SELECTED ABSTRACTS

IN ORDER OF PRESENTATION

ORAL PRESENTATIONS

51st Annual Spring Meeting
AMERICAN NEUROTOLOGY SOCIETY

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Hyatt Regency Chicago
Chicago, IL

Round and Oval Window Reinforcement for the Treatment of Severe Hyperacusis

Herbert Silverstein, MD; Jack Wazen, MD
Julie Daugherty, PhD; Rosemary Ojo, MD
Ronen Nazarian, MD

Objective: To evaluate the efficacy of a minimally invasive surgical procedure in patients with severe hyperacusis.

Study Design: Prospective, longitudinal design.

Setting: Tertiary referral center.

Patients: Adult patients with history of severe hyperacusis.

Intervention: Using a transcanal approach, the round and oval window were reinforced with temporalis fascia or tragal perichondrium in six patients (9 ears).

Main Outcome Measures: Pre and postoperative noise tolerance was measured using loudness discomfort level (LDL) test scores. In addition, a self-report validated hyperacusis questionnaire was used to assess psychosocial and quality of life impairment before and after the intervention.

Results: Preliminary analysis of the data reveals improved postoperative mean LDL test scores of 10.2 dB (SD = 5.4) in nine ears. Further, a negative linear trend was observed in the mean subjective scores for the hyperacusis questionnaire, decreasing from a mean of 32.6 (SD = 10.4) pre-operative to a mean of 17.6 (SD =6.1) following surgery. Postoperatively, there was no subjective complaints of hearing loss. However, a mild loss in the high frequencies was observed in 3 ears. Full data analysis will be presented.

Conclusion: The results suggest that reinforcement of the round and oval window with temporalis fascia or tragal perichondrium may offer significant benefit for individuals with severe hyperacusis that has not responded to traditional therapy. LDL scores and self-report measures postoperatively demonstrate improved noise tolerance, high patient satisfaction and enhanced quality of life.

Define Professional Practice Gap & Educational Need: There is a lack of contemporary knowledge regarding the treatment of hyperacusis. The presentation will offer information for a new minimally invasive surgical procedure that improves noise intolerance in patients with severe hyperacusis.

Learning Objective: To describe the results of a pilot study evaluating the efficacy of a new minimally invasive surgical procedure for the treatment of severe hyperacusis.

Desired Result: Following this presentation, attendees will gain an understanding of the criteria for appropriate patient selection, have an overall understanding of the efficacy of this procedure and will learn the steps of this novel minimally invasive surgical technique.

Indicate IRB or IACUC Approval: Approved

By invitation

Initial Results of a Safety and Feasibility Study of Auditory Brainstem Implantation in Congenitally Deaf Children

Eric P. Wilkinson, MD; Laurie S. Eisenberg, PhD
Mark D. Krieger, MD; Marc S. Schwartz, MD
Margaret Winter, MS; Jamie L. Glater, AuD
Robert V. Shannon, PhD

Objective: To determine the surgical and programming safety of auditory brainstem implantation (ABI) in children with cochlear aplasia and cochlear nerve deficiency.

Study Design: NIH-funded, IRB-Approved Clinical Trial.

Setting: Multidisciplinary ABI surgical and audiological team and children's hospital.

Intervention(s): ABI Surgery and Audiological mapping of the device.

Main outcome measure(s): The primary outcome measure is surgical and audiological programming safety as measured by number and type of adverse events. The secondary outcome measure is audiological detection using standard behavioral techniques.

Results: Seven children have been enrolled in the clinical trial. One patient was excluded for medical reasons, one family voluntarily withdrew from the study prior to surgery, and one patient was found to be progressing satisfactorily with their cochlear implant (CI) and ABI was deferred in favor of monitoring their progress. Four children underwent ABI surgery and postoperative mapping, all of whom had CI first with the exception of one patient with cochlear aplasia. All children will be one year post-surgery at the time of this presentation. One expected adverse event, a CSF leak, occurred in one patient who underwent simultaneous CI explantation, which resolved with lumbar drainage. One patient had vestibular side effects during mapping which resolved by excluding one electrode. All four children have measured detection thresholds in the longterm average speech spectrum, with three demonstrating emerging pattern perception.

Conclusions: ABI surgery and audiological mapping appears to be safe in this preliminary cohort. A total of 10 patients are anticipated to be implanted in this clinical trial.

Define Professional Practice Gap & Educational Need: 1. Lack of awareness of auditory brainstem implantation as a treatment option in pediatric patients with cochlear nerve deficiency, cochlear aplasia, or cochlear ossification 2. Lack of contemporary knowledge of current expected outcomes of auditory brainstem implantation in children

Learning Objective: The learning objectives of this presentation are 1. Educate clinicians on the new application of auditory brainstem implantation as a treatment option in pediatric patients with cochlear nerve deficiency, cochlear aplasia, or cochlear ossification, and describe the initial results of a clinical trial of such, and 2. Describe the potential early outcomes of auditory brainstem implantation in children and how this could affect parental counseling

Desired Result: Attendees will be able to discuss the relative risks and benefits of a new application of auditory brainstem implantation in children who are not candidates for cochlear implantation or who have failed cochlear implantation. Attendees will be able to discuss how subjects are chosen for this intervention and understand the surgical and audiological challenges related to such an intervention

Indicate IRB or IACUC Approval: Approved

Chondrosarcoma of the Petroclival Synchondrosis:
A Review of 44 Cases

Matthew L. Carlson, MD; Brendan P. O'Connell, MD
Joseph T. Breen, MD; David S. Haynes, MD
Paul W. Gidley MD; Colin L. Driscoll, MD
Michael J. Link MD

Objective: To analyze clinical outcomes following treatment of petroclival chondrosarcomas (PCC).

Study Design: Retrospective case review, 1995-2015.

Setting: Multicenter study

Patients: Consecutive patients with histopathologically proven PCC

Intervention(S): Microsurgery, radiation therapy

Main Outcome Measures: Disease- and treatment-associated morbidity, recurrence, mortality

Results: Forty-four patients (mean age 43 years; 39% men) presenting with primary (N=36) or recurrent (N=8) PCC were analyzed. The mean duration of follow-up was 75 months. Among primary cases, the most common symptom was diplopia (53%) and the mean tumor size at diagnosis was 3.2 cm. Subtotal resection was performed in 27(79%) patients and gross total resection in 7(21%). Adjuvant postoperative radiation was administered in 24(71%) cases. Preoperative cranial neuropathy improved in 11(32%), worsened in 9(26%) and remained stable in 14(41%) patients; notably, 9 of 15(60%) preoperative sixth nerve palsies resolved following treatment. Six recurrences occurred at a median of 47 months. Lack of postoperative adjuvant radiation was associated with an increased risk of disease progression (8% vs. 40%; p=0.047), while tumor size, grade, and extent of resection did not reach statistical significance. One patient (3%) died 46 months following treatment.
Analyzing the separate cohort of 8 cases presenting with recurrent disease, 1 received salvage surgery alone, 3 radiation therapy alone, while 4 received multimodality treatment. Tumor control was achieved in 7(88%) cases. One patient (12%) with grade 3 PCC died of rapidly progressive disease within 1 year of treatment.

Conclusions: Gross total or subtotal resection with adjuvant radiation provides durable tumor control with minimal morbidity in most patients. Surgery may improve preoperative cranial nerve dysfunction, particularly in the case of cranial nerve 6 paralysis.

Define Professional Practice Gap & Educational Need: Lack of contemporary knowledge regarding optimal management of petroclival chondrosarcoma using multimodality therapy

Learning Objective: To understand management and outcome following contemporary treatment of petroclival chondrosarcoma using multimodality therapy

Desired Result: To apply this knowledge toward improving treatment outcomes for patients presenting with petroclival chondrosarcoma

Indicate IRB or IACUC Approval: Approved

Epidermoids of the Cerebellopontine Angle: A Review of 47 Cases

Robert J. Yawn, MD; Neil S. Patel, MD
Colin L. Driscoll, MD; Michael J. Link, MD
David S. Haynes, MD; Reid C. Thompson, MD
Matthew L. Carlson, MD

Objective: To analyze clinical outcomes following treatment of cerebellopontine angle (CPA) epidermoids

Study Design: Retrospective case series

Setting: Multicenter study

Patients: Consecutive patients with previously untreated CPA epidermoids

Intervention(S): Observation and microsurgery

Main Outcome Measures: Disease- and treatment-associated morbidity, recurrence

Results: 47 patients (mean age 39 years; 53% female) were analyzed and the mean duration of follow-up was 42 months. The most common presenting symptom was headache (27; 59%); 13 (28%) exhibited preoperative asymmetric sensorineural hearing loss, 3 (6%) facial nerve paresis, and 2 (4%) hemifacial spasm. 12 patients (26%) were initially observed over a mean interval of 56 months; however 5 experienced disease progression requiring operation. 38 patients (79%) underwent surgical resection; 18 (47%) received gross total, 5 (14%) near total, and 15 (39%) subtotal resection. Three patients (8%) recurred at a median of 53 months; 2 following subtotal and 1 following gross total resection. 93% of patients with serviceable hearing maintained the same hearing class following treatment and 1 patient (3%) experienced mild long-term postoperative facial palsy (HB II/VI). All patients with preoperative facial nerve paresis or hemifacial spasm recovered normal function postoperatively. There were no episodes of stroke or death.

Conclusions: Surgical intervention is effective in alleviating symptoms in patients with cranial neuropathy or brainstem compression. Gross total resection is preferred, however subtotal removal should be considered with adherent or extensive disease as reoperation rates are low, even in the setting of aggressive subtotal resection. Conservative observation with serial imaging is a viable initial strategy in asymptomatic or minimally symptomatic patients.

Define Professional Practice Gap & Educational Need: Lack of contemporary knowledge regarding outcomes following subtotal and gross total resection of cerebellopontine angle epidermoids.

Learning Objective: To understand management and outcomes following contemporary treatment of cerebellopontine angle epidermoids.

Desired Result: To apply this knowledge toward improving counseling and treatment outcomes for patients presenting with cerebellopontine angle epidermoids.

Indicate IRB or IACUC Approval: Approved

Long Term Outcomes for Patients with Petrous Apex Cholesterol Granulomas: Surgery vs. Observation

Shawn M. Stevens, MD; Amy Manning, MD
Myles L. Pensak, MD; Ravi N. Samy, MD

Objective: Review long-term clinical outcomes of cholesterol granulomas (CG) of the petrous apex (PA)

Study design: Retrospective review

Setting: Tertiary Center

Patients: Radiographically confirmed PA CG from 1998-2015 {n=28)

Intervention(s): Compare patients who underwent observation with those who underwent surgery.

Main outcome measure(s): Comparison of clinical symptoms, signs and audiometric outcomes. Resolution rate of presenting symptoms following surgery.

Results: Mean age of all patients was 42 years. The majority of patients were white females (percentage?). Median follow up was 37 months (2-167). The most common presenting complaints were headache (50%), otalgia/aural fullness (35%), dizziness (35%), visual/retro-orbital complaints (21%) and cranial nerve palsies (21%). Thirteen of twenty-eight patients (46%) ultimately received surgery. Surgical patients had a significantly higher rate of concomitant chronic otitis media (46% vs 0%, p=0.0046) and longer follow up (44months vs. 17months, p=0.033). Infra-cochlear and infra-labyrinthine drainage procedures, with or without silastic stents, were performed at equal rates. The most likely pre-operative symptoms to be resolved by surgery were retro-orbital pain (100%) and cranial neuropathy. Resolution rates were less than 50% for headache, dizziness, and otalgia/aural fullness. The chief complaint resolution rate was 38%. Hearing was significantly worse in surgical patients both at presentation and on long-term follow up. Two patients underwent revision surgery for refractory retro-orbital pain.

Conclusions: Long-term outcomes following surgery for PA CG are highly symptom dependent. Proper patient selection is imperative. Patients who undergo surgery can have worse hearing results and may fail to resolve complaints of headache, dizziness, and otalgia/aural fullness.

Define Professional Practice Gap & Educational Need: 1. Lack of understanding regarding surgical outcomes for petrous apex cholesterol granuloma (PA CG) 2. Inconsistencies in patient selection for observation versus surgery 3. Inability to properly counsel patients with PA CG in the perioperative period

Learning Objective: 1. Identify presenting symptoms and signs most amenable to surgical intervention 2. Identify patients who are the best candidates for surgery versus observation. 3. Described hearing outcomes in patients with PA CG

Desired Result: 1. Improve patient selection for surgery versus observation 2. Optimize surgical outcomes 3. Improve patient counseling in the perioperative period.

Indicate IRB or IACUC Approval: Approved

Stereotactic Radiosurgical Treatment of Glomus Jugulare Tumors

Tyler W. Winford, MD; Leighanne H. Dorton, MD
Eric R. Oliver, MD; Michael D. Chan, MD
Stephen B. Tatter, MD, PhD; John S. May, MD
James D. Browne, MD

Objective: To determine treatment outcomes of stereotactic radiosurgery (SRS) for glomus jugulare (GJ) tumors, focusing on three-dimensional volume changes and symptoms before and after SRS, as well as complications related to SRS.

Study Design: Retrospective case review

Setting: Tertiary referral center

Patients: Forty-one patients (34 female, 7 male) treated with SRS between 2000-2014

Intervention: SRS treatment of GJ tumors

Main outcome measures: The three-dimensional tumor volume on pre-treatment and post-treatment imaging was compared utilizing the LeskellÂ® treatment plan software to assess tumor growth. Pre-treatment and post-treatment symptoms, Fisch classification, and complications were recorded to compare clinical and tumor responses.

Results: The mean radiographic follow-up was 41.9 months. The mean dose-to-tumor margin was 12.9 Gy. The mean tumor size at treatment was 6.06 cm3 and 5.67 cm3 at last follow-up. Eighteen tumors (43.9%) decreased in size, seventeen (41.5%) remained unchanged, and six (14.6 %) increased in size. The mean-marginal dose for treatment success and failure were 12.7 Gy and 13.0 Gy, respectively. Fisch classification D tumors demonstrated a relative increased chance for tumor progression after treatment. Initial tumor volume had no significance on tumor response to treatment. Symptoms improved or remained stable in 39 patients (95%), and 12 patients (29%) demonstrated possible radiation associated toxicity.

Conclusions: SRS is an effective treatment option for GJ tumors. The mean marginal dose between treatment successes and failures was not significantly different. In this study, a higher Fisch classification seems to correspond with an increased risk of tumor growth.

Define Professional Practice Gap & Educational Need: Studies have shown that stereotactic radiosurgery is an effective treatment alternative to surgical resection for glomus jugulare tumors. There is a generalized lack of knowledge in how well radiosurgery controls tumor growth and affects patient symptoms, as well as some of the complications associated with radiosurgery. This study looks into comparing pre-treatment and post-treatment three-dimensional tumor volume using a treatment planning software and compares pre-treatment and post-treatment symptoms.

Learning Objective: Learn presenting symptoms of glomus jugulare tumors Understand clinical and tumor responses of glomus jugulare tumors to stereotactic radiosurgery Appreciate some possible complications that can occur as a results of stereotactic radiosurgery

Desired Result: Appreciate that sterotactic radiosurgery is an effective treatment alternative to surgery for management of glomus jugulare tumors and understand the types of tumors and symptoms that respond best to treatment.

Indicate IRB or IACUC Approval: Approved

Single Institutional Experience with Observing Vestibular Schwannomas

Jacob B. Hunter, MD; Brendan P. O'Connell, MD
Marc L. Bennett, MD; Alejandro Rivas, MD
George B. Wanna, MD; Reid C. Thompson, MD
David S. Haynes, MD

Objective: To characterize growth rates and hearing outcomes during conservative observation of sporadic vestibular schwannoma (VS).

Study Design: Retrospective review.

Setting: Single academic center.

Patients: 711 consecutive patients with sporadic VS and at least two MRI studies prior to any intervention.

Intervention(s): Serial MRI and audiometry

Main outcome measure(s): Tumor growth and audiometric decline

Results: Between 1995 and 2015, 1,296 patients with sporadic VS were evaluated. 711 patients (average age 58.5 years; 52.3% female) were observed prior to intervention and the mean time period between the first and last MRI was 29.4 months (SD 26.6 months, range 1.1-188.3). The average maximum tumor dimension at time of diagnosis was 10.9 mm (SD 0.77 mm; range 0.2-3.54). The mean initial pure-tone average was 47.9 dB HL (SD 21.7 dB HL), the mean speech discrimination score was 65.9% (SD 35.7%), and (59%) had serviceable hearing. At last follow-up, 32.0% tumors demonstrated growth of at least 2 mm and 8.0% shrank; the average rate of growth among enlarging tumors was 0.24 mm/year. Overall, 65% of patients presenting with serviceable hearing maintained serviceable hearing at last follow-up. Age, BMI, and gender were not associated with tumor growth. Of patients initially observed, 14.5% eventually underwent surgery, and 5.8% radiation.

Conclusions: In the largest reported study of observed VS, 32.0% of tumors demonstrated growth over time and 20.3% eventually underwent treatment. These data further validate a strategy of initial observation in select patients with small to medium sized sporadic VS.

Define Professional Practice Gap & Educational Need: Inconsistencies within observed sporadic vestibular schwannoma growth rates and hearing outcomes, alone and in relation to each other, exists.

Learning Objective: To characterize growth rates and hearing outcomes during conservative observation of sporadic vestibular schwannomas.

Desired Result: Attendees will be aware of vestibular schwannoma growth rates and hearing outcomes based on presenting tumor size, hearing status, and initial growth rates.

Indicate IRB or IACUC Approval: Approved

Inhibiting P21-Activated Kinase Induces Cell Death in Vestibular Schwannoma and Meningioma via Mitotic Catastrophe

Melania E. Mercado-Pimentel, PhD; Edrick F. Villalobos
Prithvi M. Mohan; Cecilia M. Reid
Ross H. Francis, BS; Daniela N. Rolph
Abraham Jacob, MD

Hypothesis: p21-Activated Kinase (PAK) regulates signaling pathways that promote cell survival and proliferation; therefore, pharmacological inhibition of PAK will induce cell death in vestibular schwannomas (VS) and meningiomas.

Background: All VS and many meningiomas result from loss of the neurofibromatosis type 2 (NF2) gene product merlin, with ensuing PAK hyperactivation and increased cell proliferation/survival.

Methods: The novel small molecule PAK inhibitors PI-8 and PI-15 - tested in schwannoma and meningioma cells - perturb molecular signaling and induce cell death. MTT, flow cytometry and TUNEL assay analyzed PAK inhibitors' effect on cell viability, cell cycle and cell death, respectively. Western blots evaluated activation and expression of cell proliferation, apoptotic, and mitotic catastrophe markers while light microscopy evaluated cell morphology and immunohistochemistry analyzed cellular localization of phospho-Merlin.

Results: Treatment with PI-8 and PI-15 decreased cell viability at 0.65-3.7 ÂµM IC50 in schwannoma and meningioma cells. Treatment increased G1-phase by 4% and decreased S-phase by 3.5%. TUNEL and western blot for apoptotic markers found that both PAK inhibitors did not induce apoptosis; instead, the expression and activation of proliferation markers (aurora B and GSK-3Î²) known to play a role in microtubule length and chromosomal alignment/ aggregation decreased after 48 hours treatment. PAK inhibitor treated cells stained for phospho-Merlin localized to over-duplicated centrosomes of dividing cells, multiple enlarged nuclei, and misaligned/missegregated chromosomes' markers for mitotic catastrophe. Increased ATG5 levels and caspases-2 activation confirmed this cell death type.

Conclusion: PAK inhibitors induce cell death in schwannoma and meningioma cells, at least in part, by mitotic catastrophe.

Define Professional Practice Gap & Educational Need: There are no drugs currently FDA approved for the treatment of vestibular schwannomas and meningiomas; therefore, the development of novel therapeutics represents an urgent and unmet clinical need.

Learning Objective: (1) To describe the mechanisms whereby loss of the neurofibromatosis type 2 gene product merlin results in hyperactivation of the p21-activated kinase; (2) to discuss the end biological effects of treating schwannoma and meningioma cells with the novel PAK inhibitors PI-8 and PI-15; and (3) to describe hallmarks of mitotic catastrophe and discuss evidence for this mechanism of cell death in cells treated with PAK inhibitors.

Desired Result: To develop and translate PAK inhibitors as a viable treatment strategy for vestibular schwannomas and meningiomas.

Indicate IRB or IACUC Approval: Approved

Peri-Operative Complications and Readmission Rates following Surgery for Cerebellopontine Angle Neoplasms

Hossein Mahboubi, MD, MPH; Yarah Haidar, MD
Yaser Ghavami, MD; Marlon Maducdoc, MD
Harrison W. Lin, MD; Hamid R. Djalilian, MD

Objective: To investigate the 30-day peri-operative complication, readmission, and re-operation rates following surgery for cerebellopontine angle (CPA) neoplasms.

Study Design: Cross-sectional analysis.

Setting: National Surgical Quality Improvement Program data set (NSQIP 2013).

Patients: All surgical cases with an ICD-9-CM diagnosis code of 225.1, benign neoplasms of cranial nerves, which had one of the following CPT codes, were included: 61606, 61615, 61616, 61518, 61619, 61526, 61530, and 61520.

Intervention(s): Surgical resection as indicated by the CPT codes above.

Main outcome measure(s): 30-day peri-operative complications, readmission rate, and re-operation rate.

Results: Overall, 170 cases were identified, of which 63.5% were females. The average age was 52.8 (range 20-87). Deep vein thrombosis (DVT) occurred in 5 (2.9%), cerebrospinal fluid (CSF) leak in 5 (2.9%), meningitis in 2 (1..2%), sepsis in 2 (1.2%), blood transfusion in 2 (1.2%), wound dehiscence in 2 (1.2%), deep incisional infection in 2 (1.2%), superficial wound infection in 1 (0.6%), myocardial infarction in 1 (0.6%), obstructive hydrocephalus in 1 (0.6%), ventilator dependence in 1 (0.6%), and pulmonary embolism in 1 (0.6%) patients. Seventeen (10.0%) were readmitted and 8 (4.7%) underwent re-operation within 30 days post-op. Mortality occurred in one case (0.6%).

Conclusions: Readmission and re-operation rates following surgery for CPA neoplasms are 10% and 4.7%, respectively. Most common complications are infections, CSF leak, and DVT. Reasons for readmission and CPT codes associated with re-operations will be discussed.

Define Professional Practice Gap & Educational Need: Lack of data on 30 day post-operative complications, readmission rates, and re-operation rates, their causes, and outcomes.

Learning Objective: To describe the most common complications of surgeries for CPA neoplasms, the reasons for readmission and re-operation as well as their most common timing to occur post-op.

Desired Result: Identifying the complications and reasons for readmission and re-operation will result in improved informed consent, patient safety improvement, and postoperative care.

Indicate IRB or IACUC Approval: Exempt

Tinnitus Suppression after Auditory Brainstem Implantation in NF2 Patients

Daniel S. Roberts, MD, PhD; Steve Otto, MA
Brian Chen, MD; Kevin Peng, MD
Derald E. Brackmann, MD
John W. House, MD

Objective: To evaluate whether an auditory brainstem implant (ABI) can impact levels of tinnitus in neurofibromatosis type-2 (NF2) patients who have undergone translabyrinthine craniotomy for vestibular schwannoma (VS) removal and to evaluate the burden of tinnitus in these patients.

Study Design: A retrospective case series and a prospectively collected survey.

Setting: Tertiary neurotologic referral center.

Patients: NF2 patients who underwent translabyrinthine removal of VS and ABI placement between 1994 and 2015.

Interventions: A survey, retrospective review and two validated tinnitus handicap questionnaires (Tinnitus Handicap Inventory (THI) scored 0-100 and tinnitus Visual Analogue Scale (VAS) scored 0-10) were used to characterize the degree of tinnitus and whether an ABI can alter tinnitus levels.

Main Outcome Measures(s): Survey results, THI and VAS scores.

Results: 112 ABI users were contacted and 43 patients (38.3)% responded to our survey. Tinnitus was reported in 83.7% of patients. The mean THI score was 17.8Â±20.5 SD representing notable degree of tinnitus. The ABI provided a self-reported reduction of tinnitus in 54% of patients and increased tinnitus in 5.4%. For patients who believed the ABI reduced tinnitus loudness, the ABI reduced tinnitus levels immediately on activation and after 1 hour of use (mean VAS: Off=4.8; On=2.4; On 1-hr=1.8; $p<0.01$). Suppression did not continue after the device was turned off. Audiological performance with the ABI did not correlate with tinnitus suppression.

Conclusion: NF2 patients who have undergone removal of VS have a significant tinnitus handicap and a subgroup of patients benefit from tinnitus suppression through utilization of an ABI possibly through masking or electrical stimulation of the auditory brainstem.

Define Professional Practice Gap & Educational Need: Lack of evidence suggesting that an auditory brainstem implant can alter levels of tinnitus in neurofibromatosis type-2 patients and insufficient evidence quantifying levels of tinnitus handicap in these patients.

Learning Objective: To investigate whether an auditory brainstem implant can impact levels of tinnitus in neurofibromatosis type-2 patients who have undergone resection of vestibular schwannoma and to understand the burden of tinnitus in these patients.

Desired Result: Participants will recognize that neurofibromatosis type-2 patients who have undergone removal of vestibular schwannoma have a significant tinnitus burden and a subgroup of patients benefit from tinnitus suppression through utilization of an auditory brainstem implant.

Indicate IRB or IACUC Approval: Approved

NEUROTOLOGY FELLOW AWARD

TeleAudiology in the Veterans Health Administration

Seth E. Pross, MD; Andrea L. Bourne, AuD
Steven W. Cheung, MD

Objective: To assess effectiveness of TeleAudiology for hearing aid services

Study design: Retrospective case-control

Setting: Ambulatory Veterans Health Administration and Community-Based Outpatient Clinics (CBOCs)

Patients: 42,697 Veterans who received hearing aids from January through September, 2014

Intervention(s): TeleAudiology (TA) and conventional in-person (IP) Audiology care

Main outcome measure(s): International Outcome Inventory for Hearing Aids (IOI-HA) effectiveness data. The IOI-HA is a 7-item survey used to assess hearing aid effectiveness. Scored from 7 to 35 points, higher scores are more favorable.

Results: Among Veterans nationwide who received hearing aids and completed the IOI-HA survey, 1,009 received TA and 41,688 received IP care. TA and IP groups have comparable mean IOI-HA values (TA=29.6, SD=3.9; IP=28.7, SD=4.2). While comparison showed a statistically significant difference ($p<0.0001$, t-test), principally due to large sample size, the distinction is not clinically meaningful. Subgroup analysis of Veterans from San Francisco and six affiliated CBOCs showed 169 received TA and 338 received IP care. TA and IP groups have similar mean age (TA=74, SD=9.8; IP=76, SD=10.3) and gender distribution (TA male=100%; IP male=96%) with statistically significant ($p<0.05$, t-test) but clinically insignificant differences. Mean IOI-HA scores (TA=30.7, SD=3.6; IP=30.5, SD=3.1) are not different between groups ($p>0.05$, t-test).

Conclusions: IP and TA encounters to provide hearing aid services to Veterans are comparable, as both are highly effective based on IOI-HA results. The non-inferiority of TA suggests its adoption to non-Veterans may improve access while preserving high satisfaction. Financial impact of migration to TA will require future econometric analysis.

Define Professional Practice Gap & Educational Need: TeleHealth has been identified by the Institute of Medicine and others to have the potential for improved access, increased quality, and decreased expense. Otology and audiology care has lagged behind other specialties in providing TeleHealth services.

Learning Objective: To learn of ways in which hearing care can be delivered remotely using TeleHealth. To recognize that high satisfaction and effectiveness can be achieved using TeleAudiology to provide hearing aid services to Veterans. To gain perspective on immediate cost savings with the use of TeleAudiology.

Desired Result: Practitioners should become aware of the benefits of TeleAudiology care for hearing aid services and consider instituting TeleAudiology into their own practices.

Indicate IRB or IACUC Approval: Exempt

Bridging the Gap: Use of Neural Conduit to Restore Facial Function

Joshua M. Sappington, MD; Jeffrey M. Hotaling, MD
Younan Xia, PhD; Liu Wenying, PhD
John P. Leonetti, MD; Eileen M. Foecking, PhD

Hypothesis: The use of nanofiber neural conduits would result in improved reinnervation following a facial nerve segmental resection when compared to controls.

Background: Facial paralysis is a devastating condition, leaving patients with many physical and psychological deficits. The gold standard for such injury is an autograft. The use of a conduit can eliminate the need for nerve graft harvest by bridging the gap caused by resection and provide a medium to facilitate reinnervation. We investigated the use of a neural conduit on functional recovery following a resection facial nerve injury.

Methods: 16 male, Sprague-Dawley rats were randomly assigned to one of 2 treatment groups: No conduit (Control) or Conduit (Experimental). Each rat underwent microsurgical removal of a 2.0 cm section of the buccal branch of the facial nerve. A neural conduit was sutured to the remaining facial nerve stumps in the conduit group. Functional recovery of whisker movement was then assessed immediately after resection by daily behavioral observations and video analysis.

Results: The use of a neural conduit enhanced vibrissae movement when compared to controls. The conduit group demonstrated faster resolution of nose asymmetry, faster return of coordinated sweep of vibrissae, as well as a higher average mobility score. Additionally animals with the conduit demonstrated a statistically significant increased percent injured vibrissae muscle mass when compared to control animals.

Conclusion: This study demonstrates reinnervation via a neural conduit following a transection facial nerve injury. This data has exciting clinical implications for repair the facial nerve following injury regardless of etiology.

Define Professional Practice Gap & Educational Need: 1. Describe a unique use of neural conduit in a facial nerve injury model. 2. Lack of awareness of nano fiber neural conduit use in neural regeneration. 3. Lack of a truly ideal repair for facial nerve injury

Learning Objective: 1. To educate attendees about the use of nano fiber neural conduits in a rat facial nerve resection model to evaluate facial nerve outcome.

Desired Result: 1 - Attendees will be knowledgeable of nano fiber conduits in a facial nerve injury model and that the conduits hold exciting clinical promise and future research possibilities.

Indicate IRB or IACUC Approval: Approved

Successful Treatment of the Mal de Debarquement Syndrome (MdDS)

Eric Smouha MD; Mingjia Dai, PhD
Sergei Yakushin, PhD; Catherine Cho, MD
Bernard Cohen, MD

Objective: The Mal de Debarquement Syndrome (MdDS) is characterized by continuous rocking, swaying or bobbing after a cruise or flight, which can last for months or years and previously has been refractory to treatment. We determined that MDDS resulted from maladaptation of the vestibulo-ocular reflex to head roll during rotation, and that MdDS could be successfully treated with a novel form of vestibular therapy.

Study design: Case review.

Setting: Ambulatory patients in a tertiary referral center.

Patients: have continuous oscillation at 02-0.3 Hz that caused substantial mental distress, after a cruise or flight (classic form) or occurring spontaneously (aberrant form). Other physical findings included lateral movement on the Fukuda stepping test, and vertical nystagmus when the head was rolled slowly to either side. Symptoms disappeared during car rides, but promptly recurred after the ride ended.

Intervention: The head was rolled at the frequency of rocking, while viewing a rotating full-field visual surround for 3 minutes, 3-10 sessions/day, for 5 days.

Outcome measure(s): Self-rated symptom reduction by >50% on a 0-10 scale.

Results: We treated 127 patients (109 females; 18 males; 107 classic, 20 aberrant) age 46+/-12 years (from 20-81), with symptom duration of 33.7Â±40.4 months (1 month to 20 years). The treatment was successful in 76% of classic and 45% of aberrant cases. Success rate was 74% if symptom duration was <3 years and 66% if >3 years.

Conclusion: MdDS can be successfully treated in most patients. The success rate was not dependent on symptom duration or gender.

Define Professional Practice Gap & Educational Need: 1. Lack of awareness of effective treatment of Mal de Debarquement Syndrome 2. Lack of understanding of pathophysiology of Mal de Debarquement Syndrome

Learning Objective: 1. to learn an effective method for treating Mal de Debarquement Syndrome 2. to gain knowledge of the maladaptive VOR response in Mal de Debarquement Syndrome

Desired Result: Attendees will apply knowledge gained from this presentation to the diagnosis and treatment of Mal de Debarquement Syndrome

Indicate IRB or IACUC Approval: Exempt

NICHOLAS TOROK VESTIBULAR AWARD

Revision Surgery for Superior Canal Dehiscence Syndrome

Jeffrey D. Sharon, MD; Seth E. Pross, MD
John P. Carey, MD

Objective: To identify factors associated with surgical failure for superior canal dehiscence syndrome (SCDS) and define rates of complications and cure after revision SCDS repair.

Study Design: Retrospective case series

Setting: Tertiary care referral center

Patients: Adults who underwent revision surgery for SCDS

Interventions: None

Main outcome measures: Initial surgical approach, intraoperative findings at time of revision, persistence of symptoms, and complications for revision surgery.

Results: 222 patients have undergone SCDS surgery at our institution, including 22 subjects who underwent revision surgery and met inclusion criteria. 13 (59%) underwent prior middle fossa and 9 (41%) underwent prior transmastoid approaches. Intraoperative findings showed that in 16 (72%) the prior material used to plug or resurface the canal was present but not entirely covering the dehiscence. In 1 (4%) the material was not present. In 1 (4%) the material was in proper position, while in 4 (18%) the material was in proper position with very thin bone adjacent to the plug. After revision surgery, symptoms were completely resolved in 8 (36%), partially resolved in 8 (36%), and not resolved in 5 (23%). Normalization of ocular vestibular-evoked myogenic potential was associated with complete or partial symptom resolution, and findings of thin bone adjacent to the prior plug was associated with failure of symptom resolution. Three subjects (14%) experienced a significant drop in their word recognition score after revision surgery.

Conclusions: Revision surgery for SCDS is curative in some cases, but is associated with a higher failure and complication rate than primary surgery.

Define Professional Practice Gap & Educational Need: Lack of awareness of factors related to treatment failure and the need for revision surgery in superior canal dehiscence syndrome

Learning Objective: To provide education regarding factors associated with need for revision surgery in superior canal dehiscence syndrome, and provide information on surgical findings at revision surgery, and information on cure and complication rates in revision surgery

Desired Result: Attendees will be able to better understand what contributes to treatment failure in superior canal dehiscence surgery, and thereby improve rates of surgical success

Indicate IRB or IACUC Approval: Exempt

ANS TRAINEE AWARD

Correlation of Superior Canal Dehiscence Surface Area with Vestibular Evoked Myogenic Potentials and Audiometric Thresholds

Jacob B. Hunter, MD; Katie Makowiec
Jianing Wang; Brendan P. O'Connell, MD
Matthew L. Carlson, MD; Devin L. McCaslin, PhD
Jack H. Noble, PhD; George B. Wanna, MD

Objective: To correlate vestibular evoked myogenic potential (VEMP) amplitudes and thresholds, and audiometric thresholds, with the surface area of the superior canal dehiscence (SCD)

Study Design: Retrospective chart review and radiological analysis

Setting: Single tertiary academic referral center

Patients: Preoperative CT imaging, audiometric thresholds, and VEMP testing in patients with confirmed SCD

Intervention(s): A previously validated software algorithm was applied to preoperative CT imaging to measure the surface area of each SCD

Main outcome measure(s): Preoperative ocular and cervical VEMPs, air and bone conduction thresholds and surface area of the SCD

Results: Thirty-three patients (mean age 54 years) with 45 dehiscent superior canals were analyzed. The surface area of each dehiscence was calculated, with an average area of 2.22 mm2 (0.34-8.23 mm2). Pearson correlation analysis demonstrated ocular ($r = 0.56$, $p < 0.0001$) and cervical ($r = 0.49$, $p < 0.0001$) VEMP amplitudes, cervical VEMP thresholds ($r = -0.63$, $p < 0.0001$), and air conduction thresholds at 250 Hz ($r = 0.30$, $p = 0.013$) and 500 Hz (0.26, $p = 0.032$) were significantly correlated with the surface area of the dehiscence. Age, air bone gap, as well as air and bone conduction thresholds greater than 500 Hz were not correlated with SCD surface area.

Conclusions: Among patients with confirmed SCD, ocular and cervical VEMP amplitudes, cervical VEMP thresholds, and air conduction thresholds at 250 Hz and 500 Hz are significantly correlated with the surface area of the dehiscence.

Define Professional Practice Gap & Educational Need: There are no studies comparing oVEMP and cVEMP amplitudes and thresholds, audiometric thresholds, and SCD surface area.

Learning Objective: To correlate oVEMP and cVEMP amplitudes and thresholds, and audiometric thresholds in patients with confirmed SCD and the surface area of the dehiscence.

Desired Result: Attendees will be aware of significant correlations between SCD surface area and oVEMP and cVEMP amplitudes and thresholds, and air-conduction thresholds.

Indicate IRB or IACUC Approval: Approved

Intracochlear Pressure Transients during Cochlear Implant Electrode Insertion

Nathaniel T. Greene, PhD; Jameson K. Mattingly, MD
Renee M. Banakis Hartl, MD, AuD; Daniel J. Tollin, PhD
Stephen P. Cass, MD, MPH

Hypothesis: Cochlear implant (CI) electrode insertion into the round window induces pressure transients in the cochlear fluid comparable to a high intensity sound.

Background: Many patients receiving a CI have some remaining functional hearing at low frequencies, thus surgical techniques have focused on preservation of this residual hearing. To maintain functional acoustic hearing, it is important to retain function of any hair cells and auditory nerve fibers innervating the basilar membrane; however, in a subset of patients, residual low-frequency hearing is lost following CI insertion. Here, we test the hypothesis that transient intracochlear pressure spikes are generated during CI electrode insertion, which could cause damage and compromise residual hearing.

Methods: Human cadaveric temporal bones were prepared with an extended facial recess. Pressures in the scala vestibuli (PSV) and tympani (PST) were measured with fiber-optic pressure sensors during insertion of five CI electrodes, from two different manufacturers, via a round window approach.

Results: CI electrode insertion produced high intensity, low frequency pressure transients in the cochlea, which could occur alone or as part of a train of spikes. PST tended to be larger in magnitude than PSV. Pressure transients were recorded with all electrode styles tested.

Conclusions: Results suggest surgical technique and anatomical considerations likely affect the magnitude and rate of intracochlear pressure transients during CI electrode insertion. Some transients were comparable in intensity to sound pressure levels high enough to cause damage to the basilar membrane, thus all possible efforts should be undertaken to prevent these events.

Define Professional Practice Gap & Educational Need: Limited understanding of the cochlear environment during cochlear implant electrode insertion.

Learning Objective: Appreciate the potential for causing traumatic injury to the auditory system during cochlear implant surgery.

Desired Result: Contribute to the discussion on improving intraoperative strategies for minimally traumatic cochlear implant surgery.

Indicate IRB or IACUC Approval: Exempt

Investigating the Air-bone Gap: Changes in Intracochlear Sound Pressure with Air- and Bone-conducted Stimuli after Cochlear Implantation

Renee M. Banakis Hartl, MD, AuD; Jameson K. Mattingly, MD
Nathaniel T. Greene, PhD; Herman A. Jenkins, MD
Stephen P. Cass, MD; Daniel J. Tollin, PhD

Hypothesis: A cochlear implant electrode within the cochlea contributes to the air-bone gap component of postoperative changes in residual hearing after electrode insertion.

Background: Preservation of residual hearing after cochlear implantation has gained importance as simultaneous electric-acoustic stimulation allows for improved speech outcomes. Postoperative loss of residual hearing has previously been attributed to sensorineural changes; however, presence of increased postoperative air-bone gap remains unexplained and could result in part from altered cochlear mechanics. Here, we sought to investigate changes in intracochlear pressure after electrode implantation to quantify the contribution to postoperative air-bone gap.

Methods: Human cadaveric heads were implanted with titanium fixtures for bone conduction transducers. Velocities of stapes capitulum, round window, and cochlear promontory between the two windows were measured using single-axis laser Doppler vibrometry. Fiber-optic sensors measured intracochlear pressures in scala vestibuli and tympani for air- and bone-conducted stimuli before and after cochlear implant electrode insertion through the round window.

Results: Intracochlear pressures revealed only slightly reduced responses to air-conducted stimuli consistent with prior literature. Both increases and decreases in pressure were noted to bone-conducted stimuli after implantation. Velocities of the stapes capitulum and the cochlear promontory to both stimuli were stable following electrode placement.

Conclusion: Presence of a cochlear implant electrode causes alterations in intracochlear sound pressure levels to bone conducted stimuli and helps to explain changes in residual hearing noted clinically. These results suggest the possibility of a cochlear conductive component to postoperative changes in hearing sensitivity.

Define Professional Practice Gap & Educational Need: Unclear mechanism of postoperative clinical air-bone gap following cochlear implantation in some patients with significant low-frequency residual hearing.

Learning Objective: Understand changes in intracochlear pressure to air- and bone-conducted stimuli after electrode implantation to quantify the contribution to postoperative air-bone gap.

Desired Result: Improve understanding of causes of postoperative air-bone gap following cochlear implantation.

Indicate IRB or IACUC Approval: Exempt

Degree of Hearing Preservation after Cochlear Implantation Impacts Early Speech Recognition

Sarah A. Sydlowski, PhD, AuD
Erika A. Woodson, MD

Objective: Previous investigations suggest that low frequency hearing preservation (HP) in cochlear implant (CI) recipients and subsequent use of electric-acoustic stimulation (EAS) improves comprehension in complex listening environments. However, the perception exists that patients without HP will achieve comparable overall benefit to those patients with EAS capability. This study seeks to associate HP after CI with speech recognition skills.

Study Design: Retrospective Case Review

Setting: Tertiary referral center; ambulatory

Patients: CI recipients with preoperative low-frequency hearing

Intervention(s): Rehabilitative

Main outcome measure(s): Using pure tone averages for 125-1000 Hz, postoperative outcomes were categorized based on degree of HP (Minimal/No preservation = 0-25% HP; Partial = >25% to 75% HP; Complete = >75% HP) (Skarzynski, 2013). Pre-operative aided speech recognition scores were converted to standardized potential performance scores, indicating the difference between a perfect score (100%) and the patient's baseline score. Post-operative scores at 1, 3, and 6 months were compared to the possible degree of improvement with results categorized based on degree of residual hearing preservation.

Results: Although nearly all recipients demonstrated benefit with their CI, patients with complete (>75%) HP achieved more of their potential improvement in speech recognition than patients with partial, minimal, or no HP.

Conclusions: Hearing preservation positively affects post-operative outcomes, and should be a goal in all CI surgeries. Considering degree of improvement based on standardized potential for improvement rather than raw scores demonstrates the impact of HP on success with CI in patients close to the ceiling of the test batteries.

Define Professional Practice Gap & Educational Need: 1. Importance of residual hearing to level of speech recognition improvement after cochlear implantation. 2. Limitations of current test batteries to assess patient improvement when near the ceiling.

Learning Objective: 1. Appreciate the contribution of any level of residual acoustic hearing to speech recognition gains.2. Discover a method to measuring relative improvement in speech understanding to account for the ceiling effect on high-performing individuals.

Desired Result: 1.Attendees will aim to preserve residual hearing in all cochlear implant surgeries even for those individuals outside of traditional electroacoustic range. 2. Attendees will consider the described method in analyzing their own patient outcomes, and explore other means to measure speech understanding improvement near the ceiling.

Indicate IRB or IACUC Approval: Approved

The Compound Action Potential in Cochlear Implant Patients

William C. Scott, BA; Christopher Giardina, BS
Tatyana Fontenot, MD; Andrew Pappa, BS
Harold C. Pillsbury, MD; Craig A. Buchman, MD
Doug Fitzpatrick, PhD

Hypothesis: The response to tones in electrocochleography (ECochG) typically includes a compound action potential (CAP) that represents the summed, synchronous response of the auditory nerve at the onset of sounds. For patients receiving cochlear implants, who typically have severe hearing loss with preserved physiology only to low frequencies, the CAP may be absent even if significant neural activity is present.

Background: ECochG is being increasingly used during cochlear implantation (CI) to assess cochlear health. The response obtained is a complex mixture of responses from hair cells and the auditory nerve. The CAP is a well-established marker of purely neural origin. The auditory nerve neurophonic (ANN) is also neural, but is mixed with the cochlear microphonic, a hair cell response. Whether the CAP is a reliable marker of neural activity in subjects receiving cochlear implants is not known.

Methods: Intraoperative round window ECochG was performed in adult and pediatric subjects undergoing CI (n>200). Responses to tones of multiple frequencies at a high sound level (90 dB nHL) were recorded, and the CAP amplitude was measured.

Results: Only about half of the subjects analyzed had a measurable CAP at any frequency. Of those subjects without a CAP, a considerable number showed evidence of an ANN to low frequency tones.

Conclusions: Many subjects without a CAP had residual nerve activity. Therefore, measurement of the CAP alone cannot define the health of the auditory nerve in CI subjects.

Define Professional Practice Gap & Educational Need: Lack of consistency in how the compound action potential is interpreted in electrocochleography, specifically from cochlear implant patients.

Learning Objective: Recognize neural elements of electrocochleography, even if the CAP is absent.

Desired Result: Learners will be able to more accurately interpret electrocochleography results from cochlear implant patients, especially with respect to the contributions of the auditory nerve.

Indicate IRB or IACUC Approval: Approved

Automatic Cochlear Duct Length Estimation for Selection of Cochlear Implant Electrode Arrays

Alejandro Rivas, MD; Ahmet Cakir, MRes
Jacob Hunter, MD; Robert Labadie, MD, PhD
Geraldine M. Zuniga, MD; George B. Wanna, MD
Benoit Dawant, PhD; Jack Noble, PhD

Hypothesis: Automatic measurement of cochlea size could aid selection of cochlear implant (CI) electrode arrays.

Background: Cochlear duct length (CDL), which can be used to select CI electrode arrays, is estimated by measuring the distance in CT between the round window and the medial wall of the cochlea when passing through the modiolus, aka "length". Even when using special radiologic software to obtain an appropriate Stenvers view, inter-rater agreement is variable. In this work, we evaluate an automatic way to measure A as well as to directly measure the two-turn (2T) CDL.

Methods: Existing algorithms for localizing cochlear anatomy were modified to permit measuring A and 2T automatically in pre-op CT-images of 309 ears. Manual measurement of A (mA) and the estimated two-turn CDL using mA (m2T) were also measured for 88 ears. Based on these measurements, a recommendation between two different length electrode arrays was determined using the manufacturer's guidelines.

Results: Mean and maximum differences between A and mA were 0.44 and 1.86 mm. Mean and maximum differences of 2.0 and 7.1 mm were observed between 2T and m2T. Using either 2T or A did not result in any difference in choice of array, confirming accuracy of our system. A different array was chosen when using m2T vs. 2T in 3 of 88 cases.

Conclusion: Our automatic approach permits more accurate, consistent, and less labor intensive determination of CDL and could facilitate widespread patient-customized selection of arrays.

Define Professional Practice Gap & Educational Need: Currently, the cochlear duct length is determined from manual measurements to assist some cochlear implant surgeons to select appropriate length electrode arrays, while no automatic approach that simplifies the process has been described.

Learning Objective: To compare the accuracy of automatically measuring the cochlear duct length with manually measuring the diameter of the basal turn of the cochlea and estimating the cochlear duct length.

Desired Result: Attendees will be aware of an automatic approach that accurately and consistently measures the cochlear duct length.

Indicate IRB or IACUC Approval: Approved

Flat Panel CT Evaluation of Place-Pitch Mismatch in Cochlear Implant Users

Nicole T. Jiam, BA; Monica S. Pearl, MD
Courtney Carver, AuD; Charles J. Limb, MD

Objective: This study evaluates electrode placement post-cochlear implantation and quantifies frequency deviation between users' ideal and actual pitch maps.

Study Design: Retrospective case control

Setting: Tertiary Referral Hospital

Patients: 17 cochlear implant users (9 males, 8 females; mean age: 54.4) with Med-El standard 12-electrode contact arrays (31.5 mm linear insertion length, 2.4 mm between contacts).

Intervention: Flat-panel computed tomography (FPCT) images were collected for all participants. Cochlear lengths and electrode location were measured using three-dimensional curved multiplanar reconstruction on high-resolution secondary reconstructions. Ideal pitch maps were created using a modified Greenwood's function.

Main Outcome Measures: All subjects' strategy pitch maps were retrieved from electronic medical records and compared to their ideal pitch maps.

Results: Among 260 electrodes, 216 (83%) fell outside of their programmed frequency range. When differences in frequency were normalized as a function of frequency band filter size, 46 (17%) of deviations were ≤50%; 88 (34%) of deviation were 51% to 150%; 60 (23%) of deviations were 151% to 250%; 66 (25%) of deviations were ≥251%. The most apically and basally located electrodes were most misaligned with the actual pitch map. Deviations from the center frequency range from 158 to 12,872 hertz.

Conclusion: The results from this study reveal significant deviation between ideal and programmed characteristic frequencies. These deviations from ideal placement may be even more pronounced with shorter electrode arrays. We cautiously suggest that these deviations may impact pitch perception by increasing place-pitch mismatch of individual electrode contacts within the cochlea.

Define Professional Practice Gap & Educational Need: 1. Lack of tools available for post-cochlear implantation evaluation; 2. Lack of contemporary knowledge on discrepancies between actual and ideal electrode placement; 3. Inconsistencies in electrode array insertion and cochlear implant user outcomes.

Learning Objective: Learners will be able to identify electrodes most vulnerable to misalignment with the ideal pitch map and the direction of these mismatches.

Desired Result: Attendees will be able to apply this knowledge in post-operative management and reprogramming of cochlear implants. Attendees may also tailor selection of cochlear implant to minimize pitch-place mismatch. The results from this study may impact biomedical design towards creating strategy maps that align closely with an aggregated theoretical pitch map.

Indicate IRB or IACUC Approval: Approved

The Mitochondria-Targeted Antioxidant Mitoquinone Reduces Cisplatin-induced Ototoxicity in Guinea Pigs

Alan D. Tate, MD; Patrick J. Antonelli, MD
Kyle R. Hannabas, BS; Jerin K. Joseph, BS
Carolyn O. Dirain, PhD

Hypothesis: Mitoquinone (MitoQ) attenuates cisplatin ototoxicity in guinea pigs.

Background: MitoQ is an antioxidant that is derived from ubiquinone through an attached lipophilic triphenylphosphonium cation. This enables its accumulation inside mitochondria several hundred-fold higher than untargeted antioxidants. MitoQ has improved bioavailability and demonstrated safety in humans. MitoQ has been shown to reduce gentamicin ototoxicity in guinea pigs and cisplatin-induced nephropathy in mice. Cisplatin chemotherapy is commonly complicated by ototoxicity, typically manifest by sensorineural hearing loss. The goal of this study is to evaluate if MitoQ can protect against cisplatin ototoxicity.

Methods: Guinea pigs were injected subcutaneously with either 5 mg/kg MitoQ (n=9) or normal saline (control, n=9) for 7 days and 1 hour before receiving a single dose of 10mg/kg cisplatin. Auditory brainstem response thresholds were measured before MitoQ or saline administration and 3 to 4 days after cisplatin administration. Cochlear hair cell damage was assessed using scanning electron microscopy.

Results: Auditory brainstem response threshold shifts at 3 to 4 days after cisplatin treatment were smaller (27-45 dB) in guinea pigs injected with MitoQ compared with those in the control group at all tested frequencies (4, 8, 16 and 24 kHz, p=0.001-0.03). Electron microscopy showed less outer hair cell damage in the MitoQ group.

Conclusions: MitoQ reduced cisplatin-induced cochlear toxicity in guinea pigs. MitoQ appears worthy of further investigation as a means of preventing cisplatin ototoxicity in humans.

Define Professional Practice Gap & Educational Need: There is a lack of contemporary knowledge and awareness whether the mitochondria-targeted antioxidant, mitoquinone, can be used as a therapeutic agent for the prevention of hair cell death and hearing loss induced by cisplatin.

Learning Objective: At the conclusion of this presentation, the attendees will learn that the mitochondria-targeted antioxidant, mitoquinone, reduced cisplatin-induced ototoxicity in guinea pigs and should be investigated further as a means of preventing ototoxicity in humans

Desired Result: The attendees may be able apply this knowledge by recognizing that mitochondria targeted antioxidants such as MitoQ may be a promising therapeutic agent for protecting against cisplatin-induced ototoxicity.

Indicate IRB or IACUC Approval: Approved

Activation of IGF1 Signaling in the Cochlea Induces the Transcription of Its Mediators during the Protection of Cochlear Hair Cells against Aminoglycoside

Norio Yamamoto, MD, PhD; Yushi Hayashi, MD, PhD
Takayuki Nakagawa, MD, PhD; Koichi Omori, MD, PhD
Juichi Ito, MD, PhD

Hypothesis: Transcription of Erk and Akt genes as well as phosphorylation of their products are promoted by Insulin-like growth factor 1 (IGF1) during hair cell protection

Background: IGF1 protects mammalian hair cells in animal models from various damages including aminoglycoside. Moreover, the clinical trial revealed that IGF1 was effective for idiopathic sudden sensorineural hearing loss. In this process, activation of the downstream of IGF1 signaling, that is, the phosphorylation of ERK and AKT proteins is indispensable. However, the regulation of IGF1 signaling mediators at a transcriptional level has not been studied.

Methods: We used a neomycin damage model on neonatal mouse cochlear explant culture. Explants established from neonatal mice were treated with either neomycin only or neomycin and IGF1. The expression levels of IGF1 signaling mediator genes, Akt1, Erk1, and Erk2, in the explants were compared using quantitative reverse transcriptase polymerase chain reaction (qRT-PCR) at several time points. Inhibitors of IGF1 were added to confirm that this observation was dependent on IGF1 signaling.

Results: The expression levels for all genes tested were significantly upregulated in neomycin+IGF1 treatment samples ($p < 0.0001$, ANOVA). Addition of inhibitors of IGF1 signaling significantly attenuated the up-regulation of the expression levels ($p < 0.0001$, ANOVA).

Conclusions: IGF1 treatment causes up-regulation of the expression levels of its mediator genes during the protection of hair cells against aminoglycoside. The regulation of the mediator gene expression may serve as the novel treatment of sensorineural hearing loss.

Define Professional Practice Gap & Educational Need: Lack of knowledge about the mechanisms of the protection of cochlear hair cells against aminoglycoside by IGF1

Learning Objective: The learner will understand how IGF1, a novel treatment option for sensorineural hearing loss, protects cochlear hair cells against aminoglycoside and will have opportunity to consider about the novel treatment of sensorineural hearing loss.

Desired Result: The attendees will be able to apply the knowledge obtained from this presentation to the development of an innovative treatment method of sensorineural hearing loss.

Indicate IRB or IACUC Approval: Approved

Intratympanic Dexamethasone Did Not Protect Against High Dose, Single Fraction Radiation Ototoxicity in Rats in Vivo

Christine T. Dinh, MD; Si Chen, MD
Stefania Goncalves, MD; Kyle Padgett, PhD
Perry Johnson, PhD; Nagy Elsayyad, MD
Fred F. Telischi, MD

Background: Stereotactic radiosurgery for lateral skull base tumors can cause hearing loss when cochleae are exposed to high doses of radiation (HD-XRT) in a single fraction. Currently, there are no preventative treatments for radiation-induced ototoxicity.

Hypothesis: Intratympanic (IT) dexamethasone (DXM), a synthetic steroid, protects against HD-XRT-initiated auditory hair cell (HC) and hearing losses in rats in vivo.

Methods: Six rats received HD-XRT (12 Gy) to both cochleae. In the radiated rats and six non-radiated (control) rats, IT DXM was randomized to one ear, while tympanic puncture without DXM (placebo) was performed on the contralateral ear. Baseline and 4-week post-radiation auditory brainstem response (ABR) tests were performed. Cochleae were processed for HC viability studies.

Results: Cochleae exposed to HD-XRT demonstrated more outer HC (OHC) loss in the middle and basal turns than non-radiated ears ($p<0.01$). OHCs were more susceptible to HD-XRT injury than inner HCs in the basal turn ($p<0.05$). In radiated cochleae, there was less OHC loss with IT DXM in the basal turn, when compared to placebo; however, the difference was not statistically significant. HD-XRT was associated with higher ABR threshold shifts ($p>0.05$). No significant differences in ABR thresholds were demonstrated between IT DXM and placebo ears in radiated rats at all frequencies.

Conclusion: HD-XRT initiated loss of OHCs in the middle and basal turns of the cochlea and shifts in ABR thresholds at all tested frequencies. IT DXM did not protect against HD-XRT-induced OHC loss and ABR threshold shifts at 4 weeks post-radiation in vivo.

Define Professional Practice Gap & Educational Need: 1. Lack of current therapies for radiation ototoxicity 2. Lack of contemporary knowledge regarding effects of radiation on the cochlea

Learning Objective: 1. Understand that radiation can cause auditory hair cell and hearing loss in a rat in vivo model 2. Intratympanic dexamethasone did not significantly protect against radiation induced auditory hair cell loss or auditory brainstem response threshold shifts in rats in vivo

Desired Result: 1. Be aware that single fraction, high dose radiation exposure to the cochlea may cause auditory hair cell and hearing losses that can be irreversible. Significant counseling should be done with patients prior to making recommendations regarding radiation or radiosurgery for the treatment of lateral skull base tumors. 2. Currently, there is no preventative treatment for radiation ototoxicity.

Indicate IRB or IACUC Approval: Approved

Early Adoption of Hearing Aids Reduces Temporal Lobe Atrophy Associated with Presbycusis

Z. Jason Qian, BS; Peter D. Chang, MD
Gul Moonis, MD; Anil K. Lalwani, MD

Objective: A growing body of work suggests that hearing aids ameliorate the structural and functional brain changes associated with presbycusis. Here we investigate if hearing aids prevent temporal lobe atrophy using a novel method of quantitative MRI analysis, which we have previously used to demonstrate that temporal lobe atrophy (but not whole brain atrophy) is associated with hearing loss.

Intervention: MRI images of hearing aid users over 75 years of age were used to determine brain atrophy. A fully automated computer algorithm was used to quantify temporal lobe, whole brain, and surrounding CSF volume. Atrophy was computed by dividing the parenchymal brain volume by the total brain plus CSF volume.

Results: The 34 patients had a mean age of 83Â±4 years. Temporal lobe atrophy was 16.39Â±2.49% and whole brain atrophy was 20.44Â±2.19% on average. The mean temporal lobe to whole brain atrophy ratio was 0.8033Â±0.1013. When the contribution of age to brain atrophy was removed, hearing aid users had less temporal lobe atrophy than non-users. The greatest reduction of atrophy was in younger hearing aid users and the protective effect declined with age. Stratification of the results by age was not statistically significant likely due to insufficient n value.

Conclusions: Early adoption of hearing aids is likely protective against temporal lobe atrophy, however this effect was lost with age. This preliminary study shows the benefits of early implementation of hearing aids and should be followed up with a larger study to achieve greater significance.

Define Professional Practice Gap & Educational Need: There is a lack of contemporary knowledge with regards to the protective effects hearing aids and the timing of hearing aid implementation.

Learning Objective: The protective effect that hearing aids have on structural brain changes associated with hearing loss, specifically temporal lobe atrophy, is greatest in younger patients.

Desired Result: Clinicians should recommend early adoption of hearing aids in patients with presbycusis to reduce the degree of temporal lobe atrophy associated with hearing loss.

Indicate IRB or IACUC Approval: Approved

A Retrospective Review of Pediatric Temporal Bone Imaging with Respect to Bone-Anchored Hearing Aid Guidelines

Aaron R. Baker, MD; David G. Fanelli, BS
Sangam Kanekar, MD; Huseyin Isildak, MD

Objective: Current FDA guidelines allow the placement of bone-anchored hearing aids (BAHAs) in patients greater than 5 years old. This guideline is at least partially due to concern for thickness of bone stock at the implant site. International experience suggest that BAHAs may be safely placed in patients younger than 5. We aim to show that, anatomically, BAHAs may be safely placed in patients younger than 5.

Study Design: A retrospective review of high-resolution temporal bone CTs was undertaken comparing measurements between ears with chronic ear disease and controls.

Setting: Images were obtained at a single academic medical center.

Patients: 100 patients between 1-5.99 years had temporal bone CTs performed between 2000 and 2009. Patients with chronic ear disease were identified by ICD-9 code, as well as confirmation by review of the imaging.

Main Outcome Measures: Temporal bone thickness was measured on axial CT slices at a point 1cm posterior to the sigmoid sinus, at the superior margin of the bony canal.

Results: Temporal bone thickness showed little correlation to age. Average thickness was greater than 3mm in 1, 2, 3, 4, and 5 year olds (3.2mm, 3.4mm, 3.0mm, 3.7mm, and 3.4mm respectively). No significant difference was found between normal ears and ears with chronic disease (3.5mm vs. 3.3mm, p=0.21).

Conclusions: This data shows pediatric temporal bone thickness is frequently greater than the recommended 3mm, even in patients as young as 1. Anatomically, any concerns regarding temporal bone thickness in patients less than 5 could be reliably addressed with imaging.

Define Professional Practice Gap & Educational Need: 1. Current FDA guidelines allow for placement of BAHA implants in patients >5 years of age, while younger patients are able to receive implants in other countries.2. There is little data regarding the thickness of temporal bones in patients <5 years of age.

Learning Objective: Our objective is to objectively show the learner that anatomically, children >1 year of age have similar thickness temporal bones to those >5 years of age.

Desired Result: 1. Learners will be able to consider placement of BAHA in the appropriate patient at ages <5 years of age. 2. Further research and adjustment of FDA guidelines on the placement of BAHA in children.

Indicate IRB or IACUC Approval: Approved