test or sign indicating that a 'third mobile window' is transmitting pressure including

1) Eye movements in the plane of the affected superior semicircular canal when sound or pressure is applied to the affected ear
2) Low-frequency negative bone conduction thresholds on pure tone audiometry
3) Enhanced vestibular-evoked myogenic potential (VEMP) responses (low cervical VEMP thresholds or elevated ocular VEMP amplitudes)

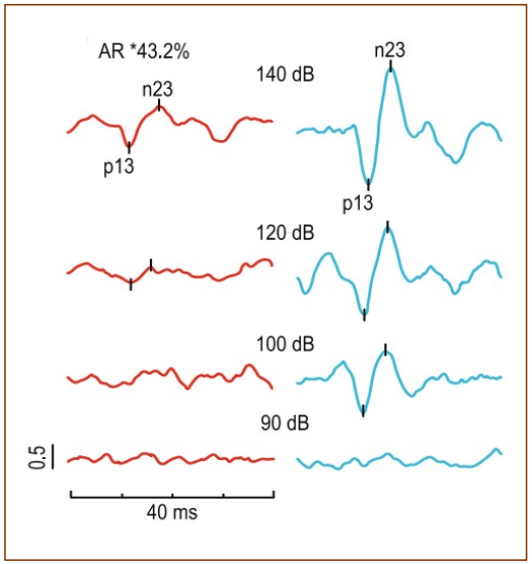
(C) HIGH RESOLUTION CT

High resolution computed tomography (CT) scan with multiplanar reconstruction in the plane of the superior semicircular canal consistent with a dehiscence.

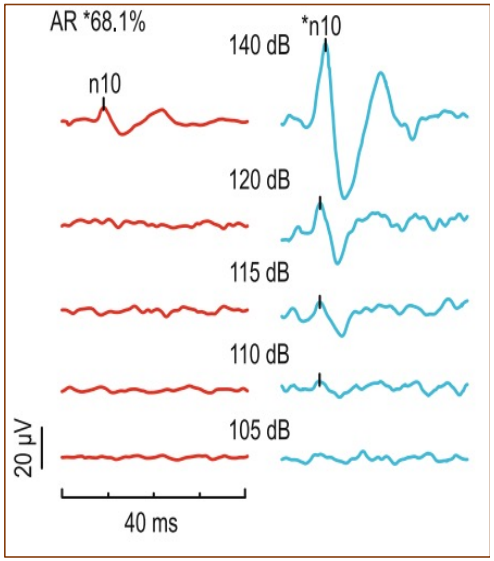
SSCD: VEMP Testing

- cVEMP and oVEMP affected in SSCD
  - High amplitude (oVEMP) and low threshold (cVEMP) in affected ears
  - cVEMP supported in literature
  - oVEMP best screening test

Saccule: cVEMP

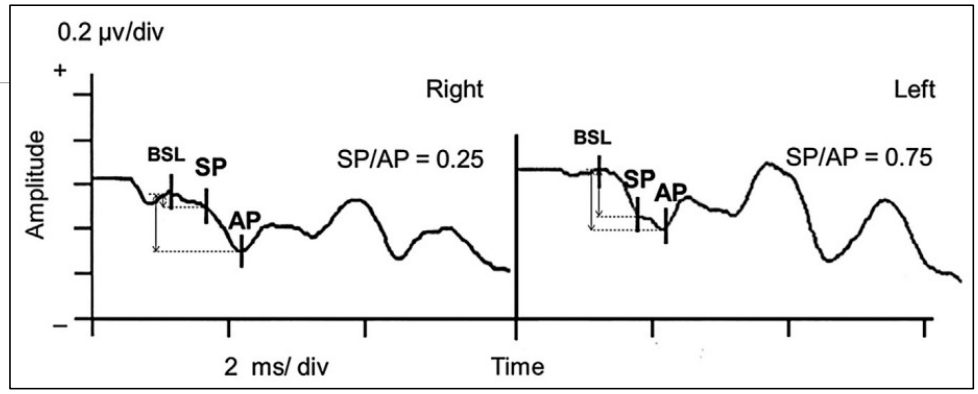


Utricle: oVEMP



Zuniga MG. Otol Neurotol. 2013; PMID 23183641
Fife TD. Neurology. 2017; PMID 29093067
Rosengren SM. Clin Neurophysiol Pract. 2019; PMID 30949613

ECochG



- SSCD: elevations in SP/AP ratio
- Corrects after surgical plugging
- **SP/AP ratio** showed a sensitivity of 92.3% and a specificity of 94.0% for distinguishing SCD

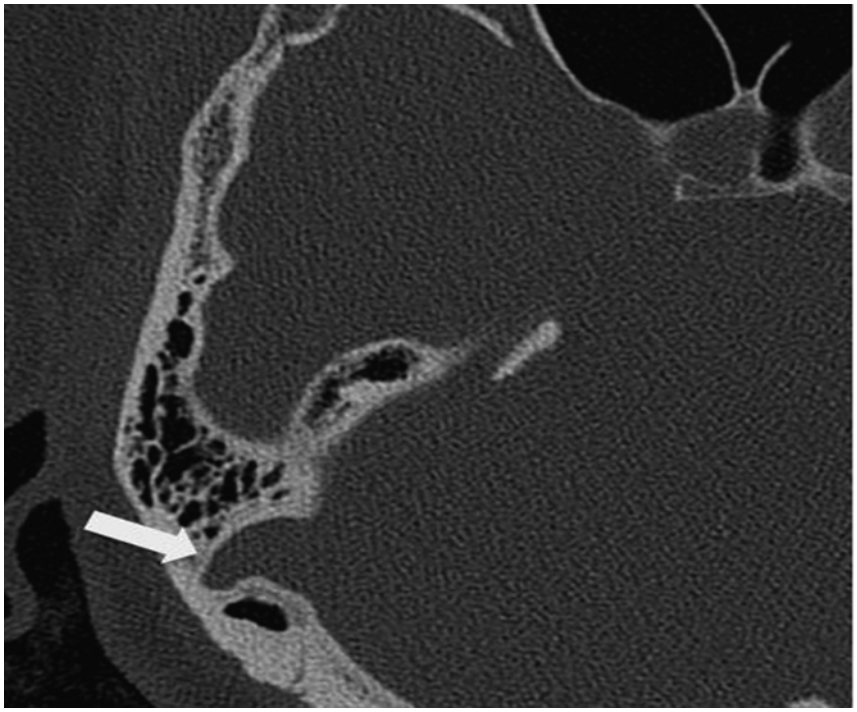
Park JH. Hear Res. 2015: PMID 25683209

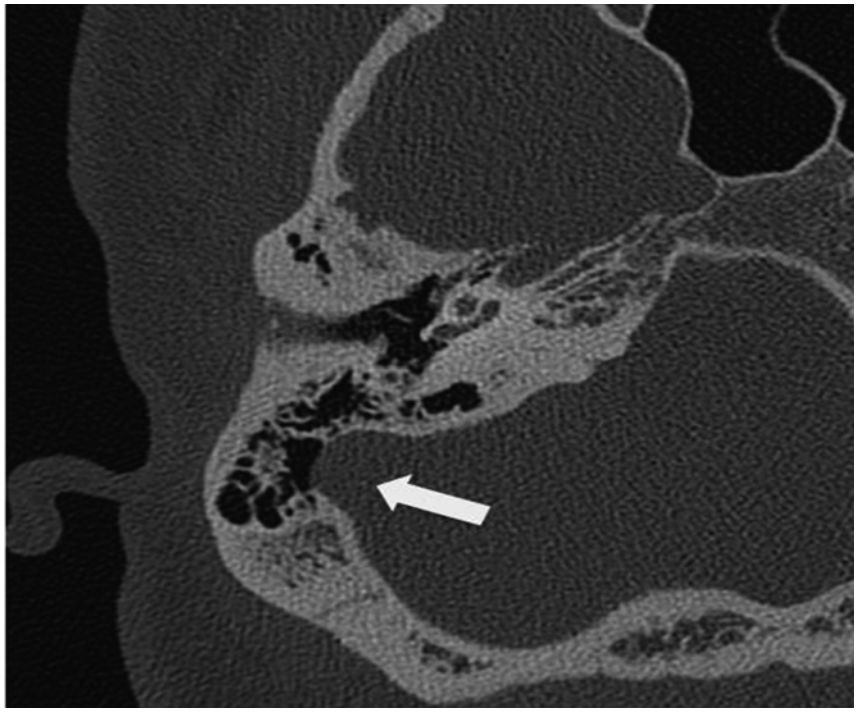
Sinus Wall Abnormalities (Sigmoid Sinus Dehiscence/Diverticula (SSDD)

- Common identifiable cause of venous PT
- Transverse-sigmoid junction most common
- Middle-aged, obese females
  - Overlap b/n SWA and IIH suggests possible link (IIH may lead to bony erosion - necessitates proper work-up)
- Venous bruit over mastoid often heard

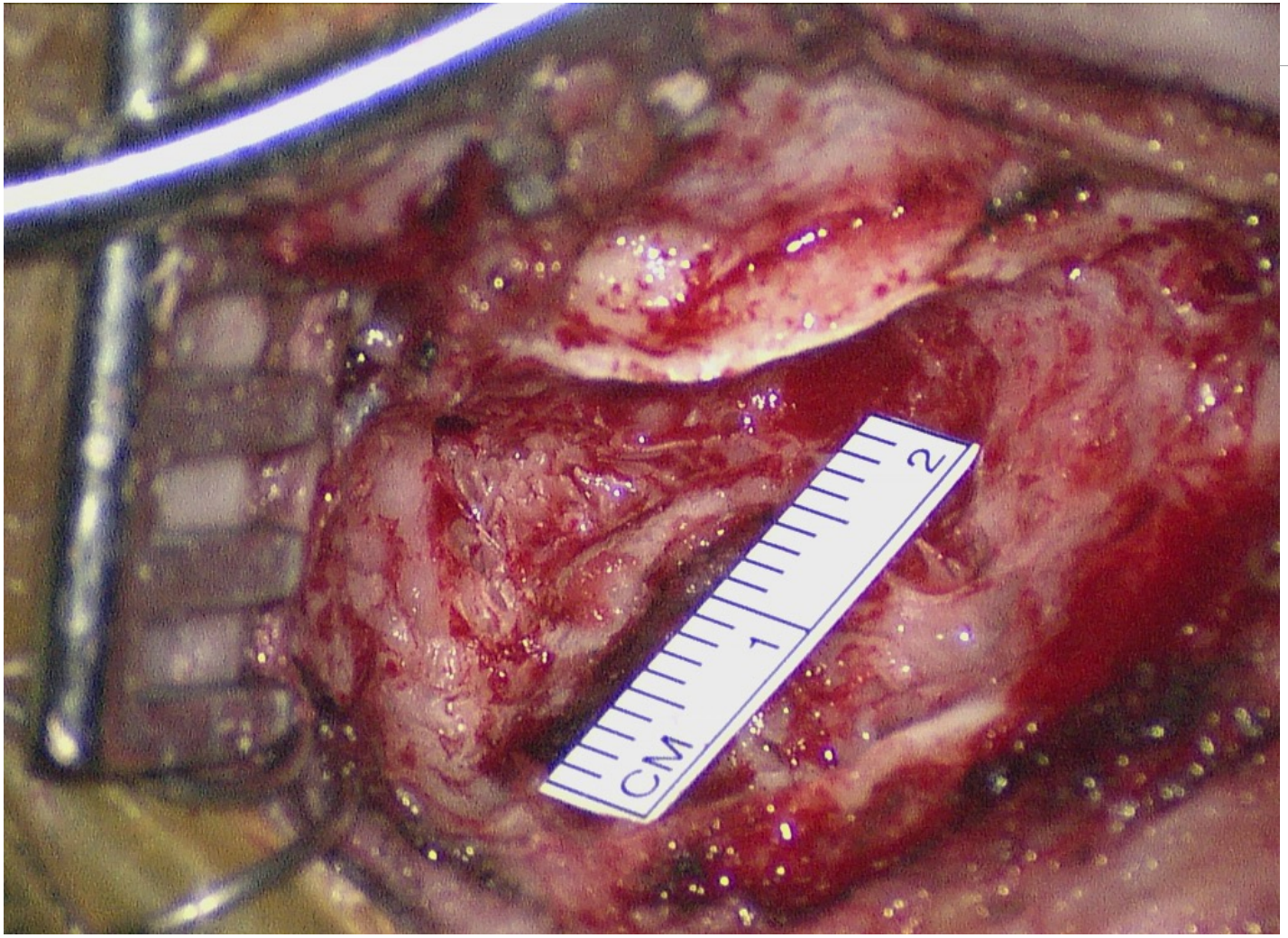
Harvey RS. Otol Neurotol. 2014; PMID 24270723
Grewal AK. Otol Neurotol. 2014; PMID 24005164
Eisenman DJ. Otol Neurotol. 2011; PMID 21799456

SWA

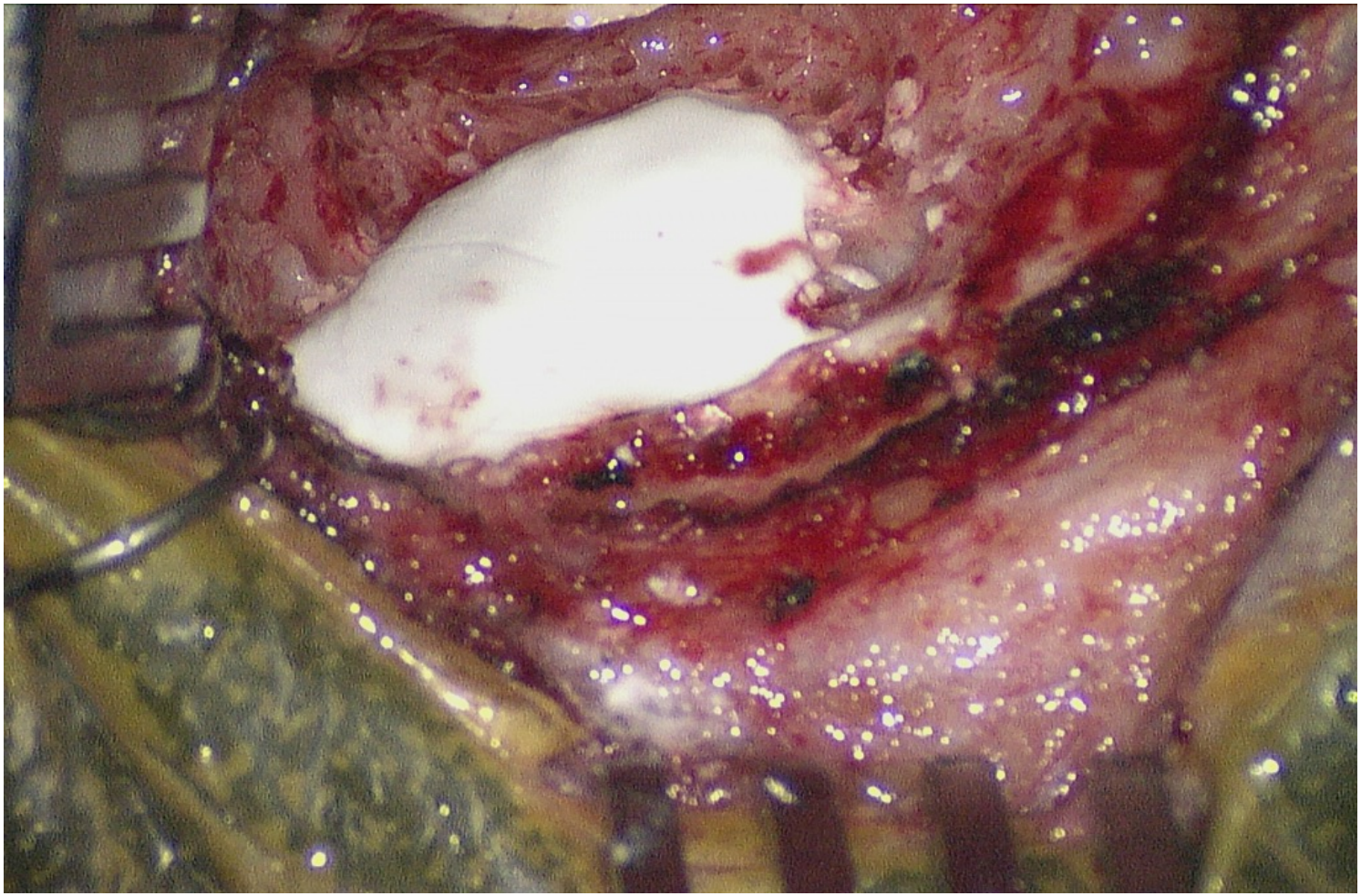




Anatomic Etiologies



Anatomic Etiologies



SWA Reconstruction

Eisenman DJ. *Otol Neurotol*, 2011.

- 13 patients (14 ears)
- 11 females
- Mean f/u 11.5 months
- All patients with complete PT resolution
- 2 complications: visual loss and intracranial hypertension; sinus thrombosis treated with anticoagulation

Benign Venous Hum (Idiopathic PT)

- Etiology – eddy currents in IJV
- Common in children (?normal), young women
- Causes: transverse process of C2, increased CO (anemia, thyrotoxicosis, pregnancy)
- DX: relieved with gentle anterior neck pressure, head to involved side increases, toward uninvolved side decreases
- Deep breathing and Valsalva increase
- Treat underlying cause (labs helpful)

Work-up for Pulsatile Tinnitus

Additional Work-up

- Neuro-ophthalmology consultation
  - Visual acuity, visual fields
  - Fundoscopy
- Lumbar puncture with opening pressure (< 200 mm H2O)
- Metabolic work-up
  - CBC, TSH, fasting blood glucose
  - Pregnancy test?
  - Vitamin A level?

STATEMENT 3. IMAGING STUDIES: Clinicians should not obtain imaging studies of the head and neck in patients, specifically to evaluate the tinnitus, unless they have 1 or more of the following: tinnitus that localizes to one ear, pulsatile tinnitus, focal neurological abnormalities, or asymmetric hearing loss. *Strong recommendation against based on observational studies, with a preponderance of benefit over harm.*

Tunkell DE. Otolaryngol Head Neck Surg. 2014; PMID 25273878

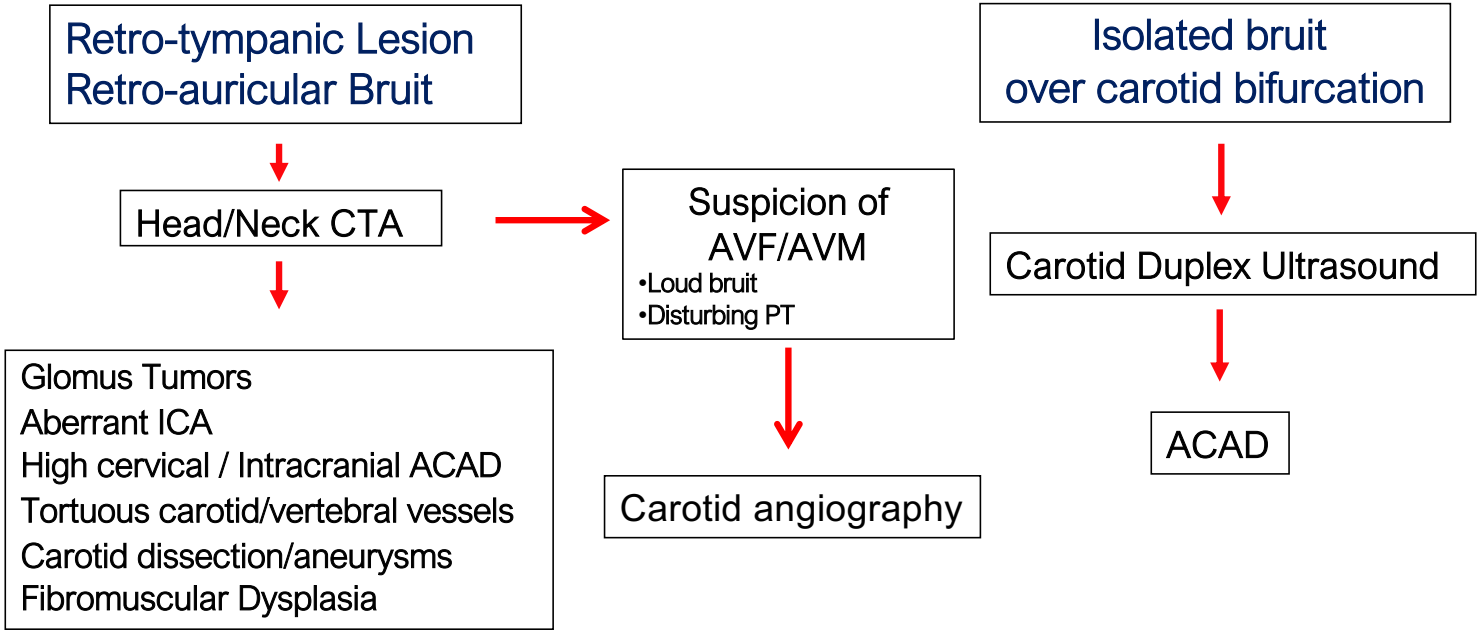
Work-up

Study	Waldvogel	Sonmez	Remley	Krishnan	Dietz	Sismanis
Total no. of patients (Percentage with objective tinnitus)	84 (42%)	74 (15%)	100 (25%)	16 (6%)	49 (33%)	145 (8%)
Type of investigation						
Ultrasound	68	12				Not stated
Computed tomography	26	72	69		10	
Magnetic resonance imaging	33	7	24		49	
Magnetic resonance angiography	7	7			49	
Selective angiography	46	5	68		17	
CTA/V				16		
Cause found	57 (68%)	50 (68%)	80 (80%)	7 (44%)	28 (57%)	132 (91%)

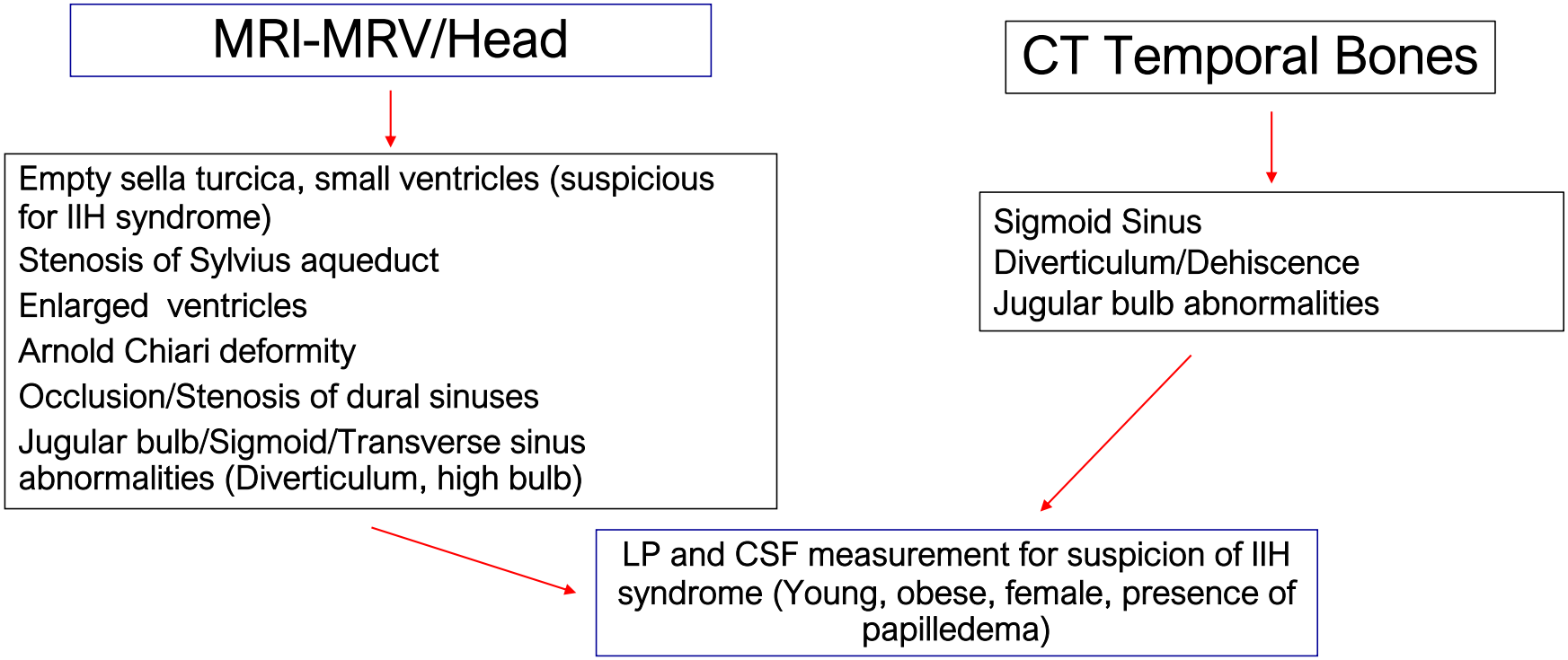
(Madani G. Clin Rad, 2008)

Waldvogel et al., 1998. *J Neurol*, *245*, 137–142.
Sonmez et al., 2007. *Clin Imaging*, *31*(2), 102–108.
Remley et al.,1990. *Radiology*, *174*(2), 383–389.
Krishnan et al., 2006. *Am J Neuroradiol*, *27*(8), 1635–1638
Dietz et al., 1994. *Am J Neuroradiol*, *15*(5), 879–889.
Sismanis 1998. *Am J Otol*, *19*(4), 472–477.

Radiologic Evaluation of Arterial PT



Radiologic Evaluation of Venous PT



Conclusions

- History and physical exam are of utmost importance
- Laboratory work-up especially important in PT
- CBT and HA only data-supported treatment for subjective tinnitus
- Radiologic evaluation should be individualized, based on CPG
- PT in obese, middle-aged female IIH until proven otherwise
- Diagnosis of other associated co-morbidities is mandatory
- Rule out all possible conditions before idiopathic venous hum diagnosed

Summary

“The art of medicine is to amuse the patient until nature heals the disease”

-Voltaire

Thank you

Daniel M. Zeitler, MD FACS

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