SELECTED ABSTRACTS

ORAL PRESENTATIONS

IN ORDER OF PRESENTATION

157th Annual Meeting
AMERICAN OTOLOGICAL SOCIETY

May 17-18, 2024
Hyatt Regency Chicago
Chicago, IL

Deep Phenotyping of a Mouse Model for Hearing Instability Disorders

J. Dixon Johns, MD; Samuel Adadey, PhD; Rafal Olszewski, PhD
Michael Hoa, MD

Hypothesis: Hearing instability in *Slc26a4*-insufficiency mice may be due to differential expression of genes related to ion homeostasis and activated macrophages.

Background: Hearing instability (HI) disorders, defined by either hearing fluctuation or sudden loss, remain incompletely understood. Recent studies have described a *Slc26a4* (pendrin)-insufficiency mouse model (DE17.5) that offers a genetically-driven model for HI, although deep audiometric and immunohistologic phenotyping of this model remains poorly characterized.

Methods: Homozygous DE17.5 mice with (F) and without (NF) HI were delineated by serial auditory brainstem response (ABR) between postnasal day 30 and 60 and compared to adult *Slc26a4*-heterozygous controls (Het). HI was defined as a change in threshold of at least 15dB in at least two frequencies or at least 20dB in at least one frequency from the prior week. Analysis of stria vascularis (SV) cell type-specific gene expression, endolymphatic hydrops (EH), endocochlear potential (EP), and macrophage activation was compared between the cohorts.

Results: F mice demonstrated significant reductions in the expression of cell-type specific genes related to ion homeostasis and increased macrophage activation within the SV compared to NF and Het cohorts, respectively. Both F and NF DE17.5 mice demonstrated reductions in EP and increased EH compared to the Het cohort.

Conclusions: Deep phenotyping of DE17.5 mice demonstrates changes in EP and EH compared to control, however, the HI phenotype was associated with differential ion homeostasis gene expression and increased macrophage activation in the SV. This provides potential further insights into the underlying pathogenesis and possible immunologic contributions of HI in humans.

Professional Practice Gap & Educational Need: To date, there is a lack of an animal model that adequately replicates disorders of hearing instability in humans. This study utilizes the *Slc26a4*-insufficiency mouse model (DE17.5) to perform deep phenotyping of a hearing instability cohort to investigate potential changes in audiometric and immunohistologic parameters.

Learning Objective: To 1) review current gaps in our understanding of the pathogenesis of disorders of hearing instability and 2) provide novel investigations into potential mechanisms hearing instability in a mouse model

Desired Result: This study supports the potential role of differential expression of genes related to ionic homeostasis and macrophage activation in the pathogenesis of disorders of hearing instability. Furthermore, an immunologic “second hit” may contribute to differential phenotypic expression of hearing instability within the DE17.5 cohort, although further studies are needed to elucidate this association.

Level of Evidence: III

Indicate IRB or IACUC: 1379

Inositol trisphosphate (IP3) and Ryanodine receptor (RyR) Signaling Are Essential and Have Distinct Roles in Regulating Neurite Pathfinding in Response to Micropatterned Growth Cues

Joseph T. Vecchi; Madeline Rhomberg; C. Allan Guymon, PhD
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Hypothesis: RyR and IP3 signaling are activated by and required for spiral ganglion neurons (SGNs) to sense and pathfind in response to topographical and biochemical substrate cues.

Background: Micro-scale patterning of surface features and biochemical cues has emerged as a promising approach to direct neurite growth into close proximity with next-generation cochlear implant electrodes. However, the underlying signaling events governing the ability of growth cones to respond to these features and cues remain unclear. Increasing evidence highlights the pivotal role of Ca^{2+} signaling in growth cone sensing and response to diverse cues.

Methods: We investigated the role of IP3 and RyR signaling in cultured mouse SGNs and dorsal root ganglion neurons as they pathfind in response to wide varieties of engineered micropatterned substrates.

Results: Stable, complex micropatterned surfaces were produced by photopolymerization using methacrylate systems. Inhibition of IP3 and RyR signaling disrupts real time Ca^{2+} transients in growth cones and neurite pathfinding in response to these biophysical features. Additionally, IP3 and RyR signaling are necessary for SGN guidance to both chemo-permissive and chemo-repulsive patterns. In exploring the roles of this signaling in pathfinding to complex cues, RyR signaling is essential for halting growth in response to a repulsive cue. Conversely, IP3 signaling is necessary for growth cone turning in response to guidance cues.

Conclusions: IP3 and RyR, fundamental Ca^{2+} signaling elements, are essential for SGNs to effectively pathfind in response to diverse biophysical and biochemical cues. Importantly, they exhibit distinct and complementary roles in the pathfinding process, shedding light on the intricate mechanisms governing neurite guidance.

Professional Practice Gap & Educational Need: Understanding how neurites sense and respond to cues informs fundamental neural development as well as offers insights into translating these principles into applications such as guiding SGN neurite growth for improved neural prostheses, including cochlear implants.

Learning Objective: Inform how the tip of SGN neurites, i.e. the growth cone, sense and turn in response to various environmental cues as the neurite grows towards a target.

Desired Result: Knowledge of the signaling pathways that enable SGN neurites to turn in response to biophysical and biochemical substrate cues and, in particular, clarification of the role of Ca^{2+} release from internal stores via RyR and IP3 in this process.

Level of Evidence - Level N/A

Indicate IRB or IACUC: IACUC 1101569, University of Iowa

Western Blot Characterization of Human Serum Prestin, an Outer Hair Cell Biomarker

Heather M. McClure, BS; Mohsin Mirza, BS; Patrick Adamczyk, BS; Ashley Parker, PhD
Erika Skoe, PhD; Kourosh Parham, MD, PhD

Hypothesis: Western blot analysis of human prestin in the blood reveals multiple bands, rather than a single band.

Background: Previously, using the ELISA method, prestin was shown to be a good biomarker of outer hair cell (OHC) health and sensorineural hearing loss that could be measured in the blood. Recently, we found that a western blot approach in guinea pigs demonstrates three prestin bands providing greater insights into prestin in the blood and its origins. This approach has not yet been explored in humans.

Methods: Serum samples from 25 healthy human subjects were analyzed. Automated western blot for each sample was generated and the bands were analyzed and compared with transient evoked otoacoustic emission levels (TEOAE).

Results: There were five bands at ~32, ~50, ~94, ~139, and ~171 kDa, respectively. Notably, the second band consistently had the largest area and height. When the subjects were divided based on TEOAE level, those with high emission levels had a significantly larger 94 kDa band than those with low emission levels ($p=0.015$).

Conclusions: Western blot characterization of OHC biomarker prestin in humans shows that the band closest to the previously estimated molecular weight of prestin (81 kDa) is related to a functional measure of OHCs. This finding increases confidence in the value of serum prestin as a biomarker. The western blot method appears to offer higher resolution information on serum prestin. Future work will be carried out under pathological conditions to inform on the application of this quantitative method in the clinical setting.

Professional Practice Gap & Educational Need: Hearing loss is currently diagnosed by audiometric testing which has limitations in the diagnosis of sensorineural hearing loss before it has occurred. The search for meaningful biomarkers of inner ear health that could be measured via blood analysis is imperative to pre-emptive and early interventions.

Learning Objective: To understand the role of prestin as a serum biomarker for sensorineural hearing loss.

Desired Result: To develop a biomarker for sensorineural hearing loss to supplement current audiometric techniques.

Level of Evidence – Level III

Indicate IRB or IACUC: UConn IRB Protocol H14-214.

Otoprotection and Effects on Cochlear Synaptopathy by Angiotensin Receptor Blockade in a Murine Model of Noise Induced Hearing Loss

Peter Eckard; Tanner Kempton; Carolina Chu; Rhong Zhuo Hua; Bryce Hunger
Miles J. Klimara, MD; Marlan R. Hansen, MD; Douglas M. Bennion, MD, PhD

Hypothesis: Angiotensin receptor blockade provides otoprotection from noise induced hearing loss.

Background: Noise overexposure causes progressive damage to cochlear hair cells, stria vascularis, and spiral ganglia causing hearing loss. Losartan is an angiotensin receptor antagonist that has systemic vascular modulating and anti-inflammatory effects with unknown cochlear microvascular effects.

Methods: 9–10-week-old CBA/J mice received either standard chow (n=7) or losartan-infused chow (n=6; 20mg/kg/day, comparable to 100mg daily dose in humans) for three days prior and two weeks after exposure to two hours of 8-16k octave band noise at 102.5dB for males and 105dB for females. ABR and DPOAE measurements and losartan serum samples were taken on -1, 1, 7, and 14 days after noise exposure (dANE). Cochleae were collected at 14dANE for whole mount and immunofluorescent staining for CtBP2 (C-terminal binding protein 2), PSD-95 (post-synaptic density protein 95), and myosin VIIA. Synapses per inner hair cell were quantified after confocal microscopy using IMARIS software.

Results: Treatment with losartan reduced ABR temporary threshold shifts (TTS) at 16kHz (5dB vs 16dB; p=0.009) and 32kHz (1dB vs 18dB; p=0.028) 1dANE. Return to baseline thresholds occurred by day 7 in both groups. There was no significant difference in DPOAE threshold at any timepoint. There was a trend toward more synapses per hair cell in Losartan-treatment compared to control (p=0.12).

Conclusions: Losartan provided otoprotection against noise induced as measured by ABR TTS in a murine model. The lack of significant difference in the synaptopathy of cochlear inner hair cells may be due to the low dose of noise exposure.

Professional Practice Gap & Educational Need: No current treatments target the pathophysiologic mechanisms of noise induced hearing loss. Further, the mechanisms of cochlear synaptopathy are incompletely described. The electrophysiologic and immunohistologic data can help provide additional treatment options for noise induced hearing loss and help describe the mechanism of synaptopathy in noise induced hearing loss.

Learning Objective: To explore cellular mechanisms of noise induced hearing loss in murine cochleae and to evaluate losartan as a potential otoprotective treatment for noise induced hearing loss.

Desired Result: Researchers and clinicians will (note) have a new understanding that losartan offers otoprotection from noise induced hearing loss in mice in this preliminary study. Additional animal and human studies are needed to determine if losartan is an effective treatment for noise induced hearing loss.

Level of Evidence – N/A (basic science lab research)

Indicate IRB or IACUC: University of Iowa, IACUC # 3022519

Effects of Smoking on Acute Postoperative Outcomes in Otologic Surgery- A Multi-National Database Study

Pablo Llerena, BS; Bryce Hambach, BS; Kathryn Nunes, BA; Joseph Lu, BS
Praneet Kaki, BS; Jena Patel, MD; Jacob B. Hunter, MD

Objective: To investigate the impact of smoking on 30-day postoperative outcomes in patients undergoing otologic surgery

Study Design: A retrospective cohort database study with propensity-score matching (PSM) utilizing TriNetX clinical database

Setting: TriNetX is a global research database which includes about 110-million patients.

Patients: Included patients had a history of surgical procedures involving the external ear, middle ear, inner ear, and temporal bone (CPT 1010116, CPT 010417, CPT 1010223, and CPT 1010242). Patients were stratified into two cohorts based on smoking status. We then did a subgroup analysis of smokers based on if they continued smoking vs quit smoking after surgery.

Interventions: Observational

Main Outcome Measures: We assessed 30-day postoperative complications in patients after otologic surgery based on smoking status. PSM was used to control for 43 patient characteristics.

Results: After PSM, smokers had an increased risk of tympanic membrane perforation (OR 1.2, 95% CI: 1.0-1.5), CSF leak (OR 1.8, 95% CI: 1.0-3.1), and wound dehiscence (OR 1.8, 95% CI: 1.1-3.0) when compared to non-smokers. Patients who continued smoking postoperatively had an increased risk of hematoma (OR 2.2, 95% CI: 1.2-3.9), myocardial infarction (OR 3.9, 95% CI: 2.6-5.9), and deep vein thrombosis (OR 3.9, 95% CI: 2.5-5.9). Comparatively, patients who quit smoking postoperatively had a decreased risk for developing sensorineural hearing loss (OR 0.3, 95% CI: 0.2-0.3), cholesteatoma (OR 0.6, 95% CI: 0.4-0.9), and tinnitus (OR 0.3, 95% CI: 0.2-0.6).

Conclusion: Patients with a smoking history are more likely to experience postoperative complications compared to non-smokers; smoking cessation after surgery decreased the risk of certain complications.

Professional Practice Gap & Educational Need: While previous literature has shown an association between smoking history and poorer otologic surgery outcomes, there are few studies that account for other confounding variables that may also impact these outcomes. By propensity-score matching, our population-level cohort-control study informs surgeons that despite controlling for other risk factors, smoking still contributes to poorer surgical outcomes. Understanding this relationship can help educate surgeons on the potential risks smoking has on patient outcomes and highlights the importance of smoking cessation in practice.

Learning Objective: 1) Identify that smoking is a risk factor for postoperative complications. 2) Understand the effects of perioperative smoking status on outcomes after otologic surgery.

Desired Result: Provide knowledge and educate healthcare providers on smoking as a risk factor for postoperative complications and enhance our understanding of how perioperative smoking status impacts outcomes following otologic surgery.

Level of Evidence – III

Indicate IRB or IACUC: Exempt.

Statins and Their Effect on Hearing: An All of Us Database Study

Benjamin J. Homer, ScB; Rishubh Jain, AB; Alexander S. Homer, AB
Viknesh S. Kasthuri, AB; Emily Gall, MD; Kathryn Y. Noonan, MD

Objective and Background: Hearing loss affects approximately 23% of Americans and is associated with medical comorbidities including hyperlipidemia. Statins, commonly used for dyslipidemia, may protect against hearing loss in animal models, but human studies show mixed results. This study aims to investigate statins and their effect on hearing loss and tinnitus.

Study Design: Retrospective cohort study.

Setting: All of Us is a NIH-funded research database representing more than 710,000 participants in the United States.

Patients: Participants with hyperlipidemia.

Methods: Patients with hyperlipidemia were labeled based on their exposure to at least one statin and additionally labeled for diagnoses of sensorineural hearing loss and/or tinnitus. Logistic regressions were performed with independent variables of statin use, aspirin use, age, race, and sex at birth and dependent variables of hearing loss and tinnitus.

Results: 90,271 patients were included in this study. The analysis showed an association between the use of statins and sensorineural hearing loss (OR=1.62, $p<0.01$) as well as tinnitus (OR=1.37, $p<0.01$). In the individual statin analysis, simvastatin was associated with the strongest correlation with hearing loss (OR=1.57, $p<0.01$) and tinnitus (OR=1.50, $p<0.01$) while fluvastatin was the least associated both hearing loss (OR: 1.15, $p<0.01$) and tinnitus (OR=1.02, $p<0.01$). Atorvastatin, the most used statin, was also associated with hearing loss (OR=1.28, $p<0.01$) and tinnitus (OR=1.212, $p<0.01$).
Conclusions: In this study, the All of Us database was used to investigate the relationship between statins and hearing loss/tinnitus. Results indicate a potential ototoxic association of statins on hearing and tinnitus.

Professional Practice Gap & Educational Need: Statins, commonly used for dyslipidemia, may protect against hearing loss in animal models, but human studies show mixed results.

Learning Objective: To evaluate if there is an association between statin use and sensorineural hearing loss or tinnitus, while accounting for race, age, sex, and hyperlipidemia.

Desired Result: To inform discussion around statin use and future research into statin side effects.

Level of Evidence – Level IV

Indicate IRB or IACUC: Exempt

Blast Exposure, Tinnitus, Hearing Loss, and Post-Deployment Quality of Life in U.S. Veterans: A Longitudinal Analysis

Hoda AO. Mohammed, MPH; Charlotte K. Hughes, MD, MPH (presenter)
Kelly M. Reavis, PhD, MPH; Samrita Thapa, MPH; Emily Thielman, MS
Wendy Helt, MA; Kathleen F. Carlson, PhD, MPH

Objective: Examine the association between military blast exposure on the quality of life (QoL) in Veterans and to determine if this association is modified by hearing loss.
Study Design: Longitudinal.

Setting: Tertiary care center.

Patients: 545 Veterans.

Interventions: Self-reported blast exposure, tinnitus (yes/no) immediately following the blast, and high-frequency hearing loss (puretone hearing threshold average 3000-8000 Hz > 20 dBHL) near the time-of-service separation.

Main Outcome Measures: WHO Disability Assessment Schedule 2.0 questionnaires at baseline and annually over 5 years. Group-based trajectory modeling was used to classify QoL of Veterans into three trajectories: (1) consistently high-QoL; (2) consistently moderate-QoL; (3), consistently low-QoL.

Results: The probability of having consistently high-QoL after military service is approximately 60% if there was no exposure to a blast or presence of hearing loss. The probability of consistently high QoL drops precipitously to approximately 20% with a self-reported military blast exposure accompanied by tinnitus and hearing loss. The probability of having consistently moderate-QoL is approximately 70% if there was a self- reported history of military blast exposure accompanied by tinnitus and hearing loss. Self-reported blast exposure increases the odds of being in the moderate-QoL group compared to the high-QoL, OR 1.58 (95% CI 0.97, 2.59). Self-reported blast exposure associated with tinnitus further increases the odds, OR 3.61 (95% CI 2.12, 6.14). Hearing loss further increases the odds of a lower QoL trajectory group.

Conclusions: Blast exposure negatively affects the quality of life of Veterans especially when compounded with tinnitus and hearing loss.

Professional Practice Gap & Educational Need: Blast exposure likely negatively affects quality of life. This effect is stronger when the blast exposure is compounded with tinnitus and hearing loss.

Learning Objective: Understand the association of blast exposure with and without tinnitus and hearing loss on quality of life.

Desired Result: Highlight the importance of exploring treatment options for hearing loss in Veterans who have been exposed to blasts to improve quality of life.

Level of Evidence – III

Indicate IRB or IACUC : #3159/9495 Joint VA Portland Health Care System (VAPORHCS) Oregon Health and Science University (OHSU)

Analysis of Adherence to AAO-HNSF Clinical Practice Guidelines for Sudden Hearing Loss

Bao Y. Sciscent, BS; F. Jeffrey Lorenz, MD; Hanel W. Eberly, BS
Andrew Rothka, BS; Mark E. Whitaker, MD; Neerav Goyal, MD, MPH

Objective: Sudden hearing loss (SHL) necessitates prompt evaluation. In 2019, the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNSF) released guidelines for the diagnosis and management of SHL and sudden sensorineural hearing loss (SSNHL). The objective of this study is to assess adherence to these guidelines on a national scale.

Study Design: Retrospective Cohort

Setting: TriNetX, a de-identified healthcare database was retrospectively queried to identify patients with SHL.

Patients: Adults with SHL

Main Outcome Measures: Adherence to guidelines was measured by the percentage of patients undergoing proper workup and treatment.

Results: 26,626 patients with unilateral SHL were identified. Guidelines for SHL include undergoing an audiogram within 2 weeks of presentation to distinguish SSNHL from conductive hearing loss (CHL). In our cohort, less than half of all patients (48.0%, n=12,784) underwent subsequent audiogram testing, and just 30.2% (n=8,065) completed it within 2 weeks. 460 patients had testing within 2 weeks-1-month, 427 patients within 1-3 months, and 161 patients between 3-6 months of SHL. Overall, 2,749 patients were diagnosed with unilateral SSNHL and 96 patients were diagnosed with unilateral conductive hearing loss (CHL). The remainder had mixed conductive and sensorineural hearing loss (n=110) or were lost to follow-up (n =9829).

For SSNHL patients, guidelines recommend MRI or ABR to evaluate for retrocochlear pathology. Among 2,749 patients with SSNHL in our cohort, just 24.7% (n=680) obtained an MRI or ABR within 1 month. The median time from diagnosis of SSNHL to MRI was 16 days. 3.7% of patients (n=101) with SSNHL were diagnosed with a vestibular schwannoma. Of these patients, <9.9% (n<10) underwent stereotactic radiosurgery (SRS) and 13.9% (n = 14) underwent surgical resection. Additionally, the guidelines emphasize the option of steroids within 2 weeks as initial therapy for SSNHL, which was the case for 49.7% (n=1,365). Less than 0.5% of patients (n<10) underwent CT scan, or were prescribed vasodilators or thrombolytics, in accordance with strong recommendations against these diagnostics and treatments. 91 (n=3.3%) patients were on antivirals despite insufficient evidence to support their effectiveness. No patients were prescribed hyperbaric oxygen although it is an optional recommendation.

Conclusions: There is significant opportunity for improvement in evaluating patients with SHL, specifically SSNHL. Proper adherence to guidelines for SSNHL may improve screening, detection, and management of neurotologic pathologies including vestibular schwannoma, and result in expedited hearing recovery and QOL in patients.

Professional Practice Gap & Educational Need: SHL is common, but missed or late diagnosis and treatment can lead to poor and costly outcomes. The AAO-HNSF guidelines were established to ensure adequate workup and determine optimal therapy. No study has assessed the adherence to clinical practice guidelines for SHL.

Learning Objective: To evaluate the adherence to the AAO-HNSF Clinical Practice Guidelines for SHL

Desired Result: To recognize and improve awareness of adherence to guidelines for SHL

Level of Evidence – Level III

Indicate IRB or IACUC: Exempt

Contemporary, Individual and Community-Level Social Determinant Associations with Acoustic Neuroma Disparities in the US

David J. Fei-Zhang, BA; Rishabh Sethia, MD; Cyrus W. Abrahamson, BA; Daniel C. Chelius, MD
Jill N. D'Souza, MD; Anthony M. Sheyn, MD; Jeffrey C. Rastatter, MD, MS

Objective: Using multivariate, social determinants of health (SDoH)-models featuring census-level Yost-Index-socioeconomic status (SES) measures, to determine whether community-level SDoH-factors quantifiably influence Acoustic Neuroma care-prognostic disparities nationally more than individual-level SDoH-factors

Study Design: Observational-Retrospective Cohort

Setting: Specially Authorized Head-Neck SEER 2020 Dataset

Patients: 23,330 adult (20+ years) patients diagnosed with Acoustic Neuroma from 2010-2018

Main Outcome Measures: Age-adjusted multivariate regressions and cox-proportional hazard models with individual-level (sex, race-ethnicity) and census-level covariate factors (Yost-Index-SES [aggregate measure of 7-measures of income, education, housing], Rurality-Urbanicity) assessing outcomes of delay-of-interventional treatment (3 months or more after diagnosis), treatment receipt, and overall survival.

Results: Increases in all-cause mortality showed markedly positive and independent associations with poor Yost-SES (HR, 1.55; 95%CI, 1.41-1.71) and Male-Sex (HR, 1.30; 95% CI, 1.19-1.43) (all $p<0.001$). Stereotactic radiotherapy receipt showed significantly negative and independent associations with poor Yost-SES (OR, 0.93; 95%CI, 0.86-0.99; $p=0.040$). Surgical resection receipt showed significantly positive and independent associations with poor Yost-SES (OR, 1.13; 95%CI, 1.07-1.20; $p<0.001$) and non-statistically significant positive associations with increasing rurality (OR, 1.10; 95%CI, 1.00-1.20; $p=0.057$). Having a delay-of-interventional treatment showed significantly negative and independent associations with poor Yost-SES (OR, 0.91; 95%CI 0.85-0.97; $p=0.005$).

Conclusions: Comprehensive, multivariate models of individual- and community-level SDoH showcased detrimental care and prognostic disparities mainly contributed by community-level SES differences across a recent, national cohort of adults diagnosed with acoustic neuromas.

Professional Practice Gap & Educational Need: Nuanced analyses assessing wide varieties of SDoH-factors inform providers and policymakers of how to specifically target and allocate resources of prospective investigations and initiatives towards the most pertinent needs of patients and their surrounding communities.

Learning Objective: To understand how to conduct comprehensive, multivariate analyses encompassing a breadth of SDoH-factors affecting individuals and their surrounding communities; to navigate and work with modern large datasets; and to apply these methods towards understanding acoustic neuroma disparities affecting patients in the real world

Desired Result: Using these multivariate, interactional analyses across 12 SDoH-factors on the individual and community-levels, this investigation hypothesizes that community/census-level SES status, as measured by the Yost Index, would confer the highest-magnitude associations in detrimental survival and treatment outcomes of adults with acoustic neuromas.

Level of Evidence - III

Indicate IRB or IACUC : Exempt

Early Use of Computer-based Auditory Training Yields Greater Speech Recognition and Quality-of-life Benefits in New Adult Cochlear Implant Recipients

James R. Dornhoffer, MD; Christian Shannon, BS; Kara C. Schvartz-Leyzac, AuD, PhD
Judy R. Dubno, PhD; Theodore R. McRackan, MD, MSCR

Objective: Computer-based auditory training (CBAT) has been shown to improve outcomes in adult CI users. This study evaluates whether early vs late CBAT intervention, post-activation, impacts the effect of CBAT on CI outcomes.

Study Design: Prospective natural experiment

Setting: Tertiary academic medical center

Patients: 65 new adult CI users

Interventions: CBAT use over the first-year post-activation

Main Outcome Measures: Speech recognition scores and CIQOL-35 Profile score improvements between CI recipients who used CBAT resources early (<3 months) vs late (3-12 month) post-activation.

Results: 43 CI recipients used CBAT within 3 months post-activation (early) and 22 after 3 months (late). Early CBAT users trended toward higher CNC (60.33-62.55% vs 45.35-54.22%;*d*-range=0.25-0.83) and AzBio Quiet (72.4-75.2% vs 49.8-65.6%;*d*-range=0.39-0.72) scores at 3-, 6-, and 12-months post-activation, compared to later CBAT users. Differences in speech recognition between early/late cohorts were greatest at 3 months (CNC:*d*=0.83 [0.22, 1.43] and Azbio:0.72 [0.14, 1.3]) and narrowed as the late cohort started using CBAT (CNC:*d*=0.25 [-0.35, 0.85] and Azbio:0.39 [-0.20, 0.98]).
Early CBAT users also had greater CIQOL-35 Profile global and all domain score improvement at all time points post-activation, compared to late users (*d*-range=0.014-0.67), with the largest difference for the communication (*d*-range=0.24-0.63) and listening effort domains (*d*-range=0.35-0.73). As with speech scores, differences in CIQOL scores were greatest at 3 months and narrowed as the late cohort started using CBAT resources, however less convergence was observed (*d*-range=0.07-0.73 vs 0.14-0.47, at 3- and 12-months respectively)

Conclusions: Auditory training with self-directed computer software (CBAT) may yield greater speech and quality-of-life benefits for new adult CI recipients if started within 3 months post-activation.

Professional Practice Gap & Educational Need: CBAT is a free and widely accessible form of auditory rehabilitation that has been shown to have a possible association with improved CI outcomes in new adult recipients. However, the most effective time-course or schedule of CBAT use after implantation is poorly understood.

Learning Objective: To explore the effectiveness of using CBAT if started early (<3 months) vs late (3-12 months) post-activation for new adult recipients.

Desired Result: Practitioners and researchers will learn that the use of CBAT starting early after activation by new adult CI recipients may offer improved outcomes as compared to training started later in the post-activation period. As such, clinicians should consider counselling on the early use of this widely accessible and effective form of auditory rehabilitation for newly implanted patients.

Level of Evidence – Level IV: Historical cohort or case-controlled studies.

Indicate IRB or IACUC: Pro00077593

Preoperative Factors Predicting Electroacoustic Stimulation Usage in Adults Following Cochlear Implantation

Ankita Patro, MD, MS; Connie Ma, MD; Natalie Schauwecker, MD; Nathan R. Lindquist, MD
Michael H. Freeman, MD; David S. Haynes, MD, MMHC; Elizabeth L. Perkins, MD

Objective: To identify preoperative clinical factors that impact electroacoustic stimulation (EAS) usage in adult cochlear implant (CI) recipients.

Study Design: Retrospective cohort.

Setting: Tertiary referral center.

Patients: 339 adults (375 ears) with preoperative residual hearing who underwent CI from 2012 to 2021. Hearing preservation (HP) was defined as low-frequency pure-tone average (LFPTA) up to 65 dB HL.

Main Outcome Measures: Demographics; audiometry; CNC; Speech, Spatial, and Qualities (SSQ).

Results: Of 149 ears who had HP at 1 or 3 months, 114 (76.5%) were fit with EAS. Compared to non-users, EAS users had higher hearing aid usage at initial evaluation (76.3% vs. 48.6%, p=0.002) and less smoking history (26.3% vs. 51.4%, p=0.016). Preoperative CNC scores in the contralateral ear (40.0% vs. 25.6%, p=0.015) and bilateral listening condition (41.1% vs. 27.0%, p=0.004) were significantly higher for EAS users. Rates of EAS fitting improved from 40% in 2013 to 100% in 2021 (p=0.043). Preoperative LFPTA and CNC in the ear to be implanted, preoperative SSQ, age at implantation, duration of deafness, etiology of hearing loss, diabetes, functional health status, gender, race, and marital status were equivalent between EAS users and non-users (p>0.05). On multivariate analysis, only higher preoperative bilateral CNC scores significantly predicted EAS usage (OR 1.06, 95% CI 1.01—1.13, p=0.048).

Conclusions: Although rates of EAS fitting have improved in the last decade, patients who are non-smokers, are hearing aid users at initial evaluation, and have better preoperative contralateral hearing are more likely to use EAS after HP surgery. These findings can help with early identification and counseling of potential EAS non-users.

Professional Practice Gap & Educational Need: Despite the known benefits of HP and EAS in adult CI patients, EAS has been reported to be underutilized in this population. To our knowledge, a comprehensive analysis of predictive preoperative factors that can influence EAS usage has not been reported in the literature.

Learning Objective: To identify preoperative demographic and audiometric factors that can impact EAS usage in adult CI recipients.

Desired Result: Providers will have knowledge about the impact of hearing aid use, smoking status, and preoperative contralateral hearing on rates of EAS utilization. These findings can help counsel patients and identify those who may reject EAS early but may still perceive benefit.

Level of Evidence: Level IV – Historical cohort or case-controlled studies.

Indicate IRB or IACUC: IRB Exempt (221833, Vanderbilt University, approved on 10/12/22).

Impact of Implantable Hearing Devices on Delirium Risk in Patients with Hearing Loss: A National Database Study

Bryce Hambach, BS; Elliott M. Sina, BA; Kathryn Nunez, BS
Jena Patel, MD; Jacob B. Hunter, MD

Objective: To test the hypothesis that utilization of implantable hearing rehabilitation devices is associated with a reduced likelihood of developing delirium in patients with hearing loss.

Study Design: A retrospective cohort database study with propensity-score matching (PSM) utilizing TriNetX clinical database.

Setting: The US Collaborative Network within the TriNetX database (100 million people).

Patients: Patients over 55-years old were selected based off of three categories: a non-hearing loss study control (ICD-10:H90-91), a hearing loss (HL without implantable device), and an implantable device cohort (ICD-10:Z96.21;Z96.29;09HD;09HE; CPT:69714;69930). Patients with prior dementia or memory loss diagnosis were excluded (F01-03, 27-29).

Interventions: Observational

Main Outcome Measures: Odds ratios with 95% confidence intervals for delirium diagnosis code (F0.5).

Results: The control cohort (n = 32.4 million) was 1:1 PSM for age and sex with the HL cohort (n = 1.55 million) in which 0.74% of patients developed delirium compared to 2.23% in the HL cohort (OR, 95% CI: 0.33, 0.32-0.34). When looking at the same PSM between HL and implantable device cohorts (n=18,463), 2.23% developed a delirium diagnosis compared to 1.45% in the implantable device cohort (OR, 95% CI: 1.54, 1.32-1.80). Further analysis accounting for 17 PSM covariates showed that 0.76% of the HL cohort developed delirium compared to 0.40% of the implantable device cohort (OR, 95% CI: 1.89, 1.43-2.50).

Conclusions: The present study supports the current literature in that patients with hearing loss were more likely to develop delirium than those with normal hearing. Importantly, patients with implantable hearing devices were significantly less likely to develop delirium compared to hearing loss patients without an implantable device. Our research highlights the importance of treating hearing loss to prevent delirium in a hospital setting.

Professional Practice Gap & Educational Need: Despite literature demonstrating a relationship between hearing loss and risk of delirium, there remains a notable gap in our understanding of clinical management strategies focused on mitigating the risk of developing delirium in hearing-impaired patients. It is critical for healthcare providers to know how hearing rehabilitation devices impact this relationship between hearing loss and delirium.

Learning Objective: 1) Identify that hearing impairment is a risk factor for delirium. 2) Understand the impact that implantable hearing devices may have on delirium compared to HL patients who may defer to hearing aids.

Desired Result: Provide knowledge and educate healthcare providers on 1) hearing loss as a risk factor for in-hospital delirium and 2) the role implantable hearing devices may play in delirium prevention.

Level of Evidence – III

Indicate IRB or IACUC: Exempt

Early Auditory Development of Cochlear Implanted Children with Sensorineural Hearing Loss following Congenital CMV Infection

Piotr H. Skarzynski, Prof; Anita Obrycka, PhD; Aleksandra Kolodziejak, MSc; Elzbieta Gos, PhD
Rita Zdanowicz, MSc; Artur Lorens, Prof; Henryk Skarzynski, Prof

Objective: The aim of the study was to assess early auditory development in CI children with CMV-related hearing loss.

Study Design: The retrospective study included children with congenital CMV who underwent cochlear implantation at an early age due to hearing loss caused by the infection.

Setting: Tertiary referral center.

Patients: 47 CI children with sensorineural hearing loss following congenital CMV infection with mean age 14 months.

Interventions: Minimally invasive cochlear implantation via round window.

Main Outcome Measures: All children underwent Auditory Brainstem Response test before operation. Early development was assessed with LittleEARS Auditory Questionnaire. The questionnaire was performed at CI activation assessing pre implant auditory development and at each follow up visit related to CI fitting to 14 months of CI use.

Results: In children with CMV-related hearing loss the mean LittleEARS total score was 5.2 pts. (SD=7.1) at CI activation, 16.7 pts. (SD=8.8) at 5 months of CI use, and 24,8 pts. (SD=8.4) at 14 months after implantation. In the reference group the mean results were as follow: 8.3 pts. (SD=7.6) at CI activation, 25.0 pts. (SD=5.6) after 5 months of CI use, and 32.3 pts. (SD=3.9) 14 months post activation.

Conclusions: Early cochlear implantation in children with sensorineural hearing loss following congenital CMV infection facilitates their early auditory development. Nevertheless in this group of children the level of auditory development is lower comparing to the level observed in children with no CMV-related hearing loss.

Professional Practice Gap & Educational Need: There are no clear guidelines on screening for CMV in children.

Learning Objective: Early detection of CMV infection in children, which causes many complications in addition to hearing impairment.

Desired Result: Introduction of newborn screening for congenital CMV infection.

Level of Evidence – III level

Indicate IRB or IACUC : The study was approved by Bioethics Committee of the Institute of Physiology and Pathology of Hearing (KB.IFPS/Statement 4/2022).

Cochlear Implantation (CI) Outcomes in Children Under 5 Years of Age with Single-Sided Deafness (SSD): A Systematic Review and Meta-analysis

Corinne Pittman, MD; Nadia Samaha, BS; Myra Zaheer, BA
Luke Llaurado, BA; Xue Geng, MS; Michael Hoa, MD

Objective: To ascertain the outcomes of CI in children under 5 years of age with SSD in the areas of speech discrimination, speech comprehension in various environments, and qualities of hearing experience.

Data Sources: Medline, Embase, Cochrane and Web of Science databases were searched using relevant MeSH terminology.

Study Selection: Inclusion criteria captured the following: 1) age ≤ 5 years, 2) diagnosis of SSD, 3) normal hearing in the contralateral ear, 4) numerical data regarding speech perception thresholds, sound localization, and patient-reported outcomes.

Data extraction: Our study was adherent to the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) reporting guidelines. Data were pooled using a random-effects model.

Data Synthesis: Among 759 articles screened, 16 met inclusion criteria. The 204 children had a mean age at implantation of 60.41 months (95% CI, 40.37-80.57), and a mean 37.44 month duration of deafness (95% CI, 24.80-50.08). Speech discrimination improved significantly after CI (MD, -0.2906; 95% CI, -0.5596 to -0.0324) and there was significant heterogeneity between studies (p=0.028). Many children showed significant improvement on the spatial hearing domain of the Speech, Spatial and Qualities of Hearing Scale (SSQ) (MD, -2.1500; 95%, -3.7679, -0.5320; p=0.009).

Conclusions: Our findings demonstrate a clinically significant improvement in speech discrimination and spatial hearing outcomes among pediatric CI patients under the age of 5 years with SSD. Further studies investigating very young children with SSD following CI are needed to refine candidacy criteria, and appropriately counsel eligible patients and their families on treatment expectations.

Professional Practice Gap & Educational Need: In 2019, the FDA approved CI for SSD in children 5 years or older, however, earlier implantation may provide better hearing outcomes by impeding preference for the normal hearing (NH) ear and, possibly, reversing adaptive cortical reorganization patterns formed in favor of the NH ear.

Learning Objective: To understand the audiological and patient-reported outcomes of CI in children under 5 years of age with SSD in the areas of speech discrimination, speech comprehension, and qualities of hearing experience, and to assess their relationship to age at implantation and duration of deafness.

Desired Result: Treatment with cochlear implantation before the age of 5 years is associated with improvements in speech discrimination and spatial hearing among children with SSD.

Level of Evidence - Level I

Indicate IRB or IACUC: Exempt

A Systematic Review and Meta-Analysis Examining Outcomes of Cochlear Implantation in Children with Bilateral Cochlear Nerve Deficiency

Jay Maturi, BS; Kimberley S. Noij, MD, PhD; Vidya Babu, BS; Carolyn M. Jenks, MD

Objective: To characterize hearing and speech outcomes after cochlear implantation (CI) in pediatric patients with bilateral cochlear nerve deficiency (CND)

Data Sources: MEDLINE, Cochrane Library, Embase, and Web of Science databases were queried from conception to July 2023.

Study Selection: Studies that reported hearing and speech outcomes of pediatric patients with bilateral CND who underwent CI were included. 314 papers were screened, and 36 met inclusion criteria.

Data Extraction: Demographics, comorbidities, inner ear abnormalities, CND classification (aplasia or hypoplasia), details of diagnostic workup, and outcomes data were extracted from each paper. Patient outcomes were assessed with the four-level Auditory Performance Level (APL) scale. Meta-analysis was performed on patients with individual data to assess factors associated with performance.

Data Synthesis: A total of 295 patients with bilateral CND who underwent CI were included: 96 underwent unilateral CI in an ear with CN hypoplasia, 138 underwent unilateral CI in an ear with aplasia, 34 patients underwent bilateral CI (14 had bilateral hypoplasia, 18 had bilateral aplasia, 2 had mixed aplasia/hypoplasia), and the remainder were not classified. Among implanted ears, 91 had additional cochlear anomalies and 49 had vestibular anomalies. 52 patients had syndromic diagnoses, the most common being CHARGE. Among 256 patients for whom post-CI APL could be defined, 50 patients (20%) showed no improvement, 58 (23%) attained parent-perceived benefit, 68 (27%) attained closed-set speech perception, and 80 (31%) attained open-set speech perception.

Conclusions: Although most patients with bilateral CND benefited from CI, outcomes were heterogenous and one fifth of patients did not experience measurable benefit from CI.

Professional Practice Gap & Educational Need: Outcomes of CI in CND are variable and poorly defined, and there remains disagreement about whether patients with CND benefit from CI. This review provides valuable information regarding CI outcomes in patients with bilateral CND and will aid providers in preoperative discussions regarding outcome expectations for this patient population.

Learning Objective: To recognize the array of features that result in successful hearing and speech improvements following cochlear implantation in bilateral CND patients.

Desired Result: Improved patient selection and counseling for patients with bilateral CND undergoing CI.

Level of Evidence - Level III (systematic review and meta-analysis including case-control studies)

Indicate IRB or IACUC : Exempt (systematic review and meta-analysis)

Tympanic Membrane Regeneration Therapy for Pediatric Tympanic Membrane Perforation

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Tomoya Yamaguchi, MD; Akiko Kumazawa, MD; Ryohei Yuki, MD
Toshiki Maetani, MD, PhD

Objective: To evaluate tympanic membrane regenerative therapy (TMRT) for pediatric tympanic membrane perforations (TMPs)

Study Design: Intervention study

Setting: Research institute hospital

Patients: Twenty cases (M/F:13/7, 13/8 ears, 0-15 y.o.) in patients with chronic TMP were evaluated in this study. As comparison, twenty pediatric patients with chronic TMP who underwent myringoplasty/tympanoplasty were included.

Interventions: For the TM repair procedure, the edge of the TMP was disrupted mechanically, and gelatin sponge immersed in basic fibroblast growth factor were placed inside and outside the tympanic cavity and covered with fibrin glue. The TMP was examined 4 ± 1 weeks later. The protocol was repeated up to four times until closure was complete.

Main Outcome Measures: Closure of the TMP and hearing improvement were evaluated at 16 weeks after the final regenerative procedure. Adverse events were monitored.

Results: The mean follow-up period was 427.1 days. The TM regenerated in all cases, but pinhole reperforation occurred in two cases, and the final closure rate was 90.5% (19/21). Hearing improved to 24.9 ± 7.6 dB on average before surgery and to 13.8 ± 5.4 dB after surgery. The AB gap improved from 12.9 ± 8.0 dB to 5.2 ± 3.5 dB. The myringoplasty/tympanoplasty group had significantly lower AB gap improvement compared to the TMRT group. There were no adverse events.

Conclusions: TMRT can be expected to regenerate near-normal TMs with a high closure ratio, resulting in better hearing improvement compared to the myringoplasty/tympanoplasty group, and is an effective treatment for children with long life expectancy.

Professional Practice Gap & Educational Need: TMRT is a new treatment method that became covered by health insurance in Japan in November 2019. This treatment method is based on a tissue engineering concept that is fundamentally different from traditional tympanic membrane reconstruction. Therefore, it is important to fully understand this idea in order to regenerate the eardrum reliably. Appropriate treatment can regenerate a near-normal eardrum and provide good hearing with a very small AB gap. TMRT is gradually replacing most myringoplasty and some tympanoplasty in Japan. Although a tympanic membrane regeneration rate of over 90% has been reported in adults, there have been no reports only in children, so I would like to make this presentation and discuss some precautions.

Learning Objective: At the conclusion of this presentation, the participants should be able to know how to regenerate the tympanic membrane without conventional surgical therapy. This new tissue engineered treatment will change the former concept of the otologic surgery.

Desired Result: TMRT is currently undergoing Phase II clinical trials in the United States, and Phase III trials are planned for next year to obtain FDA approval. This treatment is expected to spread around the world because it is short, minimally invasive, low cost, and requires easy training for the surgeon. I hope that this announcement will be of some help.

Level of Evidence - Level III

Indicate IRB or IACUC : IRB No.2106006, Medical Research Institute Kitano Hospital. Initial approval 14/06/2021
TMRT became covered by health insurance in Japan in November 2019.

Unique Cell-Type Specific Signaling Patterns Define Cholesteatoma

Christopher M. Welch, MD, PhD; Shuze Wang, PhD; Joerg Waldhaus, PhD

Hypothesis: Cholesteatoma has a unique cellular composition and cell-type specific signaling pathways relative to normal tympanic membrane tissues that drive its behavior.

Background: Cholesteatoma is a complex, heterogeneous, expansile and destructive cystic epithelial lesion that occurs within the middle ear and temporal bone. It causes destruction of surrounding tissue, leading to significant otologic complications. Currently, the only treatment option is surgical removal of the disease, and despite surgical treatment, rates of recurrent or residual cholesteatoma following surgery approach 40-50% 10 years later. Extensive research has attempted to generate medical treatments by delineating signaling pathways that drive cholesteatoma behavior, with numerous pathways identified. This work has been hampered by the inherent heterogeneity of cholesteatoma, with cell-type specific behaviors obscured by bulk analysis of cholesteatoma.

Methods: Single-cell RNA (scRNA) sequencing was utilized to evaluate human cholesteatoma specimens, which were compared to available scRNA data for normal human tympanic membrane. Results were validated utilizing immunohistochemistry on human cholesteatoma specimens and in an *in vitro* model of cholesteatoma. The CellChat algorithm analyzed differential patterns in cell signaling pathways.

Results: Cholesteatoma cellular composition differs notably from normal tympanic membrane, with increased numbers of immune cells in cholesteatoma. A number of cell signaling pathways are also differentially regulated between cholesteatoma and normal tissues, including growth factor, Wnt, interleukin, cell adhesion, and tumor necrosis factor pathways, with unique cell-type specific patterns in cholesteatoma.

Conclusions: scRNA sequencing data defines the cellular composition and cell-type specific signaling pathways in cholesteatoma, demonstrating unique composition and signaling patterns relative to normal tympanic membrane.

Professional Practice Gap & Educational Need: The molecular understanding of cholesteatoma remains poor, resulting in a lack of medical treatments for this relatively common and troublesome condition.

Learning Objective: To define the cellular profile and cell-type specific signaling pathways of cholesteatoma relative to normal tympanic membrane.

Desired Result: To define the unique cell-type specific signaling pathways within cholesteatoma that may warrant further evaluation as potential therapeutic targets for medical treatment of cholesteatoma.

Level of Evidence – Not applicable, *in vitro* cellular study.

Indicate IRB or IACUC: IRB HUM00153531

The NLRP3 Inflammasome in Macrophages Causes Sensory Hearing Loss in Chronic Suppurative Otitis Media (CSOM)

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Ankur Gupta, MD; Kourosh Efthekarian, MD; Peter Santa Maria, MD, PhD

Hypothesis: The NLRP3 inflammasome causes sensory hearing loss in CSOM.

Background: CSOM is a global disease and affects 300 million people worldwide. We previously showed that sensory hearing loss (SHL) in CSOM is associated with macrophages and not due to direct bacterial invasion or direct ototoxin exposure. We aimed to investigate the macrophage associated mechanism that drives hearing loss in CSOM. The NLRP3 inflammasome is an innate immune sensor and is expressed in monocytes and macrophages. It can be activated via multiple different pathways, including many direct pathogen-associated molecular patterns (PAMPs) or damage-associated molecular patterns (DAMPs) that are toxic.

Methods: We investigated in our validated pseudomonas aeruginosa CSOM mouse model.

Results: We found that the relative mRNA levels of components of the NLRP3 pathway (NLRP3, PYCARD, Caspase 1, IL-1b) were significantly increased at 7 days in CSOM without depletion of cochlear macrophages. We then used a NLRP3 knockout mouse model (NLRP3 -/-) to study the inflammasome function in CSOM. We found that the knockout condition was protective for HC loss in the cochlea and showed significantly better outer hair cell (OHC) survival at 14 days compared to the WT control ($p = 0.0393$). The protein levels of NLRP3 ($p = 0.0018$) and its downstream cytokines IL-1b ($p = 0.0004$) and IL-18 ($p = 0.0129$) were significantly increased at 7 days in CSOM compared to the non CSOM control.

Conclusion: The NLRP3 inflammasome in macrophages causes SHL in CSOM and could be a potential target for future therapeutics development to prevent NLRP3 associated hearing loss.

Professional Practice Gap & Educational Need: CSOM is a global disease and the most common cause for permanent hearing loss in children in the developing world. There is currently no effective medical cure due to the lack of understanding what drives the sensory hearing loss in CSOM. There is a need to understand the mechanism to be able to develop therapeutics to prevent sensory hearing loss in CSOM.

Learning Objective: To study the role of the NLRP3 inflammasome in macrophages towards sensory hearing loss in CSOM.

Desired Result: NLRP3 activation causes sensory hearing loss in CSOM and sensory hearing loss can be prevented in a knockout mouse model.

Level of Evidence – III

Indicate IRB or IACUC: Approved by Stanford IACUC (APLAC) 32833

RESIDENT RESEARCH TRAVEL AWARD

Outcomes after Exoscopic versus Microscopic Ossicular Chain Reconstruction

Caleb J. Fan, MD; Jacob C. Lucas, MD; Robert M. Conway, DO
Masanari G. Kato, MD; *Seilesh C. Babu, MD*

Objective: To analyze the outcomes of exoscopic versus microscopic ossicular chain reconstruction (OCR)

Study Design: Retrospective chart review

Setting: Tertiary care otology-neurotology practice

Patients: Adult subjects with a diagnosis of ossicular discontinuity from 2018-2022

Interventions: Exoscopic or microscopic primary OCR (without mastoidectomy) with a partial ossicular replacement prosthesis (PORP) or total ossicular replacement prosthesis (TORP)

Main Outcome Measures: Audiometric outcomes at 1 year post-operatively including: bone and air pure tone averages (PTA), air-bone gap (ABG), change in ABG, speech reception threshold (SRT), and word recognition score (WRS). Secondary outcomes included operative time and complication rates of primary and delayed graft failure, tympanic membrane lateralization, cerebrospinal fluid leak, facial nerve injury, profound hearing loss, persistent tinnitus, and persistent vertigo.

Results: Sixty ears underwent primary OCR and were subdivided based on prosthesis type (PORP and TORP) and surgical approach (exoscope versus microscope). Exoscopic OCR was performed on 30 ears (21 PORP, 9 TORP) and microsocpic OCR was performed on 30 ears (19 PORP, 11 TORP). Controlling for prosthesis type and surgical approach, there were no significant differences in 1) demographics; 2) intraoperative findings including post-auricular approach, cartilage use, chronic otitis media, and cholesteatoma; 3) audiometric outcomes of bone and air PTA, ABG, change in ABG, SRT, and WRS. Operative time was 64.7 minutes and 59.6 minutes for the exoscopic and microsocpic group, respectively (p=0.4, 95% CI [-16.4, 6.1], Cohen's D =0.2). There was 1 case of delayed graft failure in the exoscopic group and 1 case in the microscopic group.

Conclusions: Audiometric and surgical outcomes after exoscopic and microscopic OCR are comparable.

Professional Practice Gap & Educational Need: The current standard of care is that otologic surgery is performed with a microscope. Newer technologies such as the endoscope and exoscope have become more popular in recent years, which requires a comparison of patient outcomes to uphold standards in otologic surgery.

Learning Objective: The outcomes after exoscopic OCR are comparable to those after microscopic OCR.

Desired Result: For otologic surgeons and patients to understand that newer technologies such as the exoscope do not sacrifice outcomes in OCR surgery.

Level of Evidence – IV

Indicate IRB or IACUC: Exempt

Temporal Integration of Multisensory Stimuli in Migraine

Timothy E. Hullar, MD; Jwala Rejimon, BS; Michelle E. Hungerford, AuD; Robert J. Peterka, PhD
Angela C. Garinis, PhD; Yonghee Oh, PhD; Richard F. Lewis, MD

Hypothesis: Patients with migraine have difficulties accurately merging multisensory integration in the temporal domain, helping explain their symptoms of dizziness and motion sensitivity.

Background: Multisensory cues generated by a single event arrive at the brain asynchronously due to variable delays in transmission, encoding, and processing. The brain must accommodate for these discrepancies to form a maximally useful, unified impression of the environment. The time offset over which multiple sensory inputs are interpreted as "synchronous" is known as the temporal binding window (TBW). We hypothesized migraine patients might have abnormal (widened) TBWs, causing sensory confusion and processing difficulties. Widened TBWs are known to occur in autism, schizophrenia, dyslexia, Parkinson's, and other neurologic disorders.

Methods: Stimuli were a 10 ms flash, a 10 ms beep, and a sinusoidal yaw rotation in the dark, presented pairwise at varying temporal offsets. The TBW was defined as the time interval over which subjects were less than 75% accurate which came first. TBWs for visual-auditory, auditory-vestibular, and visual-vestibular stimuli were characterized in 34 normal controls and 17 migraine patients.

Results: Pairwise t-tests showed TBW was longer among migraine patients than normal controls for the visual-vestibular pairing (261 vs 171 ms, $p = 0.036$). Visual-auditory and auditory-vestibular pairings were not different between participant groups ($p=0.125$ and 0.384 respectively). Vestibular response thresholds were correlated with TBW but independent of participant group.

Conclusions: Prolonged TBW may relate to imbalance and motion sensitivity in migraine patients. Narrowing the TBW with specific training techniques may help improve these symptoms.

Professional Practice Gap & Educational Need: Patients with migraine often present with generalized symptoms of imbalance and related motion sensitivity, but our inadequate understanding of its pathophysiology limits the development and implementation of effective treatment options.

Learning Objective: To describe important characteristics of multisensory balance-related sensory information in patients with imbalance and motion sensitivity.

Desired Result: To demonstrate the relationship between multisensory integration in the temporal domain and migraine.

Level of Evidence: 3

Indicate IRB or IACUC: [1635600-4] VAPORHCS/OHSU J (7/1/2020)

Artificial Intelligence for Diagnostic and Treatment Planning:
Is It Ready to Be Your Doctor?

Camryn Marshall, BS; Jessica Forbes, MS; Luis Roldan, MD
Jim Atkins, MD; Michael D. Seidman, MD

Objective: Investigate the precision of language-model artificial intelligence (AI) in diagnosing conditions by contrasting its predictions with diagnoses made by board-certified otologic/neurotologic surgeons, using patient-described symptoms.

Study Design: Prospective Correlational Study.

Setting: Tertiary Care Center

Patients: 100 adults participated in the study. These included new patients or established patients returning with new symptoms. Individuals were excluded if they could not provide a written description of their symptoms.

Interventions: Summaries of the patients' current illnesses were supplied to three publicly available AI platforms: Chat GPT 4.0, Google Bard, and WebMD "Symptom Tracker" licensed by DXplain.

Main Outcome Measures: This study evaluates the accuracy of three distinct AI platforms in diagnosing otologic conditions by comparing AI results to diagnoses provided by three different otologic/neurotologic surgeons.

Results: AI-generated diagnoses were broad, non-specific, and often unrelated to diagnoses provided by physicians after thorough history-taking. As it stands, AI is not yet ready to be your doctor.

Conclusions: Contemporary language-model AI platforms can generate extensive differential diagnoses with limited data input. However, doctors are able to refine these diagnoses through focused history-taking, physical examinations, and clinical experience – skills that current AI platforms lack.

Professional Practice Gap & Educational Need: Recognizing the existing and prospective roles of AI in patient care is imperative for medical professionals, especially considering the large number of individuals who research medical details online, including potential diagnoses from their symptoms, before seeing a healthcare professional. Currently, AI does not possess the capability to fine-tune a differential diagnosis using patient-centric history-

Learning Objective: Clarify the accuracy and, consequently, the present role of AI as a diagnostic tool in medicine.

Desired Result: Physicians will cultivate an understanding of the role, benefits, and risks that AI can inadvertently present in diagnosis and patient care.

Level of Evidence: Level III

Indicate IRB: IRB 2079755, Advent Health, Orlando, Initial approval 10/10/2023

RESIDENT RESEARCH TRAVEL AWARD

Artificial Intelligence Tracking of Otologic Instruments in Mastoidectomy Videos

George S. Liu, MD; Sharad Parulekar; Trishia El Chemaly, MS; Melissa C. Lee, BS
Mohamed Diop, MD; Roy Park, MD; Nikolas H. Blevins, MD

Objective: Develop an artificial intelligence (AI) model to track otologic instruments in mastoidectomy videos.

Study Design: Retrospective case series.

Setting: Tertiary care center.

Subjects: 6 otolaryngology residents (PGY 3-5) and one senior neurotology attending with >25 years of experience.

Interventions: Thirteen 30-minute videos of cadaveric mastoidectomies were recorded by residents. The suction irrigator and drill were manually annotated. Videos were split into training (N=8), validation (N=3), and test (N=2) sets, and used to develop an AI model by adapting YOLOv8, a state-of-the-art object tracking model, to track the drill and suction irrigator.

Main Outcome Measure(s): Precision, recall, and mean average precision using an intersection over union cutoff of 50% (mAP50). Differential patterns of motion between resident and attending surgeon in two prospectively collected live mastoidectomy videos.

Results: The model achieved excellent accuracy for tracking the drill (precision 0.93, recall 0.89, and mAP50 0.93) and suction irrigator (precision 0.67; recall 0.61; and mAP50 0.62) in hold-out test videos. Prediction speed was fast (~100 ms per image) and included detection of when instruments were absent. Predictions on prospective videos revealed accurate tracking in attending and resident-performed surgeries and faster drill speed in the former (8.6 ± 5.7 mm/s versus 7.6 ± 7.4 mm/s, respectively; mean ± SD; $p<0.01$).

Conclusions: Our AI model can accurately track otologic instruments in mastoidectomy videos with high accuracy and near real time processing speed. Automated tracking opens the door to the automated analysis of objective metrics of surgical skill without the need for manual annotation and will provide valuable data for future navigation and augmented reality surgical environments.

Professional Practice Gap & Educational Need: Objective analysis of otologic surgical technique based on instrument tracks in recorded videos is limited by the time needed to manually annotate videos. With advances in AI technology, developing systems to automate the assessment of surgical techniques using computer analysis of surgical video recordings is feasible.

Learning Objective: Review existing and new applications of computer vision technology to quantitatively track and analyze otologic instrument motion in recorded videos.

Desired Result: Discuss the opportunities and limitations of applying computer vision technology to aid in the assessment of otologic surgical technique in recorded mastoidectomy videos.

Level of Evidence: IV

Indicate IRB or IACUC: Stanford University IRB #40945 approved 5/14/2019