SELECTED ABSTRACTS

ORAL PRESENTATIONS

IN ORDER OF PRESENTATION

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AMERICAN NEUROTOLOGY SOCIETY

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NEUROTOLOGY FELLOW AWARD

Investigating the Minimal Clinically Important Difference for AzBio and CNC Speech Recognition Scores

Ankita Patro, MD, MS; Aaron C. Moberly, MD; Michael H. Freeman, MD; Elizabeth L. Perkins, MD
Marc L. Bennett, MD, MMHC; David S. Haynes, MD, MMHC
Naweed I. Chowdhury, MD MPH

Objective: To assess the minimal clinically important difference (MCID) values for speech recognition scores, which have not been previously reported.

Study Design: Retrospective cohort.

Setting: Tertiary referral center.

Patients: 863 adult patients who underwent cochlear implantation between 2009 and 2022.

Main Outcome Measures: MCID values for Consonant-Nucleus-Consonant (CNC) word scores and AzBio sentences in quiet and noise scores using distribution-based methods (half-standard deviation, standard error of measurement, Cohen's d, and minimum detectable change).

Results: In this cohort, the median preoperative CNC score was 8% (IQR, 0—22). The median preoperative AzBio in quiet score was 9% (IQR, 0—34), and the median preoperative AzBio in noise score was 11% (IQR, 3—20). The average MCID of several distribution-based methods for CNC, AzBio in quiet, and AzBio in noise were: 7.4%, 9.0%, and 4.9%, respectively. Anchor-based approaches with the Speech, Spatial, and Qualities of hearing patient-reported measure did not have strong classification accuracy across CNC or AzBio in quiet and noise scores (ROC areas under-the-curve $\leq$ 0.69), highlighting weak associations between improvement in speech recognition scores and subjective hearing-related abilities.

Conclusions: Our estimation of MCID values for CNC and AzBio in quiet and noise allows for enhanced patient counseling and clinical interpretation of cochlear implant-related outcomes research.

Professional Practice Gap & Educational Need: To our knowledge, MCID values for speech recognition scores in the cochlear implant population have not been estimated, representing a critical gap in the current literature.

Learning Objective: To identify MCID values for CNC and AzBio in quiet and noise scores.

Desired Result: Providers will have knowledge about MCID values in speech recognition scores in the cochlear implant population, where certain percentage improvements may offer clinically meaningful results in addition to those that are statistically significant. These findings can be utilized to interpret speech recognition scores with patients as well as interpret past, current, and future research assessing cochlear implant outcomes.

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).

Qualifying Cochlear Implant Candidates – Does it Matter how Patients are Qualified?

David S. Lee, MD; Jacques A. Herzog, MD; Cameron C. Wick, MD
Nedim Durakovic, MD; Craig A. Buchman, MD; Matthew A. Shew, MD

Objective: Evaluate different qualification criteria for cochlear implant (CI) recipients.

Study Design: Retrospective cohort study

Setting: Single-institution tertiary referral center

Patients: 2,124 adults that underwent unilateral CI categorized by qualifying status: AzBio quiet (n=1,239), +10dB SNR (but not in quiet; n=519), +5dB SNR (but not in quiet or +10 dB SNR; n=366). Separate analysis was performed comparing CNC ≤40% (n=720) vs CNC 41-60% (n=39).

Interventions: CI

Main Outcome Measures: Pre- and post-operative speech perception performance. Clinically meaningful improvement is defined as at least ≥10%.

Results: Quiet qualifiers experienced improvement in AzBio quiet (44.3%[95%CI=42.0-46.7%]), whereas +10dB qualifiers and +5dB qualifiers did not (11.1%[95%CI=8.7-13.5%] and 9.5%[95%CI=5.7-13.3%], respectively). When qualifying in +10dB, CI recipients experienced improvement in +10dB SNR(24.0%[95%CI=21.6-26.3%]); similarly, +5dB qualifiers only experienced improvement in +5dB SNR (31.8%[95%CI=28-35.5%]). When stratified by Medicare eligibility (AzBio ≤60%), patients that qualified in noise experienced clinically meaningful gain when tested in their qualifying condition (e.g., +10dB qualifiers tested in +10dB SNR), but not in quiet, regardless of Medicare eligibility status. CNC ≤40% qualifiers experienced meaningful benefit in CNC and AzBio quiet, but CNC 41-60% qualifiers only experienced meaningful benefit in AzBio quiet (18.1%[95%CI=11-25.2%]) and +10dB (23.8%[95%CI=14.1-33.5%]), but not CNC (6.3%[95%CI=-0.3-12.9%]).

Conclusions: Quiet qualifiers improved regardless of testing condition, while those qualifying in noise received benefit only in their qualifying test condition. This may be due to ceiling effects. Newly proposed CNC criteria (≤60%) shows improvement in AzBio conditions, but should be used with caution. Future studies will need to explore the impact of different qualification criteria on quality of life.

Professional Practice Gap & Educational Need: To highlight how institutional differences in CI candidacy evaluation affect hearing outcomes among unilateral CI recipients.

Learning Objective: To understand the effect of qualification in noise on hearing outcomes among unilateral CI recipients.

Desired Result: To improve knowledge of how qualifying conditions affect hearing outcomes.

Level of Evidence - III

Indicate IRB or IACUC : 201911036, Washington University in St. Louis

Cochlear Implantation for Single-Sided Deafness in Pediatric Patients: A Critical Assessment of Long-term Usage Rate

Robert J. Macielak, MD; Celine Richard, MD, PhD; Prashant Malhotra, MD
Ursula M. Findlen, PhD; Oliver F. Adunka, MD, MBA

Objective: To assess the long-term usage rate of pediatric patients undergoing cochlear implantation (CI) for single-sided deafness (SSD)

Study Design: Historical cohort study

Setting: Tertiary pediatric referral center

Patients: Pediatric patients (age < 18 years-old) who underwent CI for SSD

Interventions: CI with requisite audiometric follow-up

Main Outcome Measures: Implant use and audiometric testing at last available visit up to two years post-implantation

Results: Sixty-six patients were implanted for SSD between 12/2018 and 7/2023 at a median age of 4.7-years-old (IQR 1.7-7.7). The cause of hearing loss was unknown in the majority of cases (27 patients, 41%) with cytomegalovirus being the most common known cause (17 patients, 26%). Hearing loss was pre-lingual in 38 patients (58%). Post-implantation, 12 patients (18%) were identified as lost to follow-up. For the remaining 54 patients, the median length of audiometric follow-up was 1.4 years (IQR 0.9-2.2). At last evaluation, only 10 of these 54 patients (19%) were designated as users (≥6 hours per day), and 13 patients (24%) were designated as limited users (>2 but <6 hours per day). Of patients capable of performing speech-in-noise testing (n=12), 10 patients (83%) showed improvement on BKB-SIN SNR-50 testing with their implant on versus off with a mean improvement of 3 dB. Notably, 3 of these 10 patients (30%) were categorized as non-users despite this benefit.

Conclusions: Despite audiometric benefit from CI in the pediatric SSD population, long-term usage rate remains lower than anticipated at a high-volume, well-resourced tertiary pediatric center. Critical assessment is needed to identify trends for these findings to assure appropriate distribution of limited resources.

Professional Practice Gap & Educational Need: Benefit of cochlear implantation in the pediatric single-sided deafness population has been shown, but limited data has been reported regarding long-term results and usage rates in this population.

Learning Objective: The goal of this talk is to describe the difficulties with follow-up and usage rate in pediatric patients undergoing cochlear implantation for single-sided deafness.

Desired Result: The listener will appreciate the difficulties observed in performing cochlear implantation in this population allowing for more comprehensive assessment of this practice.

Level of Evidence: Level IV

Indicate IRB or IACUC: Nationwide Children's Hospital IRB Protocol #00001351

Single Institution Failure Rates and Speech Recognition Outcomes in HiRes Ultra Series Recall

Taimur Siddiqui, BSA, BBA; Benjamin D. Lovin, MD
Alex D. Sweeney, MD; Nathan R. Lindquist, MD

Objective: To report failure rates of Advanced Bionics (AB) HiRes Ultra (V1) and Ultra 3D (V1) cochlear implants (CI) and determine speech recognition outcomes after revision.

Study Design: Retrospective cohort study

Setting: Tertiary referral academic center

Patients: Adult and pediatric patients implanted with V1 devices.

Interventions: CI placement, integrity/audiometric evaluation, revision surgery

Main Outcome Measures: CI failures, revision surgery rate, speech recognition outcomes

Results: Seventy AB V1 were implanted in 25 adults and 27 children. In total, 47 (67.1%) implants failed at a mean 2.75 years after implantation with forty-five (95.7%) believed to be related to the recall issue. Failure was most often determined by recorded performance decline (77.8%) and drop in impedances (73.3%). Of these 45 failures, there was no statistically significant difference in failure rates between adults and children (63.0% and 68.3%, respectively; p=0.65). The mean time to device failure was 2.8 years for adults and 2.7 years for children (p=0.95). To date, 25 (75.8%) patients with recall-related CI failures have undergone revision surgery. For adults, CNC scores improved after revision surgery (mean CNC = 35.0% to mean CNC = 61.4%, p=0.005) and were similar to best pre-revision scores (p=0.51). AzBio scores for adults demonstrated a drop in performance pre-revision (mean best AzBio score = 86.5% to mean pre-revision AzBio = 59.0%, p=0.03), but was did not show significance in improvement post-revision (mean post-revision AzBio = 74.5%, p=0.16).

Conclusions: A significant number of AB V1 implants failed in adult and pediatric patients. While CNC scores returned patients with revision surgery to best pre-revision testing, post-revision AzBio scores did not return to best pre-revision scores. Further investigations and multicenter studies are needed to fully quantify outcomes for these patients.

Professional Practice Gap & Educational Need: CI recalls are an important consideration when providing patient counseling for primary and revision CI surgery. Analyses of CI failure rates from a large healthcare institution provides manufacturer-independent failure rate data, improve patient counseling, and elucidate outcomes for CI failures.

Learning Objective: The audience should be able to quantify CI failure rates among adults and pediatrics at a single institution and understand CI revision outcomes.

Desired Result: To corroborate previous data on AB CI failure rates and improve patient counseling with metrics for CI failures and outcomes of CI revision, if indicated.

Level of Evidence – Level V

Indicate IRB or IACUC : H-49479

A Multi-Institutional Analysis of Advanced Bionics HiRes V1 Cochlear Implant Device Failures

Michael H. Freeman, MD; Nathan R. Lindquist, MD; James R. Dornhoffer, MD; Benjamin D. Lovin, MD
Kristen L. Yancey, MD; Matthew L. Carlson, MD; Marc L. Bennett, MD, MMHC

Objective: To assess Advanced Bionics (AB) HiRes Ultra (V1) and Ultra 3D (V1) cochlear implant electrode failures over time at four large cochlear implant programs.

Study Design: Retrospective cohort.

Setting: Five tertiary referral centers.

Patients: Patients receiving AB HiRes Ultra (V1) and Ultra 3D (V1) devices as of December 31, 2022.

Main Outcome Measures: Failure rate, revision surgery, speech recognition scores.

Results: To date, 206 (42.7%) of the 483 implanted V1 devices have failed. Device failure rate varied across institutions from 32% to 67%. Of the 206 detected failures, 163 (79%) have undergone revision surgery, with 94% of revisions being performed with Advanced Bionics devices. Average time from implantation to diagnosis of device failure was 2.68 ± 1.24 years. After revision, patients had an average CNC score improvement of 23.8% over their most recent pre-revision scores and demonstrated average datalogging of 12.2 ± 4.2 hrs/day at most recent evaluation. 78% of patients with available testing matched or exceeded their best pre-failure speech performance following implant revision.

Conclusions: Comparison of patients across multiple high-volume implant centers confirms the presence of ongoing device failures. There is variability across institutions in the rate of revision surgery once a patient is diagnosed with a V1 device failure, as well as in the rate of device failure detection. Inter-institutional variability in failure rates may be explained by the variation in the routine use of electrical field imaging. Reimplantation with a new device typically results in a return to pre-failure peak performance.

Professional Practice Gap & Educational Need: To our knowledge, a comparison of AB HiRes (V1) device failures across multiple institutions has not been conducted.

Learning Objective: To identify device failure rate across multiple institutions with different testing protocols.

Desired Result: Providers will have an improved understanding of the trajectory of device failures for HiRes (V1) devices over time. Providers will also be able to project

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

Indicate IRB or IACUC: IRB Exempt (230017, Vanderbilt University).

HERBERT SILVERSTEIN AWARD FOR RESEARCH EXCELLENCE IN OTOLOGY/NEUROTOLOGY

Expression of TGFβ-1 and CTGF in the Implanted Cochlea and its Implication on New Tissue Formation

Adam Y. Xiao, MD, PhD; Ivan A. Lopez, PhD
Gail Ishiyama, MD; Akira Ishiyama, MD

Hypothesis: TGFβ-1 and CTGF are upregulated following cochlear implantation and may play an important role in the pathogenesis of post-implantation new tissue formation.

Background: Cochlear implantation can lead to insertion trauma and foreign body reaction resulting in new tissue formation that adversely affects device performance. Transforming growth factor beta-1 (TGFβ-1) and connective tissue growth factor (CTGF) are pro-fibrotic proteins implicated in various pathologic conditions, but little is known about their role in the cochlea. The present study aims to characterize the expression of these proteins in the human implanted cochlea.

Methods: Archival HTB samples acquired from 12 patients with prior CI as well as human intra-cochlear scar tissue harvested during revision CI surgery were used in this study. Histopathologic analysis of fibrosis and osteoneogenesis was conducted using H&E. Protein expression was characterized using immunofluorescence and RNA expression was quantified with qRT-PCR.

Results: TGFβ-1 and CTGF were upregulated in implanted HTB and surgical specimens. TGFβ-1 was diffusely expressed within the fibrous capsule while CTGF was expressed vectorially towards the modiolus. There was also strong expression of CTGF at the fibrosis-osteoneogenesis junction as well as within the new bone. RNA expression of TGFβ-1 ($p<0.05$) was also significantly higher in intra-cochlear scar tissue compared to control.

Conclusions: To our knowledge, this is the first study to demonstrate increased expression of TGFβ-1 and CTGF in the human implanted cochlea and may provide better understanding of the mechanism behind this pathogenic process to guide future therapies.

Professional Practice Gap & Educational Need: Cochlear implantation can lead to new tissue formation that detrimentally affects device performance over time. Better understanding of this process can lead to more effective therapeutic interventions.

Learning Objective: To understand the expression pattern of TGFβ-1 and CTGF in the fibrous capsule and new bone of implanted cochlea.

Desired Result: Participants should better appreciate the potential role of TGFβ-1 and CTGF in new tissue formation following cochlear implantation.

Level of Evidence – Not applicable

Indicate IRB: UCLA IRB #22-001587

TRAINEE AWARD

Impact of Modifiable Surgical Factors on Ossiculoplasty Outcomes after Controlling for Ear Environment Risk: A Multi-institutional Study

Ryan T. Judd, MD; Richard K. Gurgel, MD, MSCI; John L. Dornhoffer, MD
Matthew Carlson, MD; Walter Kutz, MD; Jafri Kuthubutheen, MD
Michael B. Gluth, MD

Objective: To determine the impact of modifiable surgical factors on ossiculoplasty outcomes after controlling for ear environment risk.

Study Design: Multi-institutional retrospective review.

Setting: Six tertiary care centers from 2011-2019.

Patients: Adults and children.

Interventions: Ossiculoplasty, including: synthetic ossicular replacement prosthesis, autograft interposition, bone cement repair, and mobilization.

Main Outcome Measure: Correlation between modifiable surgical factors and pure-tone average air-bone gap (PTA-ABG) at most recent audiogram after controlling for preoperative risk using a new statistically-validated Ear Environment Risk (EER) score previously developed from the presented database.

Results: 1,679 cases were included with median follow-up time of 20 months (IQR 5-51). After controlling for EER score, ossiculoplasty engaging the malleus was associated with lower PTA-ABG versus engaging the tympanic membrane without malleus engagement (beta= -2.6dB (-4.3, -1.0), p=0.001). For total ossicular replacement prostheses (TORP), use of a footplate prosthesis was associated with lower PTA-ABG than footplate engagement without a footplate prosthesis (beta= -3.5dB (-6.1, -1.0), p=0.029). For synthetic prostheses, titanium+hydroxyapatite had lower PTA-ABG than either full titanium or polyethylene prostheses (p<0.05). There was no significant difference in PTA-ABG for: single-stage versus multi-staged approach for cholesteatoma or non-cholesteatoma cases; use of a cartilage cap over reconstruction versus no cartilage; and incudostapedial joint reconstruction with joint prosthesis/bone cement versus synthetic PORP (p>0.05).

Conclusions: In this large multi-center study, prothesis engagement of the malleus and use of a footplate prosthesis with a TORP were associated with better outcomes. Among cases involving synthetic prostheses, combination hydroxyapatite+titanium prostheses were superior to other materials. Staging and use of cartilage cap did not impact outcomes.

Professional Practice Gap & Educational Need: Large volume, multi-center evidence pertaining to the impact of surgical technique on ossiculoplasty outcomes is limited.

Learning Objective: Elucidate which surgical factors can be modified in order to optimize ossiculoplasty hearing outcomes.

Desired Result: Improved ossiculoplasty hearing outcomes

Indicate IRB or IACUC: IRB18-1713, The University of Chicago Biological Sciences Division.
Approved 12/18/2018.

Optical Coherence Tomography Imaging of Middle Ear Glomus Tumors in Clinic

Dorothy W. Pan, MD, PhD; Marcela A. Moran, BS; Wihan Kim, PhD
Jack C. Tang, PhD; Frank D. Macias-Escriva, BS
Brian E. Applegate, PhD; John S. Oghalai, MD

Hypothesis: Optical Coherence Tomography (OCT) can be utilized to diagnose glomus tumors by imaging through the tympanic membrane (TM).

Background: OCT is a noninvasive imaging technique used clinically in ophthalmology. For otology, OCT has been used experimentally to image middle ear structures through the TM, with penetration into the cochlear promontory. In Doppler mode, blood flow within tissues can be measured.

Methods: We designed and built a custom handheld OCT clinical system that can be used similar to an otoscope. It operates with a laser emitting at 1310 nm and 39 nm bandwidth with a 200 kHz sweep rate, and provides 33.4 um axial and 38 um lateral resolution (in tissue, n=1.3). Cross-sectional images of the middle ear space, including Doppler OCT, were recorded in an academic neurotology clinic. The experimental group included patients with glomus tumors and the control group included patients with normal ear exams by otomicroscopy.

Results: OCT images revealed key structures within the middle ear space, including TM, ossicles (malleus and incudostapedial joint), chorda tympani, and cochlear promontory. OCT also identified all four patients with a glomus tumor that was visible on otomicroscopy. This was quantified by comparing image intensity within the mesotympanic space normalized to image intensity of the TM. These values were 0.72±0.11 (mean ± SEM, n=4) for glomus tumors and 0.085±0.013 (mean ± SEM, n=4) for normal ears, a difference that was statistically significant (p=0.001, non-paired t-test). Doppler OCT revealed vascularity within glomus tumors, but no vascularity was found in normal ears.

Conclusions: OCT permits noninvasive imaging of the TM and middle ear space in a clinic setting and provides details beyond otomicroscopic examination. OCT provides information that can help with the diagnosis of glomus tumors.

Professional Practice Gap & Educational Need: Making a conclusive diagnosis of a middle ear mass can be difficult with otomicroscopy alone. OCT is a technology that will soon be available for use in neurotology clinics, and it has the potential to help overcome this limitation.

Learning Objective: OCT permits visualization of middle ear structures non-invasively, and can provide information that can help narrow the differential diagnosis of otopathology

Desired Result: OCT can be used to image and identify middle ear pathology such as glomus tumors in the clinic.

Level of Evidence - Level III

Indicate IRB or IACUC: IRB approved, University of Southern California HS-17-01014

Pain Control After Otologic Surgery: Do Nonopioid Analgesics Suffice?

Mustafa G. Bulbul, MD, MPH; Zulkifl Jafary, BS
Brian M. Kellermeyer, MD; Scott B. Shapiro, MD

Objective: Investigate whether nonopioid analgesics provide adequate pain control after otologic surgery.

Study Design: Retrospective multi-center cohort.

Setting: Two quaternary academic medical centers.

Patients: Patients over 12 years old who underwent otologic surgery involving the middle ear and/or mastoid at two centers over a 4-month period, though the study is ongoing.

Interventions: Patients were prescribed acetaminophen and ibuprofen post-operatively and instructed to contact the surgical team if pain control was inadequate, in which case an opioid medication was prescribed. Level of pain and medication use were assessed with a standardized questionnaire 1 week after surgery.

Main Outcome Measures: Post-operative pain levels during the first week after surgery (0-10), proportion of patients requiring opioid medication.

Results: Fifty-six patients were included. Of these, 39.3% underwent mastoidectomy, 23.2% cochlear implant, 14.3% post-auricular tympanoplasty, 12.5% trans-canal tympanoplasty, and 10.7% had a different surgery. The mean of the average level of pain during the first post-operative week was 4.6/10 (+/-2.5). The mean highest level of pain was 6.1/10 (+/-2.8). Six patients (10.7%) required breakthrough opioid pain medication. The remaining 89.3% utilized nonopioid analgesics only. One week after surgery, 59.9% were taking nonopioid analgesics only while the remaining 41.1% of all patients were not taking any pain medication at all. Though opioids were required infrequently, there were no significant differences in medication use between the two centers.

Conclusions: Nonopioid analgesics provide adequate pain control for most patients after middle ear and mastoid otologic surgery. Opioid analgesics do not routinely need to be prescribed.

Professional Practice Gap & Educational Need: Preliminary research has suggested patients may not require opioid analgesics after routine middle ear and mastoid surgery. Despite this, current pain control regimens utilized are highly variable across the otologic surgery community and often continue to routinely prescribe opioid analgesics.

Learning Objective: Learners will understand that a nonopioid analgesic regimen consisting of acetaminophen and ibuprofen is adequate for most patients after middle ear and mastoid surgery.

Desired Result: Otolaryngologists will not routinely prescribe opioid analgesics after middle ear and mastoid surgery.

Level of Evidence – Level III

Indicate IRB or IACUC: IRB approval was obtained from both institutions (Rutgers protocol #2021001523 April 2, 2023 and WVU Protocol #2106339604 September 29, 2021)

Detection of CSF Leaks with Intrathecal Gadolinium MRI Cisternograms

Douglas J. Totten, MD, MBA; Cody Whitted, BS; Kevin T. Booth, PhD
Kristine M. Mosier, DMD, PhD; Evan Cumpston, MD
Nicholas A. Koontz, MD; Rick F. Nelson, MD, PhD

Objective: To compare the efficacy of MRI and CT Cisternograms on detection of cerebrospinal fluid (CSF) leaks

Study Design: Retrospective cohort study.

Setting: Tertiary referral center.

Patients: Adult patients with suspected CSF leak who underwent computed tomography (CT) or magnetic resonance (MR) imaging cisternograms alone or in combination to assess for CSF leak between 2018-2022.

Main Outcome Measures: Evidence of CSF leak on single or multiple cisternogram types.

Results: 32 patients (66% female) had an age range of 22-80 years where a CSF leak was absent in 18 and confirmed in 14 patients. CT cisternogram was performed in 31 (97%) patients while MR cisternogram was performed in 16 (50%) patients. There were no false positive tests for either CT or MR cisternograms. CT cisternograms had sensitivity of 69% and a negative predictive value (NPV) of 82% while MR cisternograms had a 100% sensitivity and 100% NPV. No adverse events were experienced by any patient.

Conclusions: MR cisternograms appear to be more sensitive than CT cisternograms in detecting CSF leaks. MR cisternograms should be utilized when appropriate to assess for lateral skull base CSF leaks when there is a high-index of suspicion with inconclusive imaging and beta-2 transferrin testing.

Professional Practice Gap: Incidence of CSF leaks continues to increase across the United States. While beta-2-transferrin requires collection of draining fluid and often has a delayed result, cisternograms allow for highly accurate and more immediate results while showing anatomic area of defect.

Learning Objective: CT and MR cisternograms are helpful tools in diagnosis of CSF leaks

Desired Result: CT and MR cisternograms are highly effective in diagnosing or ruling out CSF Leaks in patients with a high degree of suspicion of a CSF leak.

Level of Evidence: IV

IRB: Indiana University IRB #13133 (approved 10/14/2022)

NEUROTOLOGY FELLOW AWARD

Lumbar Puncture Opening Pressure and Polysomnogram Findings in Patients with Lateral Spontaneous Cerebrospinal Fluid Leaks

Evan Cumpston, MD; William Zhang, BS; Douglas J. Totten, MD, MBA
Charles W. Yates, MD; Rick F. Nelson, MD, PhD

Objective: Evaluate postoperative opening pressures (OP) on lumbar puncture (LP) and polysomnogram (PSG) findings in patients who underwent middle cranial fossa (MCF) repair in patients with lateral spontaneous cerebrospinal fluid (sCSF) leaks.

Study Design: Retrospective cohort

Setting: Tertiary referral center

Patients: Temporal bone sCSF leak who underwent MCF repair with bone cement between 8/2019-3/2023.

Interventions: MCF repair of sCSF leak, PSG, and postoperative LP.

Main Outcome Measures: Incidence of intracranial hypertension, IIH (LP OP >25 cm H20), and of OSA (apnea-hypopnea index (AHI) >5)

Results: 66 patients had an average (standard deviation) age of 56.7 (±11.7) years and BMI of 39.0 (±9.9) kg/m2. There were no unilateral recurrent CSF leaks. OP was completed by 31 patients at a mean 155.5 days (±172.3) postop with a mean OP 22.3 cmH_2O (±8.3). Only 10 (32%) patients had an LP ≥25 cmH_2O. Papilledema was observed in 1 of 11 patients on retinal exam. OSA was observed in 93% of patients (n = 32) with a mean AHI was 25.7 (±35.1). There was no significant correlation between OP and AHI (p=0.57). In the 3 patients who developed a contralateral leak, the mean OP was 27.5 (±8.8), AHI 16.5 (±2.5), and mean BMI 37.2 (±12.6). Only one had a history of anterior sCSF leak.

Conclusions: The incidence of IIH on postoperative LP is observed in 32% of lateral sCSF leak patients and papilledema is rare, yet nearly all patients have OSA. Concomitant anterior and lateral CSF leaks are rare, yet patients are at risk for development of a contralateral temporal bone sCSF leak.

***Professional Practice Gap & Educational Need:** The association of IIH, OSA and sCSF leaks following repair of sCSF leaks of the lateral skull base. This study describes the OP and polysomnogram findings in a series of sCSF leak patients who underwent repair.

***Learning Objectives:** Most patients with lateral sCSF leaks have OP less than 25 cmH_2O following repair. OSA is common in patients with lateral sCSF leaks.

***Desired Results:** Define the mean opening pressure in patients with previous lateral sCSF leak repair.

Level of Evidence: IV

IRB: Indiana University IRB #1907071217.

Long-Term Prospective Quality-of-Life Outcomes in 445 Patients with Sporadic Vestibular Schwannoma

Eric E. Babajanian, MD; Christine M. Lohse, MS; Nicole M. Tombers, RN
Michael J. Link, MD; Matthew L. Carlson, MD

Objective: To evaluate the long-term changes in sporadic vestibular schwannoma (VS) disease-specific quality-of-life (QOL) outcomes.

Study Design: Prospective longitudinal study using the Penn Acoustic Neuroma Quality of Life (PANQOL) scale.

Setting: Large academic skull base center and Acoustic Neuroma Association.

Patients: Patients with sporadic VS who completed a baseline survey before treatment and at least one follow-up survey.

Interventions: Observation, microsurgery, radiosurgery.

Main Outcome Measures: Change in PANQOL scores from baseline to most recent survey.

Results: A total of 445 patients were eligible for study with a mean duration of follow-up of 4.4 (SD 2.3) years, including 122, 218, and 105 in the observation, microsurgery, and radiosurgery groups, respectively. Patients managed with observation ($p=0.03$) or microsurgery ($p<0.001$) demonstrated improvement in anxiety scores. Changes in facial function scores differed significantly by management group ($p=0.01$), with patients undergoing microsurgery demonstrating a mean decline of 10 in facial function scores compared with mean declines of 3 for those managed with observation or radiosurgery. Hearing loss scores decreased similarly over time for all three groups ($p=0.3$). There were minimal changes in total PANQOL scores over time across all management groups ($p=0.5$).

Conclusions: Long-term changes in total QOL among VS treatment groups are not significantly different. Microsurgery may continue to confer an advantage with regard to anxiety, presumably due to the benefit of a "cure," but with a greater decline in facial function when compared to observation or radiosurgery. Long-term decline in hearing was not statistically significant among groups.

Professional Practice Gap & Educational Need: With differing practice patterns across institutions, we need to better understand whether treatment strategy for VS impacts long-term QOL for patients.

Learning Objective: To describe long-term disease-specific QOL outcomes in patients with VS over time.

Desired Result: To provide guidance on long-term QOL outcomes in VS depending on treatment strategy.

Level of Evidence: III

Indicate IRB: Mayo Clinic IRB#14-009331

Residual Vestibular Schwannomas and Low Tendency for Future Growth

Douglas J. Totten, MD, MBA; Evan Cumpston, MD; Samuel Kaefer, BS
Troy Wesson, BS; Brooke Stephanian, BS; Rohit Chatterjee, BS
Sabin Karki, BS; Rick F. Nelson, MD, PhD

Objective: To assess growth rates of residual vestibular schwannoma after subtotal and near-total surgical resection

Study Design: Retrospective cohort study

Setting: Tertiary referral center

Patients: Patients with residual vestibular schwannoma after surgical resection

Main Outcome Measures: Tumor growth after subtotal or near-total surgical resection of vestibular schwannoma

Results: 51 patients with residual tumor from 2011-2022 were included. Patients were further subdivided into those with subtotal resection or near-total resection (less than 5 mm of remaining tumor). Most patients (44, 79%) had tumors of 2 cm or larger. Mean (SD) follow-up time of 21 (22) months. Residual growth requiring further intervention was noted in 6 (12.2%) of patients. Four patients received salvage radiosurgery while two patients underwent salvage surgical resection. No further growth was seen in any tumor at an average of 21 months after salvage radiosurgery or 20 months after salvage surgery. Of remaining tumors, 15 (31%) had shrank while 25 (51%) did not grow and five (10%) experienced mild growth (mean 0.5, SD 0.4 cm) but at last follow up were still being observed. Of 46 patients with postoperative data, 31 (67.4%) had a Good facial nerve outcome (House-Brackmann I-II/VI) was achieved in 31 (67%) of patients at last follow up. Single variable logistic regression did not identify STR vs. NTR or pre-operative tumor size as significantly predictive of likelihood of growth of residual tumor (p=0.62 and 0.65, respectively) or increased likelihood of poor facial nerve outcomes (p=0.63 and 0.67, respectively).

Conclusions: Patients with residual tumor after surgical resection often have large initial tumor volume complicating surgical resection and placing patients at higher risk of facial nerve weakness postoperatively. Residual tumors appear to have low rates of future growth regardless of initial tumor size. More conservative surgical resection may be warranted if facial nerve function may be more effectively preserved.

***Professional Practice Gaps:** The determination of when to allow residual tumor to remain on the vestibular nerve remains highly controversial. This study attempts to assess how likely residual tumor is to re-grow and/or require further intervention.

***Learning Objectives:** Residual vestibular schwannoma is unlikely to grow to the point of requiring further intervention.

***Desired Results:** Patients with residual vestibular schwannoma after tumor resection do not often require further surgical and/or radiosurgical intervention.

Level of Evidence: IV

IRB: Indiana University IRB #13133 (approved 10/14/2022)

Effect of Simvastatin and Radiation on Viability of Primary Vestibular Schwannoma

Matthew Wiefels, BS; Olena Bracho, BS; Mikhail Marasigan, BS; Fred F. Telischi, MD, MEE
Michael Ivan, MD; Cristina Fernandez-Valle, PhD; Christine T. Dinh, MD

Hypothesis: Simvastatin reduces viability of irradiated and non-irradiated *NF2*-mutant human Schwann cells (HS01) and primary vestibular schwannoma (VS) cells.

Background: Statin drugs are cholesterol lowering medications that promote apoptosis, inhibit proliferation, and enhance radiation response in several cancers. Although radiotherapy is a standard treatment for VS, ~9-12% of irradiated VS continue to grow. In this study, we determine the effect of simvastatin on viability of irradiated and non-irradiated HS01 and VS cells.

Methods: HS01 and primary VS cells (n=3) were cultured on 384-well plates (5,000 cells/well) and pre-treated with simvastatin (0 or 1 μM) prior to irradiation (0 or 18 Gy). Viability was measured using cell-based assays. Immunocytochemistry was performed for γ-H2AX nuclear foci (DNA damage) and RAD51 expression (DNA repair). Statistical analysis was performed with two-way analysis of variance.

Results: HS01 cells demonstrated small decreases in viability (~10%) with simvastatin but had greater reductions (~30-35%) with 18 Gy or 18 Gy + Simvastatin. VS cells also had small decreases in viability (~20%) with simvastatin; however, viability responses with radiation and simvastatin were variable. Irradiated VSB13 and VSB14 demonstrated ~20% decrease in viability, and addition of simvastatin caused greater reductions (~30-45%). Although VSB11 was resistant to radiation, simvastatin caused small reductions in viability (~20%) regardless of radiation status. Expression patterns for γ-H2AX and RAD51 are described in relation to viability.

Conclusions: Simvastatin reduced viability of VS cells and may improve radiation response in select VS. Further investigations are warranted to assess whether statin drugs alone or with radiation are effective for VS tumor control.

Professional Practice Gap & Educational Need: Long-term tumor control rates for VS are approximately 10%. It is unknown whether simvastatin alone or with radiation may be effective at tumor control in patients with VS.

Learning Objective: Describe the effect of simvastatin on cell viability, DNA damage, and DNA repair in irradiated and non-irradiated *NF2*-mutant Schwann cells and primary VS cells.

Desired Result: Physicians understand that statin drugs are a class of cholesterol lowering drugs that may be beneficial in tumor control in non-irradiated and irradiated VS.

Level of Evidence: N/A

Indicate IRB or IACUC: IRB #20150637. Vestibular Schwannoma. Date of University of Miami IRB approval: 9/26/2017.

Angiotensin-Receptor Blockers Prevent Vestibular Schwannoma-Associated Hearing Loss

Samuel A. Early, MD, MS; Alyssa Brown, BS; Lei Xu, MD, PhD
Konstantina M. Stankovic, MD, PhD (presenter)

Objective: Vestibular schwannomas (VS) tumors typically present with sensorineural hearing loss (SNHL). Losartan has recently demonstrated prevention of tumor-associated SNHL in a mouse model of VS through suppression of inflammatory and pro-fibrotic factors, and the current study investigates this association in humans.

Study Design: Retrospective.

Setting: This is a retrospective study of patients with unilateral VS and hypertension followed with sequential audiometry at a tertiary referral hospital from January 1994 through June 2023. Patients were stratified into subgroups by anti-hypertensive medication class. SNHL progression was assessed using Kaplan-Meier analysis to account for variable follow-up times.

Patients: Two hundred thirty six patients were identified with diagnosis of both VS and hypertension, and with sequential audiometry. Of these, 186 were taking anti-hypertensive therapy at time of initial VS diagnosis, and 23 were taking losartan or another angiotensin receptor blocker (ARB).

Interventions: None (retrospective analysis).

Main Outcome Measures: Serial audiometry over time.

Results: Patients taking an ARB were both more likely to have normal baseline hearing and no progressive hearing loss with 36.5 total patient-years of follow-up. Patients taking other anti-hypertensives all showed expected declines in hearing consistent with natural history of VS tumors.

Conclusions: This study represents the first statistically significant association between ARB intake and hearing preservation in a real-world VS patient population. Significant confounding factors, such as concomitant hypertension in these patients, cloud still cloud the full effect of ARB medications' interaction with SNHL progression. Given that ARBs are well-tolerated and safe, the results advocate for a prospective clinical trial to validate this effect.

Professional Practice Gap & Educational Need: Treatment options for Vestibular Schwannoma are currently limited to surgery, radiation treatment and observation. No reliable drug therapies exist. This study supports the possible role of an established, well-tolerated, FDA-approved medication class to reduce progression of tumor-associated hearing loss.

Learning Objective: Understand the role of angiotensin receptor blockers in modulating the inflammatory pathways associated with tumor-associated hearing loss.

Desired Result: Appreciation for the potential role of new medical therapies for treating Vestibular Schwannoma.

Level of Evidence: IV

Indicate IRB or IACUC: Human Studies Committee at Massachusetts Eye and Ear and Massachusetts General Hospital (IRB 16-103H)

Amplifying Endoplasmic Reticulum Stress with Adenosine Triphosphate-Coated Gold Nanoclusters: A Promising Approach for the Treatment of Vestibular Schwannoma

Peter J. Kullar, MA, PhD, FRCS; Laurent A. Bekale, PhD
Jing Chen; Rohit Duggaraju; Zin Mie Mie Htun
Peter L. Santa Maria, MBBS, PhD

Hypothesis: Novel gold nanoclusters coated with adenosine triphosphate (AuNC@ATP) can enhance endoplasmic reticulum stress and inhibit the growth of vestibular schwannoma (VS).

Background: There is an unmet need for an effective pharmacotherapy for the treatment of VS that does not carry the risk profile of current therapeutic modalities.

The endoplasmic reticulum (ER) is a multi-functional cellular organelle critical in protein synthesis and folding. ER stress is an essential regulator of tumor growth and is thus an appealing target for antitumor therapy. Our previous research demonstrated that AuNC@ATP display antimicrobial properties through their ability to induce a stress response that results in the accumulation of unfolded proteins. We therefore sought to determine whether AuNC@ATP could enhance ER stress and inhibit schwannoma growth *in vitro*.

Methods: AuNC@ATP were synthesized and characterized using spectrophotometry and transmission electron microscopy. Rat schwannoma cells (S16) were grown in DMEM/F-12 supplemented with 10% FBS and 1% Penicillin-Streptomycin. S16 viability was measured using a colorimetric MTT assay. Cell growth was measured using automated cell counting. ER stress was measured by Thioflavin T (Th-T) fluorescence.

Results: Addition of AuNC@ATP to S16 for 24 hours caused a decrease in cell viability directly related to its concentration. A concentration of 27.93 μM led to a substantial loss of cell viability (95%). We next cultured S16 in a medium containing a sub-lethal concentration of AuNC@ATP (6.98 μM). After 96 hours, S16 cells reached 10^7 when growing without AuNC@ATP compared to 10^5 when growing with it. Additionally**,** AuNC@ATP caused a concentration dependent increase in Th-T fluorescence.

Conclusions: We have demonstrated that AuNC@ATP can inhibit schwannoma cell growth *in vitro.* The antitumor activity of AuNC@ATP appears to be mediated through amplified ER stress. This study reinforces the concept of engineering nano-drugs that induce ER stress for tumor treatment.

Professional Practice Gap & Educational Need: Vestibular schwannoma are common skull base tumors that are associated with significant morbidity. There is a current unmet need for a non-surgical, non-radiation based treatment that reduces the risk of adverse events associated with these treatments.

Learning Objective: To deepen the understanding of the potential of nanomedicines in the treatment of vestibular schwannoma.

Desired Result: This work demonstrates the potential of AuNC@ATP as novel pharmacotherapy for vestibular schwannoma.

Level of Evidence - Level V

Indicate IRB or IACUC : Exempt.

Successful Audiologic Outcomes with Auditory Brainstem Implantation including Bilateral Implantation

Douglas M. Bennion, MD, PhD; Alicia Williams, AuD
Rick A. Friedman, MD, PhD; Marc S. Schwartz, MD, PhD

Objective: Auditory brainstem implantation (ABI) is an option for patients with profound deafness resulting from auditory nerve pathology, as in Neurofibromatosis type 2. Performance outcomes in ABI recipients vary widely, with achievement of rudimentary auditory function (e.g. sound awareness) typically considered a successful endpoint. We set out to characterize recent audiologic outcomes among ABI patients treated at our institution since 2018.

Study Design: Retrospective case series

Setting: Single tertiary care hospital

Patients: Audiologic outcomes were reviewed in sixteen patients who underwent ABI placement at our institution since 2018. Implantation in four of these patients was on their second side.

Interventions: Auditory brainstem implantation and audiometric testing

Main Outcome Measures: Sound awareness (sound-field threshold testing) and speech understanding (spondee, CNC word, HINT sentence scores)

Results: Sound awareness was achieved in 100% of patients (16/16) using an average of 13 electrodes (range 7-20). Persistent non-auditory sensations were reported by 19% (3/16). Among those with sufficient follow-up from the time of implantation, improved speech understanding was achieved in 92% (12/13). Among four patients who underwent second sided ABI placement, one uses bilateral ABIs at all times with remarkable benefit: HINT sentence score of 92% with auditory-only input.

Conclusions: While results vary based on a variety of patient and center-specific factors, ABI represents a viable option for patients who are at risk of developing bilateral profound deafness. Further, for those patients in whom second sided implantation becomes an option at the time of contralateral tumor resection, second sided device implantation has the potential to significantly improve auditory outcomes.

Professional Practice Gap & Educational Need: As an uncommon procedure, ABI and associated outcomes are often reported in smaller groups over extended periods of time. The inclusion of 16 patients over a five year period represents a uniquely large sample for assessing outcomes in this population.

Learning Objective: Learners will come to appreciate key factors to maximizing success in auditory brainstem implantation, which include:
-The use of reliable intraoperative electrophysiologic feedback
-Reliance on detailed anatomic knowledge to guide precise array placement
-Patient participation in appropriate post-implantation device programming and comprehensive auditory rehabilitation

Desired Result: Learners will come away with useful data to assist in clinical decision making, prognostication of outcomes and implementation of best practices to promote optimal audiologic function in ABI patients.

Level of Evidence: Level V

IRB: Exempt

Superior Semicircular Canal Dehiscence in Chronic Ear Disease: Is it Clinically Relevant?

Kurt C. Mueller, MD; Jacob P. Hagen, BS; Christian K. Kerut, BS
Rahul Mehta, MD; Anne K. Maxwell, MD

Objective: To investigate if radiographic evidence of superior semicircular canal dehiscence (SSCD) in patients with chronic otitis media (COM) coincides with symptomatic manifestation of SSCD syndrome.

Study Design: Retrospective chart review

Setting: Tertiary referral center

Patients: 848 patients (1696 temporal bones) who underwent surgery and high-resolution computed tomography (HRCT) of their temporal bones for chronic ear disease.

Interventions: HRCT of each ear was reviewed for SSCD or thinning. Presence and site of cholesteatoma/COM, subjective symptoms, and vestibular testing were ascertained for those with radiographic SSCD or thinning.

Main Outcome Measures: Presence of subjective and objective manifestation of SSCD syndrome in patients with COM, chronic otomastoiditis, and/or cholesteatoma with radiographic evidence of SSCD or thinning.

Results: Of the 1696 temporal bones and superior semicircular canals analyzed, 44 (2.6%) were dehiscent, 103 (6.1%) were thin, and 1549 (91.3%) were normal.

86 temporal bones had both COM and SSCD or thinning. Of these, 23 (26.7%) were dehiscent and 63 (73.3%) were thin. 82 (95.3%) had evidence of chronic otomastoiditis and 32 (37.2%) had cholesteatoma. Locations of cholesteatoma included epitympanum (75.0%), tympanic cavity (62.5%), mastoid (62.5%), and protympanum (3.1%). Only six ears (7.0%) had true vertigo and three (3.5%) had pulsatile tinnitus. None had autophony, sound-induced vertigo, or pressure-induced vertigo. cVEMP was obtained on eight ears; four were normal and four were absent. Four ears underwent Tullio and fistula testing; none were abnormal. No superior canals were repaired surgically for SSCD syndrome.

Conclusions: Although COM may increase the radiographic presence of SSCD, it may not necessarily increase the risk of symptomatic manifestation of SSCD syndrome.

Professional Practice Gap & Educational Need: Current evidence indicates that patients with COM have an increased prevalence of radiographic superior semicircular canal dehiscence compared to non-diseased ears. However, the clinical significance of this is undetermined, as many patients have radiographic evidence of dehiscence without symptoms. This study aims to further elucidate the relationship between radiographic SSCD and clinically active symptoms among patients with COM.

Learning Objective: Understand the impact of chronic ear disease on the radiographic appearance of the superior semicircular canals. Understand the clinic relevance of radiographic SSCD in chronic ear patients with regards to its symptomatic manifestations.

Desired Result: Attendees will have a better understanding of the relationship of radiographic evidence of SSCD with symptomatic manifestations of the syndrome in patients with chronic ear disease.

Level of Evidence - Level IV

IRB: Louisiana State University Health Sciences Center - New Orleans IRB #2172. Exempt.

Long-term Outcomes Following Sinus Wall Reconstruction for Sigmoid Sinus Wall Anomalies

Adaobi E. Ahanotu, BS; Kimberly Oslin, MD
Marjohn M. Rasooly, MSN; David J. Eisenman, MD

Objectives: To assess long-term outcomes following transtemporal sinus wall reconstruction (SWR) for pulsatile tinnitus (PT) due to sigmoid sinus wall anomalies.

Study Design: Prospective observational study of previously treated patients

Setting: Tertiary care academic medical center in the United States

Patients: Ninety-nine ears from 97 patients underwent SWR from 2007-2022, sixty of which (60 ears, 58 patients) were greater than five years status-post surgery. Thirty-five (58.3%) eligible patients with 37 ears operated on completed the survey via email, mail, or telephone

Interventions: None

Main Outcome Measures:
1. Recurrence or persistence of PT
2. Development of other symptoms or signs of idiopathic intracranial hypertension (IIH)

Results: There were no significant differences in demographics and clinical findings between the study cohort and the complete cohort of patients undergoing SWR. Survey results indicated that sinus wall reconstruction was successful in eliminating PT in 24 out of 37 (64.9%) ears and significant partial resolution of PT in an additional 10 ears (27%), for a total long-term satisfactory result of 91.9%. Three (8.6%) patients developed idiopathic intracranial hypertension (IIH) at some point during the follow up period, one of whom required a ventriculoperitoneal (VP) shunt. Another had cerebrospinal fluid (CSF) leak repair. Another two (5.7%) patients had transverse sinus stents placed but did not report a formal diagnosis of IIH.

Conclusions: By five or more years post-operatively, patients who underwent SWR can achieve either complete or significantly partial tinnitus resolution. A small percentage developed symptomatic IIH at some point in the follow up period.

Professional Practice Gap & Educational Need: Uncertainty still exists about long-term outcomes, both regarding PT and development of IIH, for patients undergoing SWR for PT associated with sigmoid sinus wall anomalies. In particular, there is concern about recurrence of PT because of persistence of associated transverse sinus stenosis, or development of complications due to compromised posterior fossa venous outflow. This long-term follow-up study with mean follow up of 9.5 years provides cross-sectional data on outcomes in this treated group of patients

Learning Objective: To evaluate the long-term effects of SWR in treating PT

Desired Results:
- Quantify long-term success of SWR for PT due to sigmoid sinus wall anomalies
- Describe incidence of IIH and its potential complications in this cohort

Level of Evidence – Level III

Indicate IRB or IACUC : Exempt

NICHOLAS TOROK VESTIBULAR AWARD

Nationwide Resource Utilization of Dizziness/vertigo Presentations to the ED

D. O'Neil Danis, III, MD; Matthew Kovoor;
Kathryn Y. Noonan, MD; Jonathon S. Sillman, MD

Objective: This study aims to assess overall rates of neuroimaging (computed tomography [CT] or magnetic resonance imaging [MRI]) and cerebrovascular accidents (CVAs) in patients presenting to the emergency department (ED) with primary diagnoses of dizziness/vertigo to determine if neuroimaging is overutilized in this population.

Study Design: Population-based ED registry analysis.

Setting: 2020 Nationwide Emergency Department Sample.

Patients: Patients presenting to the ED with dizziness/vertigo.

Interventions: Rates of neuroimaging (both CT and MRI), common associated diagnoses and symptoms, and CVAs.

Main Outcome Measures: Odds ratio (OR) and multivariate analysis was performed on the associations of variables of interest with admission and CVAs.

Results: 1,115,826 ED presentations received a primary diagnosis of vertigo/dizziness resulting in $8.4 billion in ED charges. Of patients discharged from the ED, 42.29% underwent neuroimaging. Overall, 2,046 (0.18%) patients had a diagnosis of CVA. 89.46% of vertigo/dizziness patients with a CVA had at least one of 24 risk factors, including diabetes, history of thromboembolic event, nystagmus, and others, that were significantly associated with presence of CVA in multivariate analysis. Current procedural terminology (CPT) codes of H81.2 (vestibular neuronitis) and H81.4 (vertigo of central origin) were significantly associated with CVA when compared to other forms of dizziness/vertigo (adjusted ORs of 3.26 and 3.98; $p<0.001$).

Conclusions: A high proportion of ED patients with vertigo/dizziness undergo neuroimaging to rule out CVA, while only 0.18% are diagnosed with CVA. 24 diagnoses are positively associated with CVAs in patients primarily presenting with vertigo/dizziness and can potentially help stratify neuroimaging and lower healthcare costs.

Professional Practice Gap & Educational Need: Vertigo/dizziness is a common reason for patients to present to the ED, and these visits are associated with significant healthcare costs. Neuroimaging is frequently obtained for these patients to rule out CVAs, although most of these patients do not have CVAs. There is limited research on the risk factors associated with CVAs in patients with vertigo/dizziness or on when to obtain neuroimaging in these patients.

Learning Objective: Determine when neuroimaging is appropriate for patients presenting to the ED with vertigo/dizziness.

Desired Result: Physicians will better understand factors that are associated with CVA in patients with vertigo/dizziness. Physicians will use the presence of these associated factors to risk stratify the utility of obtaining head imaging in patients with vertigo/dizziness and to lower healthcare costs.

Level of Evidence - Level V

Indicate IRB or IACUC: Exempt.

MICHAEL E. GLASSCOCK SCIENTIFIC MERIT AWARD

Cochlear Implantation with Sporadic Inner Ear Schwannomas: An International Multi-Institutional Study of 90 Patients

John P. Marinelli MD; J. Thomas Roland, Jr., MD; Kevin D. Brown MD
Elizabeth L. Perkins MD; Simon K.W. Lloyd, MBBS, FRCS
Matthew L. Carlson, MD; Stefan K. Plontke, MD

Objective: To evaluate cochlear implant speech perception outcomes among patients with sporadic inner ear schwannoma who underwent ipsilateral implantation.

Study Design: Retrospective cohort study.

Setting: Twelve tertiary academic medical centers across the United States and Europe.

Patients: Ninety patients with sporadic inner ear schwannoma who received an ipsilateral cochlear implant from 2011 to 2022.

Interventions: Ipsilateral cochlear implantation with observation, radiosurgery, or microsurgery for tumor management.

Main Outcome Measures: Monosyllabic speech perception testing scores and rates of open-set speech acquisition.

Results: Among 90 patients studied, 87 (97%) achieved open-set speech perception with a median of 18 months (IQR 12-36) of audiometric follow-up. Median ipsilateral monosyllabic word testing at last follow-up was 70% (IQR 54-85) and median ipsilateral AzBio in quiet was 77% (IQR 55-90). The majority (n=77; 86%) underwent microsurgery for tumor control, with cochlear implantation performed simultaneously in 75 patients. Open-set speech performance did not significantly differ between those undergoing microsurgical resection compared to observation (n=11) (p=0.7). Thirteen of the 90 patients studied (14%) experienced deterioration in cochlear implant performance over time. Among a subset of 32 patients with available imaging, the region where the tumor was/is located could be visualized postoperatively on MRI in all patients.

Conclusions: Open-set speech perception is achieved in most patients with inner ear schwannoma undergoing ipsilateral cochlear implantation. Tumor surveillance with MRI is feasible with protocoling modifications.

Professional Practice Gap & Educational Need: The advent of MRI and widespread adoption of screening protocols for asymmetrical sensorineural hearing loss has resulted in a significant increase in the detection rate of inner ear schwannomas. However, existing data surrounding cochlear implantation outcomes among patients with sporadic inner ear schwannomas is limited.

Learning Objectives: (1) Describe cochlear implant performance outcomes among patients with sporadic inner ear schwannoma who undergo ipsilateral cochlear implantation; (2) Understand the influence of tumor location within the inner ear on cochlear implant performance; (3) Describe the feasibility and limitations of postoperative MRI surveillance in the setting of inner ear schwannoma with ipsilateral cochlear implantation.

Desired Result: At the conclusion of this presentation, providers should be better equipped to understand the benefits and limitations of cochlear implantation in the setting of sporadic inner ear schwannoma.

Level of Evidence: III

Indicate IRB or IACUC: IRB approval was obtained from each participating center prior to data collection (15-008224 for group).

Simultaneous Ipsilateral Labyrinthectomy and Cochlear Implantation in Patients with Refractory Ménière's Disease

Robert J. Macielak, MD; Markus E. Harrigan, PhD; Vivian F. Kaul, MD
Aaron C. Moberly, MD; Edward E. Dodson, MD
Oliver F. Adunka, MD, MBA; Yin Ren, MD, PhD

Objective: To assess the efficacy and safety of simultaneous ipsilateral labyrinthectomy and cochlear implantation (CI) in patients with refractory Ménière's disease (MD).

Study Design: Historical cohort study

Setting: Tertiary academic referral center

Patients: Patients with refractory MD and hearing loss

Interventions: Simultaneous ipsilateral labyrinthectomy and CI

Main Outcome Measures: Control of vertigo, Consonant-Nucleus-Consonant (CNC) word testing in quiet, and AzBio sentence testing in quiet

Results: Eighteen patients underwent simultaneous transmastoid labyrinthectomy and CI between 7/2015 and 2/2023 (median age 57-years-old, range 21-71 years, 67% female). Preoperative median aided CNC score was 23% (range 0-88%, n=10), and median AzBio score was 18% (range 0-96%, n=14). Two patients (11%) developed delayed postoperative facial weakness which recovered completely. No other postsurgical complications occurred. Complete resolution of vertigo was noted in 17 patients (94%). Evaluating available data at ≥6 months postoperatively, AzBio scores significantly improved (41% pre-op vs. 62% post-op, p=0.02; n=10), and CNC scores improved but did not reach statistical significance (33% pre-op vs. 43% post-op, p=0.60; n=8); however, these improvements are even greater when considering the results from a surgically deafened ear where testing would otherwise show profound deafness. Further localization testing comparing results with the device off versus on (n=5) noted improvements in both sound identification (27% vs. 37%, p=0.06) and degree error (47.1 vs. 24.5, p=0.10) at a median of 7 months postoperatively.

Conclusions: The present study represents one of the largest cohorts of refractory MD patients undergoing simultaneous labyrinthectomy and CI. Combination of these procedures appears safe and allows for excellent vertigo control and aural rehabilitation in appropriately selected candidates.

Professional Practice Gap & Educational Need: The practice gap is knowledge of the efficacy and safety of simultaneous ipsilateral labyrinthectomy and CI for the MD population.

Learning Objective: The learner should be able to understand the efficacy and potential benefits of simultaneous ipsilateral labyrinthectomy and CI in the refractory MD population.

Desired Result: The desired result is that the provider will understand the potential benefits and intricacies of managing patients with MD through this combined procedure.

Level of Evidence: IV

Indicate IRB or IACUC: The Ohio State University Study ID #2017H0273

Intraoperative Electrical Stapedius Reflex Testing is a Reliable Method for Monitoring Cochlear Nerve Integrity during Simultaneous Vestibular Schwannoma Resection and Cochlear Implantation

Ghazal S. Daher, MD; Aniket A. Saoji, PhD; Collin L. W. Driscoll, MD
Brian J. Neff, MD; Matthew L. Carlson, MD

Objective: To compare the utility of intraoperative electrically evoked stapedial reflex testing (eSRT), electrically evoked auditory brainstem response (eABR), and streaming neural response telemetry (NRT) for cochlear nerve integrity monitoring during simultaneous translabyrinthine resection of vestibular schwannoma (VS) and cochlear implantation.

Study Design: Retrospective chart review

Setting: Tertiary academic referral center.

Patients: Seven patients (8 ears) who underwent translabyrinthine resection of VS with simultaneous placement of a commercial cochlear implant device. One patient with neurofibromatosis type II-related schwannomatosis underwent bilateral resection of VS and cochlear implantation.

Interventions: Prior to tumor resection, a standard commercial cochlear implant was placed, facilitating intraoperative cochlear nerve monitoring during tumor resection using eSRT, eABR, and NRT through a CI-delivered electrical stimulus.

Main Outcome Measures: Correlation of intraoperative monitoring outcomes with postoperative cochlear implant speech perception.

Results: Four ears lost eSRT signal during surgery and were found to perceive no sound through the cochlear implant postoperatively. Of the 4 ears that retained eSRT signal at the end of tumor resection, all are currently successful cochlear impant users with good open-set speech perception (CNC word scores 71-98%; AzBio sentence scores in quiet 78-93%). Electrical ABR and NRT were intact in all 8 patients intraoperatively, indicating that half of cases yielded a false-positive result using the latter 2 monitoring methods.

Conclusions: Intraoperative eSRT through a commercial CI is a promising new method for monitoring the integrity of the cochlear nerve during VS resection. Patients that retained eSRT at the end of tumor resection had favorable cochlear implant outcomes. NRT and eABR were less reliable at predicting postoperative hearing outcomes in this series.

Professional Practice Gap & Educational Need: A reliable intraoperative monitoring technique of the cochlear nerve is necessary.

Learning Objective: Understand the significance of intraoperative monitoring techniques, such as eSR, eABR, and NRT, in predicting postoperative outcomes for vestibular schwannoma patients undergoing simultaneous cochlear implant and resection.

Desired Result: Acquire a comprehensive understanding of how intraoperative monitoring techniques like eSR, eABR, and NRT can be utilized to predict and assess postoperative outcomes for patients undergoing simultaneous vestibular schwannoma resection and cochlear implantation.

Level of Evidence - Level V

Indicate IRB or IACUC : ID 16-007363 approved prior to study date, Mayo Clinic

Electrocochleography-Guided Pull-Back Technique of Perimodiolar Electrode for Improved Hearing Preservation

Amit Walia, MD, MSCI; Matthew A. Shew, MD; Amanda Ortmann, PhD
Jordan Varghese, MD; Shannon Lefler, AuD; Jacques A. Herzog, MD
Craig A. Buchman, MD

Objective: To evaluate whether electrocochleography-guided pull-back of the perimodiolar electrode improves perimodiolar proximity, hearing preservation (HP), and cochlear implant performance.

Study Design: Prospective cohort study

Setting: Tertiary referral center

Patients: 60 adult CI recipients with residual acoustic hearing (low-frequency pure tone average of 125, 250, 500 Hz, LFPTA ≤60 dB HL)

Intervention: Unilateral implantation, comparing standard insertion (N=30) with electrocochleography-guided electrode pull-back (N=30). The guided method uses active electrocochleography from the apical electrode during adjustment and post-insertion electrode sweep ('optimal response' defined as maximum response for 250 Hz at most apical electrode on electrode sweep).

Main Outcome Measures: Perimodiolar proximity (wrapping factor on postoperative CT); speech-perception testing at 6-months post-activation (CNC, AzBio in noise +10 dB SNR); and HP (LFPTA ≤80 dB HL)

Results: Of the subjects undergoing electrocochleography-guided insertion, 14 needed pull-back based on responses, while the remaining 16 exhibited 'optimal responses' post-insertion, requiring no adjustment. Improved perimodiolar proximity was achieved with the electrocochleography-guided method (mean wrapping factor difference, 8.2, 95% CI:3.2-11.8). Forty percent preserved hearing using electrocochleography versus 27.5% without (LFPTA shift mean difference 10.3 dB HL, 95% CI:6.1-16.3). There was no difference in CNC scores among both cohorts, but AzBio in noise at 6-months was improved in the electrocochleography-guided pull-back cohort (mean difference, 11.4%; 95% CI, 4.2-18.6).

Conclusions: Electrocochleography-guided pull-back increased perimodiolar proximity and HP rates. While there was no difference in CI performance in quiet environments, a significant improvement was noted in noisy conditions, potentially attributable to HP and the utilization of hybrid stimulation.

Professional Practice Gap & Educational Need: Recent developments have highlighted the potential of intraoperative, intracochlear electrocochleography, using the electrode array, as an instrument for hearing preservation. However, most existing literature concentrates on its use with lateral wall electrodes and subsequent adjustments during insertion, such as pausing insertion or leaving electrodes out to optimize electrode positioning for hearing preservation. The investigation of electrocochleography's application during insertion with precurved perimodiolar electrode arrays has been limited. This may be attributed to challenges posed by sheath-based insertions and the potential risk of tip roll-over upon adjustments. Here, we investigate a potential method for using electrocochleography with precurved perimodiolar electrode arrays after full insertion, specifically to assess the need for electrode pull-back for optimal modiolar proximity and potentially enhancing hearing preservation outcomes.

Learning Objective: To understand how electrocochleography responses can be used after full insertion of the precurved perimodiolar electrode array to determine whether pull-back is necessary and whether this results in improved hearing preservation and speech-perception outcomes.

Desired Result: Practitioners and researchers will further realize the value of using electrocochleography with the precurved perimodiolar electrode array to optimize electrode positioning and cochlear implant performance.

Level of Evidence - IV

Indicate IRB or IACUC: Washington University in St. Louis IRB #202007087 (5/16/23).

Intraoperative Acoustic Monitoring Using Behavioral Audiometry during Cochlear Implantation Under Local Anesthesia: Towards Optimizing Hearing Preservation Outcomes

Karl R. Khandalavala, MD; Sarah E. Ostlie, AuD; Max M. Ladsten
Amanda R. Lohmann, RN; Matthew L. Carlson, MD

Objective: To demonstrate feasibility of monitoring acoustic hearing on awake patients using intraoperative behavioral responses to supra-threshold stimuli while undergoing cochlear implantation (CI) without general anesthesia or conscious sedation.

Study Design: Retrospective single-institution review.

Setting: Tertiary care academic medical center.

Patients: Adult patients with significant residual acoustic hearing undergoing CI.

Interventions: CI under local anesthesia, without any sedation.

Main Outcome Measures: Procedural tolerance, reliability of intraoperative audiometry, and correlation of intraoperative findings with postoperative residual hearing.

Results: Three patients underwent implantation, including two males and one female, with a median age of 48 years. Intraoperatively, patients reported behavioral responses to supra-threshold stimuli, and provided real time feedback on perceived stimulus change to the surgeon just prior to, during, and immediately following electrode insertion. All patients were able to complete the operation under local anesthesia. During electrode insertion, two patients reported no change, and one patient reported diminished stimulus perception that reversed with limited electrode pull back. Immediate postoperative audiogram demonstrated preservation of bone conduction thresholds within 10 dB of their preoperative baseline for all patients. Postoperative AzBio scores ranged from 45-75% at 2-month follow up. At time of writing, two additional patients are scheduled for surgery and will be presented.

Conclusions: This novel study demonstrates the feasibility of intraoperative behavioral audiometry during CI under local anesthesia, using feedback during electrode insertion to optimize hearing preservation surgery. Akin to other surgical subspecialties that utilize live patient feedback where objective intraoperative measures of neurofunction are imperfect, we demonstrate feasibility and potential utility of live acoustic monitoring during cochlear implantation.

Professional Practice Gap & Educational Need: Historically CI has been performed under local and monitored anesthesia for patients with significant comorbidities. Recently, the senior author has begun performing CI awake under only local anesthesia, with the use of intraoperative behavioral audiometry to facilitate real time monitoring of potential acoustic damage and subsequent loss of acoustic hearing during electrode insertion, as an alternative to indirect measures such as Electrocochleography (ECoG).

Learning Objective: To demonstrate the feasibility of intraoperative behavioral audiometry to monitor acoustic hearing during cochlear implantation under local anesthetic as an alternative to indirect measures of cochlear function such as Electrocochleography (ECoG).

Desired Result: For learners to understand the described technique and how it can guide acoustic hearing preservation.

Level of Evidence – Level V

Indicate IRB or IACUC: Mayo Clinic IRB#:22-000183, approved 2/25/2022.

Image Quality Improvement in MRI of Cochlear Implants After Metal Artifact Reduction

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Objective: Observe if metal artifact reduction (MAR) techniques applied to magnetic resonance imaging (MRI) performed on patients with cochlear implants (CI) or auditory brainstem implants (ABI) improves image quality.

Study Design: Prospective cohort.

Setting: Tertiary care center.

Patients: Patients with CI or ABI undergoing MRI after the application of MAR techniques.

Interventions: Patients who underwent whole brain or internal auditory canal (IAC) MRI with and without MAR techniques were identified from 2022-2023. Images were analyzed by two experienced neuroradiologists.

Main Outcome Measures: Visibility of 14 intracranial structures graded on a 4-point Likert scale to assess image artifact and impact on diagnosis. The average score for each structure and sequence was compared using paired two tailed t-tests and change in mode score.

Results: Ten patients underwent pre- and post-MAR MRI. Six had a unilateral CI, 3 had a unilateral ABI, and 1 had a CI and an ABI. One unilateral ABI patient had the device magnet removed; the remainder were all in place for both scans. One unilateral CI was manufactured by MEDEL; remaining devices were from Cochlear Americas. All structures had improved visibility on the post-MAR scan, although ipsilateral parietal and occipital lobes did not demonstrate statistically significant difference. Mode score increased from 2 to 4 for the ipsilateral occipital lobe and from 3 to 4 for the ipsilateral semicircular canals, brainstem, and cerebellar peduncles. Significant improvement was seen on all sequences except ipsilateral structures on T1w-axial pre-contrast and contralateral structures on T1w-coronal post-contrast. ABI images did not improve as much as CI because they scored better on the pre-MAR scan.

Conclusions: MAR techniques improve image quality for patients with MRI-compatible implants.

Professional Practice Gap & Educational Need: Patients with an MRI-compatible auditory implant undergo MRI more frequent imaging, however image quality still suffers due to the interference of the device magnet and the MRI magnet.

Learning Objective: Understand the clinical impact of MAR correction of MRI imaging for CI and ABI patients.

Desired Result: Improve MRI quality for patients with CIs or ABIs

Level of Evidence - III

Indicate IRB or IACUC: This study was exempt from IRB review as it was classified as a quality improvement study.