

PROGRAM and ABSTRACTS
of the
AMERICAN
NEUROTOLOGY SOCIETY

54th Annual Spring Meeting

May 3-4, 2019

GRAND 6 (FRIDAY)
GRAND 7-8 (SATURDAY)

JW Marriott Austin
Austin, TX

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CONTINUING MEDICAL EDUCATION CREDIT INFORMATION

Accreditation

This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education through the joint providership of the American College of Surgeons and the American Otological Society. The American College of Surgeons is accredited by the ACCME to provide continuing medical education (CME) for physician

AMA PRA Category 1 Credits™

The American College of Surgeons designates this live activity for a maximum of **7.0 AMA PRA Category 1 Credits™**. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Of the *AMA PRA Category 1 Credits™* listed a maximum of **0** credits meet the requirements for Self-Assessment.



AMERICAN COLLEGE OF SURGEONS
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AMERICAN COLLEGE OF SURGEONS
DIVISION OF EDUCATION

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American Neurotology Society Mission Statement

Purpose: The American Neurotology Society (ANS) is committed to improving public health care through the provision of high-quality continuing medical education (CME) to our members. The overall goal of the ANS Continuing medical Education program is to provide CME activities that will address the knowledge gaps and enhance the clinical competence of the participants. The ANS is dedicated to improving public health care through the development, dialogue and dissemination of advances in evidence-based diagnosis and management of neurotologic and related skull base disorders. The focus on the scientific advances in these combined fields is translated into approaches to quality care that are consistent with ACGME/ ABMS general competency areas and the Institute of Medicine recommendations.

Target Audience: The primary target audience includes members of both the American Neurotology Society and our sister Society, the American Otological Society as well as healthcare professionals in the fields of otology, otolaryngology neurotology and skull base research and healthcare. The members served include physicians, otologists, neurotologists, residents, fellows, researchers, nurses, occupational and speech therapists and other healthcare professionals who are involved in the care of patients with otologic and neurotologic conditions.

Types of Activities Provided: In order to accomplish the goals of the ANS CME program, the Education committee will offer a range of activities with specific educational outcomes in mind. Current offerings include:

- Scientific symposia, delivered twice per year at national venues, showcasing the latest research in the field and featuring national and international experts on related clinical topics.
- Study groups & mini-seminars offered at the annual meeting of the American Academy of Otolaryngology-Head and Neck Surgery.
- Facilitation of manuscript submission on presented materials for publication in a peer reviewed journal (Otology & Neurotology).
- The Otology & Neurotology Journal provides an additional vehicle for further collaboration and dissemination of new information, science and standards of care.

Content: The content of the ANS CME program centers on clinical issues related to Neurotology and disorders of the skull base. The ANS also strives to respond to our members' educational needs that are not being met by other organizations, and therefore also offers activities in the areas of risk management, patient safety, physician-patient communications, coding, HIPAA compliance, and other regulatory issues as they relate to Neurotology. The educational efforts will also highlight the ACGME/ABMS general competencies within the context of this field and relate the significance of communication, professionalism, patient safety and systems-based practice within these workplace environments.

Expected Results: The CME program of the ANS strives to enhance the participants' knowledge and clinical competence in subject areas relevant to the field of Neurotology. The other expected outcome from this CME program is continued development of new evidence-based science, dissemination of ongoing research in the clinical area of Neurotology.

**Resolution on Diversity of Meeting Presenters and Participation for the
American Otological Society and the American Neurotology Society**

- Whereas, the councils of the American Neurotology Society and American Otological Society desire to promote inclusivity within the membership of both organizations.
- Whereas it is recognized that diverse leadership and diversity of presenters allows for cross pollination of knowledge, perspective and experiences enabling a stronger and more robust educational experience for our members.
- Whereas the Councils of the organizations recognize the importance of acknowledging diversity among our patients, our trainees and our colleagues.
- Whereas, the purpose of the education programs of both organizations is to disseminate information designed to improve physician knowledge, patient care and outcomes, and advance the respective specialties.
- Whereas, valuable scientific contributions to Otology and Neurotology by colleagues (regardless of gender, race, or other attributes) should be presented at the society's respective meetings.
- Be it resolved that the Scientific Program Committees of the American Neurotology Society and American Otological Society will select speakers and panel members endeavoring to balance educational goals while promoting the diversity of our respective Societies' memberships and educational offerings.
- Be it resolved the Executive Councils of the ANS and AOS will select participation at all levels of the organizations endeavoring to reflect diversity of our respective Societies' memberships.

ANS Continuing Medical Education Planning Process

Practice gaps in Neurotology are identified through polling the registered ANS attendees at the close of each CME activity by way of an online CME evaluation, required by ACCME. The evaluation is used as a tool to determine the success of the CME program in meeting program objectives, addressing professional practice gaps and educational needs. The responses are reviewed by the ANS Education Committee and the ANS Executive Council prior to the next meeting to assist the Education & Scientific Program Committee in developing future ANS Continuing Education programs. The educational program is designed to address the topics identified as practice gaps through individual presentations and in depth panel discussions.

Based on the responses from the 2018 evaluations and follow up questionnaires, the following data regarding professional practice gaps among attendees were noted:

- There is inconsistent knowledge regarding the importance of brain processes in predicting cochlear implant outcome in children.
- There is a lack of understanding of how the middle fossa surgery can be optimally and safely used in skull base surgery
- There is a lack of awareness of disorders of intracranial pressure, how they present in neurotologic practice and their appropriate management.
- There is a lack of understanding of which therapies are supported by the evidence, which have been discredited and which require further study.

To close the identified practice gaps, participants of this activity will need to learn:

- Physicians should be aware and have a broad understanding of the various ways in which cognitive processes influence language acquisition and best practices for optimizing these effects.
- Physicians should be aware of the rationale and technical details for safe and effective management of skull base tumors using the middle fossa approach
- Physicians should be aware of how disorders of intracranial pressure can mimic or lead to neurotologic disorders, as well as the appropriate referrals, testing and management options
- Evidence based approach to medical and procedural management of dizziness and hearing loss related to Meniere's disease

Learning Objective(s) - At the end of this activity, participants will be able to:

- Describe in detail the cognitive processes that influence and predict language acquisition in children with cochlear implants, as well as clinical evaluations and interventions that may improve outcomes.
- Describe the technical and relevant historical details of the middle fossa approach and its contemporary role in skull base surgery.
- Describe presentation, diagnosis and management of disorders of intracranial pressure and their relevance to the neurotologic patient.
- Describe the scope of management of Meniere's disease that is supported by evidence and that which has been refuted or requires further study.

How will this educational activity improve competence, practice performance, and patient outcomes?

- This activity will improve competence of physicians by providing education and thus, a more thorough understanding, of the scientific advances and evolving methods of evaluation and therapies for children with hearing loss who meet candidacy requirements for cochlear implantation. A particular emphasis will be placed on the cognitive processes relevant to language acquisition that need to be considered by the cochlear implant team.
- This activity will improve competence by providing physicians education on some of the challenges surgeons and their multidisciplinary teams can face in the surgical management of skull base disorders. With the use of a variety of instructional methods including surgical videos, this activity will clarify the important technical details required for safe and effective management using the middle fossa approach.
- This activity will involve the discussion of complex cases and will improve competence of physicians managing

otologic complaints that may be caused by disorders of intracranial pressure. This multidisciplinary panel discussion will provide improved understanding of the scientific advances and potential therapeutic applications in this patient population.

- This activity will improve physicians' understanding of the level of evidence that support common and/or emerging therapies of Meniere's disease.

The following statement was read, submitted, and signed by every individual connected with this educational activity. Failure to comply disqualifies the individual from planning or speaking at any ANS Continuing Medical Education program.

DISCLOSURE INFORMATION

In compliance with the ACCME Accreditation Criteria, the American College of Surgeons, as the accredited provider of this activity, must ensure that anyone in a position to control the content of the educational activity has disclosed all relevant financial relationships with any commercial interest. All reported conflicts are managed by a designated official to ensure a bias-free presentation. A complete disclosure list will be available onsite and the on the COSM app.

In accordance with the ACCME Accreditation Criteria, the American College of Surgeons, as the accredited provider of this activity, must ensure that anyone in a position to control the content of the educational activity has disclosed all relevant financial relationships with any commercial interest. Therefore, it is mandatory that both the program planning committee and speakers complete disclosure forms. Members of the program committee were required to disclose all financial relationships and speakers were required to disclose any financial relationship as it pertains to the content of the presentations. The ACCME defines a 'commercial interest' as "any entity producing, marketing, re-selling, or distributing health care goods or services consumed by, or used on, patients". It does not consider providers of clinical service directly to patients to be commercial interests. The ACCME considers "relevant" financial relationships as financial transactions (in any amount) that may create a conflict of interest and occur within the 12 months preceding the time that the individual is being asked to assume a role controlling content of the educational activity.

ANS is also required, through our joint providership partners, to manage any reported conflict and eliminate the potential for bias during the activity. All program committee members and speakers were contacted and the conflicts have been managed to our satisfaction. However, if you perceive a bias during a session, please report the circumstances on the online CME evaluation form.

Please note we have advised the speakers that it is their responsibility to disclose at the start of their presentation if they will be describing the use of a device, product, or drug that is not FDA approved or the off-label use of an approved device, product, or drug or unapproved usage.

The requirement for disclosure is not intended to imply any impropriety of such relationships, but simply to identify such relationships through full disclosure and to allow the audience to form its own judgments regarding the presentation.

POSITION STATEMENT: Any presentations, conversations, exhibits, or other meeting communications, including descriptions of the use of drugs or devices, does not imply or constitute endorsement of any company, product, application, or use by the American Neurotology Society.

PUBLICATION/SUBMISSION STATEMENT

The material in this abstract, has not been submitted for publication, published, nor presented previously at another national or international meeting and is not under any consideration for presentation at another national or international meeting. The penalty for duplicate presentation/publication is prohibition of the author and co - authors from presenting at a COSM society meeting for a period of three years. Submitting Author's Signature (required)

All authors were advised that the submitted paper becomes the property of Otology & Neurotology and cannot be reprinted without permission of the Journal.

Duplicate abstract submission to more than one Society will result in the abstract being disqualified and it will not be considered for presentation on either the ANS or AOS program.

**THE AMERICAN NEUROTOLOGY SOCIETY WOULD LIKE TO THANK THE FOLLOWING MEMBERS
FOR THEIR CONTRIBUTION TO THE 2019 ANS SCIENTIFIC PROGRAM**

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Howard Francis, MD, Education Director-Elect
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(Research Committee Chair)

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(ANS Young Member representative)

John P. Leonetti, MD
(Coordinator-Facial Nerve Study Group)

Poster Judges

Soha N. Ghossaini, MD
Ronna P. Hertzano, MD, PhD
Brian J. McKinnon, MD, MBA, MPH
Jeffrey D. Sharon, MD

Program Moderators

Brandon Isaacson, MD
Mia E. Miller, MD
Andrew A. McCall, MD
Andrea Vambutas, MD
Ana H. Kim, MD

Combined Poster Reception ANS, AOS, ASPO, TRIO

Friday, May 3, 2019

5:30 pm – 7:00 pm

JW Marriott - *Griffin Hall—Level 2*

WIN Reception (Women in Neurotology)

Friday, May 3, 2019

6:00 – 7:00

JW Marriott - *Level 2-203-204*

ANS President's Reception

Friday, May 3, 2019

7:00 – 8:30

JW Marriott -*Level 4-Grand 2*

AAO-HNSF Annual Meeting & OTO EXPO

September 15-18, 2019 *New Orleans, LA*

ANS “Super Saturday”

Saturday September, 14th, 2019

Hilton Riverside - *New Orleans, LA*

UPCOMING MEETINGS

55th ANS Spring Meeting (in conjunction with COSM)

April 24–26, 2020 - Hilton Atlanta - Atlanta, Georgia

The Abstract deadline for the ANS 55th Annual meeting is Tuesday, October 15, 2019.

Abstract Instructions and submission form will be available on website July 15.

Website - www.americanneurotologysociety.com

All primary and contributing authors are required to complete a disclosure/conflict of interest statement at time of abstract submission in order for the abstract to be considered by the Scientific Program Committee.

Journal Requirements/Instructions to Primary Authors

Manuscripts are required of ALL ORAL AND POSTER presentations. Manuscripts must be submitted online a minimum of four weeks prior to the annual meeting, via the journal’s website. Instructions for registering, submitting a manuscript, and the author guidelines can be found on the Editorial Manager site:

<https://www.editorialmanager.com/on/>

The journal of *OTOLOGY & NEUROTOLOGY* does not accept paper manuscripts. Manuscripts will be peer reviewed prior to the Annual meeting for conflict of interest review and resolution.

Failure to comply with the guidelines & requirements of the American Neurotology Society and the O&N Journal will result in the disqualification of your presentation.

For Society business, please forward all inquiries to:

Kristen Bordignon, Executive Administrator

Ashley Eikenberry, ANS Co-Administrator

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AMERICAN NEUROTOLOGY SOCIETY
54th Annual Meeting
SCIENTIFIC PROGRAM
May 3-4, 2019
JW Marriott Austin
Austin, TX

FRIDAY, MAY 3, 2019

1:00 BUSINESS MEETING (*New member introduction*)
(*Members Only*)

1:30 SCIENTIFIC PROGRAM
(*Open to registered Members and Non-members – Badge required for admittance*)

1:30 WELCOME & OPENING REMARKS BY THE PRESIDENT
Barry E. Hirsch, MD

PRESIDENTIAL CITATIONS

Eugene N. Myers, MD
Jonas T. Johnson, MD
Donald B. Kamerer, MD

1:42 WILLIAM F. HOUSE MEMORIAL LECTURE
Cortical Predictors of Language: A Top-down Exploration of Pediatric Cochlear Implantation
Nancy M. Young, MD
Lillian S. Wells Professor of Pediatric Otolaryngology
Northwestern University Feinberg School of Medicine
Head, Section of Otology & Neurotology, Division of Otolaryngology
Ann & Robert H. Lurie Children's Hospital of Chicago

2:07 INTRODUCTION - OUTCOMES IN COCHLEAR IMPLANTATION
Brandon Isaacson, MD

2:09 Five Years of Electric-Acoustic Stimulation (EAS) Listening Experience: Hearing Preservation and Benefits of Acoustic Representation of the Fundamental Frequency
Elizabeth Perkins, MD
Margaret Dillon, AuD
Kevin Brown, MD, PhD

2:16 General Health Quality of Life Instruments Underestimate the Impact of Bilateral Cochlear Implantation
Theodore R. McRackan, MD, MSCR
Joshua E. Fabie, BS
Prashant N. Bhenswala, MD
Shaun A. Nguyen, MD
Judy R. Dubno, PhD

2:23 Slim Perimodiolar Arrays are as Effective as Slim Lateral Wall Arrays for Functional Hearing Preservation after Cochlear Implantation
Erika A. Woodson, MD
Rebecca Nelson, MD
Thomas J. Haberkamp, MD
Sarah Sydlowski, AuD, PhD

- 2:30 Predicting Changes in Tinnitus after Unilateral Cochlear Implantation in Adults**
Peter R. Dixon, MD
David Shipp, MA
Kari Smilsky, MCLSc
Vincent Y. Lin, MD
Trung Le, MD, PhD
Joseph M. Chen, MD
- 2:37 Cognitive Functions in Adults Receiving Cochlear Implants: Predictors of Speech Recognition Outcomes and Changes after Implantation**
Aaron C. Moberly, MD
Michael S. Harris, MD
David B. Pisoni, PhD
William G. Kronenberger, PhD
Christin Ray, PhD, CCC-SLP
- 2:44 DISCUSSION**
- 2:47 BREAK WITH EXHIBITORS**
- 3:15 INTRODUCTION - VESTIBULAR SCHWANNOMA - IN VIVO AND IN VITRO**
Mia E. Miller, MD
- 3:17 Preclinical Evaluation of Compounds Targeting Schwannoma in an NF2 Mouse Model**
Charles W. Yates, MD, MS
Waylan Bessler, BS
Li Jiang, MD
Abbie Smith, BS
D. Wade Clapp, MD
- 3:24 Vestibular Schwannoma Tumor Size is Correlated with Acute Vestibular Symptoms After Gamma Knife Therapy**
Daniel Y. Lee, BS
David K. Lerner, MD
James G. Naples,
MD Jason A. Brant,
MD
Douglas C. Bigelow, MD
John Y.K. Lee, MD, MSCE
Michelle Alonso-Basanta, MD, PhD
Michael J. Ruckenstein, MD, MSc
- 3:31 NEUROTOLOGY FELLOW AWARD**
What Genes Can Tell: A Closer Look at Vestibular Schwannoma
Ksenia A. Aaron, MD
Zarko Manojlovic, PhD
Sharon Chang, BS
Eric Kwok, BS
Nathan Tu, MD, MPH
Kyle Hurth, MD, PhD
Rick A. Friedman, MD, PhD

3:38 Effects of Single-Fraction Radiation on Merlin-Deficient and Normal Schwann Cells in Vitro
Erin R. Cohen, MD
Brian Marples, PhD
Nagy Elsayyad, MD
Michael Ivan, MD
Cristina Fernandez-Valle, PhD
Fred F. Telischi, MD
Christine T. Dinh, MD

3:45 DISCUSSION/INTRODUCTION

3:50 ANS RESEARCH GRANT
Verbal Memory as Outcome Predictor in Adults Receiving Cochlear Implants
Michael S. Harris, MD
Medical College of Wisconsin
ANS Research Grant recipient 2017-18

4:00 INTRODUCTION

4:02 PANEL
Meniere's Disease: What Do We Know and What Don't We Know?
Anil Lalwani, MD, Moderator
Greg J. Basura, MD, PhD
Akira Ishiyama, MD
Michael J. Ruckenstein, MD, MSc
Alec N. Salt, PhD
Hinrich Staecker, MD, PhD
Andrea Vambutas, MD

5:00 ANNOUNCEMENT OF ANS & AOS POSTER WINNERS
Craig A. Buchman, MD - ANS Education Director
Marlan R. Hansen, MD - AOS Education Director

5:05 CLOSING REMARKS/ADJOURNMENT

SATURDAY, MAY 4, 2019

7:00 BUSINESS MEETING (Committee Reports)
(Members Only)

7:30 SCIENTIFIC PROGRAM
(Open to registered Members and Non-members – Badge required for admittance)

7:30 WELCOME & OPENING REMARKS BY THE PRESIDENT
Barry E. Hirsch, MD

7:33 INTRODUCTION - INNER EAR PHYSIOLOGY
Andrew A. McCall, MD

**7:35 The Role of The Spiral Ligament in Sensorineural Hearing Loss in Humans:
A Temporal Bone Study**
Karen B. Teufert, MD
Fred H. Linthicum Jr., MD

- 7:42 Anatomical and Functional Consequences of Microneedle Perforation of Round Window Membrane**
Michelle Yu, BS
Daniel N. Arteaga, BA
Aykut Aksit, MS
Harry Chiang, BA
Jeffrey W. Kysar, PhD
Anil K. Lalwani, MD
- 7:49 TRAINEE AWARD**
Neurotrophin Signaling in Various Degrees of Hearing Loss using MicroRNA Perilymph Profiling
Matthew Shew, MD
Helena Wichova, MD
Jacob New, PhD
Athanasia Warnecke, MD
Thomas Lenarz, MD, PhD
Hinrich Staecker, MD, PhD
- 7:56 NEUROTOLOGY FELLOW AWARD**
Intratympanic Diltiazem-Chitosan Hydrogel as a Novel Otoprotectant Against Cisplatin-Induced Ototoxicity in a Mouse Model
James G. Naples, MD
Michael J. Ruckenstein, MD
Jarnail Singh, PhD
Brandon C. Cox, PhD
Daqing Li, MD
- 8:03 Neuroprotection of NIR Light in Ananimal Model of Cochlear Implantation**
Arne Ernst, MD, PhD
Dietmar Basta, PhD
- 8:10 DISCUSSION/INTRODUCTION**
- 8:15 ANS/AAO-HNSF HERBERT SILVERSTEIN RESEARCH AWARD**
Novel Neurotrophin-Bisphosphonate Conjugates to Promote Cochlear Synaptogenesis
David H. Jung, MD, PhD
Massachusetts Eye and Ear Infirmary/Harvard Medical School
Silverstein Grant recipient 2016-18
- 8:25 INTRODUCTION - COI, ACTIVE BONE CONDUCTION, COCHLEAR IMPLANT INTEVENTIONS**
Andrea Vambutas, MD
- 8:27 Evaluating the Industry Relationships of Physicians Presenting at the American Neurotology Society Spring Meetings**
Milap H. Desai, BS
Darshak M. Vekaria BS
Brian J. McKinnon, MD, MBA, MPH
- 8:34 Active Bone Conduction Implants Improve Patient Reported Outcomes Measures – A 12-Month Prospective Study**
Matthew G. Crowson, MD
Euna A. Hwang, MD

Julija Adamonis, M.Sc. Reg. CASLPO
Trung Le, MD, PhD
Vincent Lin, MD
Joseph Chen, MD

8:41 Subclinical Age-Related Hearing Loss is Associated with Cognitive Impairment

Justin S. Golub, MD, MS
Adam M. Brickman, PhD
Adam J. Ciarleglio, PhD
Nicole Schupf, PhD
José A. Luchsinger, MD, MPH

8:48 Impact of Auditory-Motor Musical Training on Melodic Pattern Recognition in Cochlear Implant Users

Divya A. Chari, MD
Anirrudh Patel, PhD
Karen C. Barrett, PhD
Lauren Jacobs, BS
Patpong Jiradejvong, MS
Charles J. Limb, MD

8:55 The Use of Artificial Intelligence in Cochlear Implant Programming

Susan B. Waltzman, PhD
David C. Kelsall, MD

9:02 Intracochlear Pressure Transients During Cochlear Implant Electrode Insertion: Effect of Micro-mechanical Control on Limiting Pressure Trauma

Renee M. Banakis Hartl, MD, AuD
Christopher Kaufmann, MD, MS
Marlan R. Hansen, MD
Daniel J. Tollin, PhD

9:09 Electrocochleographic Patterns in Patients with Sudden Sensorineural Hearing Loss Undergoing Cochlear Implantation

Michael S. Harris, MD
William J. Riggs, AuD
Kristin Kozloski, AuD
Oliver F. Adunka, MD

9:16 DISCUSSION

**9:19 WILLIAM E. HITSELBERGER MEMORIAL LECTURE
Evolution of the Middle Fossa Access for Skull Base Disorders**

Bruce J. Gantz, MD
Head, Department of Otolaryngology - Head and Neck Surgery
Brian F. McCabe Distinguished Chair in Otolaryngology - Head and Neck Surgery
Professor of Otolaryngology & Neurosurgery
University of Iowa

9:45 BREAK WITH EXHIBITORS

10:15 INTRODUCTION - FACIAL NERVE, VESTIBULAR SCHWANOMMA INVESTIGATIONS

Ana H. Kim, MD

10:17 Transgenic Mouse Model for Facial Nerve Synkinesis

Mostafa Ahmed, MD

Alex Deich, BS

Grace Balfour, BS

Ark Lorin, MD

Greg Kelts, MD

Richard Williams, DMD, PhD

10:24 Post Traumatic Complete Facial Palsy: Comparative Analysis of Outcomes of Conservative Management vs Surgical Exploration: A University Hospital Study and Review of Literature

Diptarka Bhattacharyya, MD

Pravin Rajgadkar, MD

10:31 Association between Metformin Usage and Tumor Growth Rate in Vestibular Schwannoma Patients

Austin Y. Feng, MD

Ali Kouhi, MD

Alejandro Enriquez-Marulanda, MD

Justin M. Moore, MD, PhD

Yona Vaisbuch, MD

10:38 Delayed Tumor Growth in Vestibular Schwannoma: An Argument for Lifelong Surveillance

Robert J. Macielak, MD

Neil S. Patel, MD

Katherine A. Lees, MD

Nicole M. Tombers, RN, CCRP

John P. Marinelli, BS

Matthew L. Carlson, MD

10:45 Rate of Initial Hearing Loss Predicts Risk of Non-Serviceable Hearing among Observed Sporadic Vestibular Schwannoma

Matthew L. Carlson MD

Eric M. Dowling, MD

Christine M. Lohse, MS

Brendan P. O'Connell, MD

Katherine A. Lees MD

David S. Haynes, MD

Jacob B. Hunter, MD

10:52 Factors Associated with Cranial Neuropathy following Gamma Knife for Vestibular Schwannoma

David K. Lerner, MD

Daniel Y. Lee, BA

James G. Naples, MD

Jason A. Brant, MD

Douglas C. Bigelow, MD

Michelle Alonso-Basanta, MD, PhD

Michael J. Ruckenstein, MD

10:59 DISCUSSION/INTRODUCTION

11:05 PANEL

Disorders of Intracranial Pressure

David S. Haynes, MD, Moderator

Paul A. Gardner, MD

Matthew L. Carlson, MD

Howard W. Francis, MD

Ester X. Vivas, MD

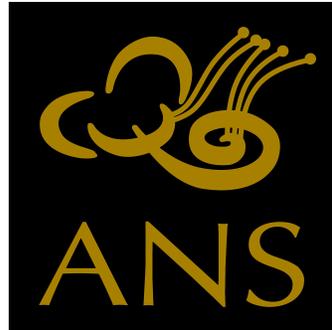
12:00 INTRODUCTION OF INCOMING PRESIDENT

Nikolas H. Blevins, MD

12:05 CLOSING REMARKS/ADJOURNMENT

SELECTED ABSTRACTS
in order of presentation

**ORAL
PRESENTATIONS**



54th Annual Spring Meeting

AMERICAN NEUROTOLOGY SOCIETY

***May 3-4, 2019
JW Marriott Austin
Austin, TX***

Five Years of Electric-Acoustic Stimulation (EAS) Listening Experience: Hearing Preservation and Benefits of Acoustic Representation of the Fundamental Frequency

*Elizabeth Perkins, MD; Margaret Dillon, AuD
Kevin Brown, MD, PhD*

Objectives: To compare long term speech recognition performance of cochlear implant (CI) recipients with and without hearing preservation. To determine the influence of acoustic representation of 125 Hz on speech recognition with electric-acoustic stimulation (EAS).

Study Design: Prospective clinical trial

Setting: Tertiary referral center

Patients: Twenty-six subjects with preoperative bilateral, normal to moderate low-frequency hearing sloping to severe-to-profound high-frequency hearing loss and an aided CNC word score in the ear to be implanted of less than or equal to 60% correct.

Interventions: Subjects underwent cochlear implantation with a short electrode array (FlexEAS) and grouped into either preserved low-frequency hearing fit with EAS (<80 dB HL at 125 Hz; EAS group) and those with unaidable low-frequency hearing (CI-alone group).

Main outcome measures: Pre- and post-operative CNC words in quiet, and AzBio sentences in a 10-talker babble (10 dB SNR).

Results: At 5 years, the speech recognition of the CI-alone group (n=9) continued to exceed preoperative abilities (t(8)=-5.83, p<0.001). The EAS group (n=17) demonstrated significantly better performance on CNC words (t(13.2)=3.53, p=0.004) and AzBio sentences (t(16.9)=2.60, p=0.02) compared to the CI-alone group. The EAS group was stratified by frequencies of aidable residual hearing [125 Hz only (n=5), 125 & 250 Hz only (n=8), and >250 Hz (n=4)]. Each subgroup had significant improvement in speech recognition scores, including those with aidable hearing at only 125 Hz.

Conclusion: Even when residual hearing was lost, subjects experienced a significant improvement in speech recognition. The acoustic representation of 125 Hz provides benefit for EAS users due to better resolution of the fundamental frequency.

Define Professional Practice Gap & Educational Need: 1. Long-term, prospective data on speech perception outcomes of hearing preservation failures following cochlear implantation with the MED-EL FlexEAS (Flex 24) has yet to be reported
2. Of those patients that failed hearing preservation, the value of hearing at the fundamental frequency of 125 Hz has yet to be determined

Learning Objective: 1. To compare long term speech recognition performance of cochlear implant recipients with and without hearing preservation. 2. To determine the influence of acoustic representation of 125 Hz on speech recognition with electric-acoustic stimulation

Desired Result: Attendees will have a better understanding of the importance of hearing at 125 Hz in electroacoustic stimulation. In addition, attendees will gain knowledge of long-term outcomes of CI recipients with and without hearing preservation with the MED-EL FlexEAS electrode.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

General Health Quality of Life Instruments Underestimate the Impact of Bilateral Cochlear Implantation

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Prashant N. Bhenswala, MD; Shaun A. Nguyen, MD
Judy R. Dubno, PhD*

Objective: Determine the extent to which bilateral cochlear implantation increases patient-reported benefit as compared to unilateral implantation and no implantation.

Data Sources: PubMed, Scopus, CINAHL, and Cochrane databases searches were performed using the keywords ("Cochlear Implant" or "Cochlear Implantation") and ("bilateral").

Study Selection: Studies assessing hearing/CI-specific (CI) and general-health-related (HR) quality of life (QOL) in adult patients after bilateral cochlear implantation were included.

Data Extraction: Of the 31 articles meeting criteria, usable QOL data were available for 16 articles (n=355 bilateral CI recipients).

Data Synthesis: Standardized mean difference (Δ) for each measure and weighted effects were determined. Meta-analysis was performed for all QOL measures and also independently for hearing/CI-specific QOL and HRQOL.

Conclusion: When measured using hearing/CI-specific QOL instruments, patients reported very large improvements in QOL comparing before cochlear implantation to bilateral CI ($\Delta=2.07$ [1.76 to 2.38]) and medium improvements comparing unilateral CI to bilateral CI ($\Delta=0.51$ [0.32 to 0.71]). Utilization of parallel vs. crossover study design did not impact QOL outcomes ($\chi^2=0.512$, $p=0.47$). No detectable improvements were observed in either CI transition when using HRQOL instruments (no CI to bilateral CI: $\Delta=0.40$ [-0.02 to 0.81]; unilateral CI to bilateral CI: $\Delta=0.22$ [-0.02 to 0.46]). The universal nature of HRQOL instruments may render them insensitive to the medium to large QOL improvements reported by patients using hearing/CI-specific QOL instruments. Given that HRQOL instruments are used to determine the economic benefit of health interventions, these measurement differences suggest that the health economic value of bilateral cochlear implantation has been underestimated.

Define Professional Practice Gap & Educational Need: 1. Lack of knowledge regarding the quality of life improvement after bilateral cochlear implantation as reported through patient reported outcome measures, which are evaluated by the FDA and CMS. 2. inconsistencies between outcomes after bilateral cochlear implantation as measured using hearing/cochlear-specific quality of life instruments and general health quality of life instruments. 3. Lack of awareness of the above differences can impact the health economic evaluation of bilateral cochlear implantation.

Learning Objective: 1. Attendees will understand the quality of life improvement after bilateral cochlear implantation reported using hearing/cochlear implant-specific instruments. 2. Attendees will understand the measurement differences after bilateral cochlear implantation between hearing/cochlear implant-specific and general health-related quality of life instruments. 3. Attendees will understand how the lack of general health quality of life improvement undervalues the health economic benefit of bilateral cochlear implantation

Desired Result: 1. Attendees will be able to discuss the hearing-and cochlear implant-specific quality of life improvements from no cochlear implants to bilateral cochlear implants. 2. Attendees will be able to discuss the hearing-and cochlear implant-specific quality of life improvements from unilateral cochlear implantation to bilateral cochlear implantation.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Exempt

Slim Perimodiolar Arrays are as Effective as Slim Lateral Wall Arrays for Functional Hearing Preservation after Cochlear Implantation

*Erika Woodson, MD; Rebecca Nelson, MD
Thomas Haberkamp, MD; Sarah Sydlowski, AuD, PhD*

Objective: To compare functional hearing preservation (HP) with a slim perimodiolar array (SPA) and a slim lateral wall array (SLW) in cochlear implantation (CI)

Study design: Retrospective chart review

Setting: Tertiary referral center

Patients: All adult, post-lingual CI recipients with serviceable preoperative hearing serially implanted with SPA or SLW electrodes from July 2015 to August 2018.

Intervention(s): Cochlear implantation

Main outcome measure(s):

Hearing preservation (HP). Patients with a low frequency pure tone average (LFPTA) (125, 250, 500 Hz) threshold < 80dB were considered HP candidates based on preoperative audiograms. Postoperative audiograms were obtained before activation. Successful HP was defined as retention of LFPTA <80 dB. The change in LFPTA (deltaLFPTA) was also calculated.

Results: 123 patients were implanted with either the SPA or SLW electrodes, 81 (40,42) of whom were HP candidates with postoperative audiograms. Average preoperative LFPTA was 53.5 dB and 52.4 dB for SPA and SLW respectively, with a mean deltaLFPTA of 24.1 and 24.6 dB. Successful HP was achieved in 22 (55%) and 22 (52%). Preoperative LFPTA, deltaLFPTA, and postoperative LFPTA were not significantly different ($p=0.39, 0.47, 0.28$) between electrodes.

Conclusions: The SPA is as effective at immediate functional HP after CI as a SLW.

Define Professional Practice Gap & Educational Need: 1. Lack of contemporary knowledge of the perimodiolar electrode as a design which supports hearing preservation.

Learning Objective: 1. Attendees will recognize that perimodiolar electrode arrays can achieve similar clinical results as lateral wall arrays for functional hearing preservation.

Desired Result: Attendees will recognize that hearing preservation is achievable with a perimodiolar array and will integrate this knowledge into their surgical decision-making.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

Predicting Changes in Tinnitus after Unilateral Cochlear Implantation in Adults

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Objective: Identify characteristics associated with odds of improved tinnitus after cochlear implantation

Study design: Retrospective cohort

Setting: Academic center

Patients: Adult unilateral cochlear implant (CI) recipients implanted between 1996 and 2017 with pre-implant tinnitus

Interventions: Candidate predictors included 25 pre-operatively measured characteristics

Main outcome measure: Clinically significant improvement in Tinnitus Handicap Inventory (THI) or tinnitus resolution at 1-year post-activation

Results: Of the 345 patients with tinnitus, 228 (66.1%) had improved or resolved at 1-year post-activation. Identified independent predictors were baseline hearing in noise test in quiet condition (HINTq), hearing handicap inventory (HHI), THI, and device manufacturer. Confidence that each variable is truly an independent predictor in our population was high. Each of the 4 identified predictors was selected in more than 57% of 1,000 bootstrap replicates of the dataset. Each 10% increase in HINTq was independently associated with 15% reduction in odds of improved or resolved tinnitus (OR 0.85). Each 10-point increase in THI and HHI was associated with 1.2 and 1.3 times higher odds of the composite outcome respectively. Relative to Advanced Bionics (AB), those implanted with Cochlear devices had 76% lower odds of improved or resolved tinnitus (OR 0.24) and Med-El devices had 30% lower odds of improved or resolved tinnitus (OR 0.70).

Conclusion: Patients with worse pre-implant sentence recognition and higher handicap from hearing impairment and tinnitus have higher odds of improved tinnitus after CI. Advanced bionics CI systems may be independently associated with higher odds of improved tinnitus compared with Cochlear and Med-El devices. Potential explanations for this finding are discussed.

Define Professional Practice Gap & Educational Need: Lack of understanding of factors that influence tinnitus-related quality of life after unilateral cochlear implantation in adults

Learning Objective: Identify patients who are more likely to have improved or resolved tinnitus after cochlear implantation

Desired Result: Improve ability to predict changes in tinnitus after cochlear implantation for the purposes of counselling patients, particularly in situations where a cochlear implant is being considered as a treatment for debilitating tinnitus.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

Cognitive Functions in Adults Receiving Cochlear Implants: Predictors of Speech Recognition Outcomes and Changes after Implantation

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Christin Ray, PhD, CCC-SLP*

Hypothesis: Significant variability in speech recognition persists among adults who receive cochlear implants (CIs). Two hypotheses were tested: (1) pre-operative cognitive skills assessed visually would predict post-operative speech recognition at 6 months after CI; and (2) cochlear implantation would result in benefits to cognitive processes at 6 months.

Background: Neurocognitive functions, such as working memory, processing speed, inhibition-concentration, and nonverbal reasoning, have been identified as contributors to speech recognition in adults with hearing loss, and particularly in CI users. There is also mounting evidence that cochlear implantation can lead to improvements in cognitive functioning. This study examined whether pre-operative cognitive functions would predict speech recognition after cochlear implantation, and whether cognitive skills would improve as a result of implantation.

Methods: Twenty postlingually deafened adult CI candidates were tested pre-operatively using a visual battery of tests to assess working memory, processing speed, inhibition-concentration, and nonverbal reasoning. Six months after implantation, participants were assessed for recognition of isolated words and words in sentences in quiet, and cognitive tests were repeated.

Results: Word and sentence recognition at 6 months of CI use were predicted by pre-operative working memory capacity ($\beta = .38$ to $.64$), and less so by nonverbal reasoning ($\beta = .18$ to $.31$). Improvements in processing speed and a measure of working memory were demonstrated from pre- to post-CI.

Conclusions: Findings provide evidence that pre-operative cognitive factors contribute to speech recognition outcomes for adult CI users, and support the premise that implantation may lead to improvements in some cognitive functions.

Define Professional Practice Gap & Educational Need: 1. Lack of contemporary knowledge regarding effective pre-operative predictors of post-operative cochlear implant patient performance. 2. Inconsistencies in the literature regarding the effects of cochlear implantation on cognitive functions.

Learning Objective: 1. To understand potential pre-operative cognitive predictors of outcome performance for adult cochlear implant users 2. To become aware of possible cognitive effects of cochlear implantation in adults.

Desired Result: Attendees will be better able to counsel their patients regarding pre-operative contributions to post-operative performance, as well as the potential benefits to cognition of receiving and using a cochlear implant.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

Preclinical Evaluation of Compounds Targeting Schwannoma in an NF2 Mouse Model.

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D. Wade Clapp, MD*

Objective/Hypothesis: A genetically modified mouse model of NF2 may be an *in vivo* system for testing therapeutics that may have an effect on NF2 related vestibular schwannoma (VS). 100% of the postn-Cre NF2 (flox/flox) mice develop schwannoma in the dorsal root ganglia (DRG) and intracranially. Mice also progressively develop hearing loss as determined by auditory brainstem response testing (ABR). Multiple chemotherapeutic agents that showed previous *in vivo* or *in vitro* positive data were assessed. The objective of the current study is to validate a preclinical chemotherapy for reduction in size of VS.

Study Design: *In vivo* mouse study.

Methods: Fourteen mice were treated for a 3-month period with agent and compared to a control group that was gavage fed the vector alone. ABR testing was performed throughout the study period at monthly intervals. Mice were examined via necropsy section and DRG were assessed for tumor size and compared.

Results: Tumor size, as determined by volume of DRG schwannoma, was reduced by Brigatinib, Dasatinib, and AR42 compared to controls. GSK2126458, Panobinostat, and CuDC-907 showed no difference. The behavior of the mice was similar to the control. ABR testing showed a statistically significant trend toward less decline in hearing for the treated mice with Brigatinib, Dasatinib, and AR42.

Conclusions: Brigatinib, Dasatinib, and AR42 suppresses growth of DRG schwannoma in a novel genetically engineered mouse model of NF2. This is further data that supports use of these compounds in human trial.

Define Professional Practice Gap & Educational Need: Preclinical testing for chemotherapies for NF2 related disease has a lack of awareness in the Neurotology community of the research direction of treatments in preclinical models.

Learning Objective: To illustrate progress of testing preclinical chemotherapies for NF2 in preclinical NF2 mouse model.

Desired Result: To expand knowledge of chemotherapies for future clinical trials and application of that knowledge.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

Vestibular Schwannoma Tumor Size is Correlated with Acute Vestibular Symptoms after Gamma Knife Therapy

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Objective: To assess how vestibular schwannomas tumor characteristics correlate with vestibular symptoms after Gamma Knife (GK) surgery.

Study Design: A retrospective chart review of patients undergoing gamma knife treatment for vestibular schwannoma at this institution from 2005 to 2018 was performed.

Setting: Tertiary referral center

Patients: All patients receiving GK surgery for vestibular schwannomas were evaluated. Patients with neurofibromatosis 2 or prior surgery were excluded.

Main outcome measures: Clinical records were assessed for tumor dimensions, cochlear radiation dose, development of post-treatment vestibular symptoms, and necessity of vestibular rehabilitation.

Results: Out of 134 patients, all patients received a radiation dose between 12 and 13 Gy. The average age was 60 years, with 51.9% of patients male and 48.1% female. Nineteen (14.2%) patients developed new and 25 (18.7%) patients developed worsening vestibular symptoms (vertigo, dizziness, and imbalance) within 6 months after GK. Out of 13 patients undergoing vestibular rehabilitation, 10 reported an improvement. Pre-treatment tumors were significantly smaller for patients who developed new or worsening acute vestibular symptoms (mean 1.51 cm vs 1.74 cm, $p = 0.0357$), with 24.5% of patients with tumors smaller than 1.6 cm offered vestibular rehabilitation at 6 months compared to just 9.1% of those with tumors greater than 1.6 cm ($p = 0.0248$, OR=3.25, 95% CI (1.23,8.58)).

Conclusions: Vestibular schwannomas smaller than 1.6 cm were significantly associated with higher rates of post-GK vestibular symptoms requiring rehabilitation. Tumor size may be used to counsel patients on the likelihood of post-GK vestibular symptoms and vestibular rehabilitation.

Define Professional Practice Gap & Educational Need: It is difficult to predict the likelihood of developing post-gamma knife vestibular symptoms for vestibular schwannoma patients. There are currently few effective prognostic markers for predicting vestibular symptoms after gamma knife radiation. Vestibular symptoms have a significant impact on quality of life, and we felt there was a gap in understanding the pre-treatment tumor characteristics that contribute to potential post-treatment vestibular symptoms. Our work identifies tumor size as a potential prognostic indicator of post-treatment vestibular symptoms, which will help physicians better counsel patients on expectations with gamma knife therapy for vestibular schwannoma.

Learning Objective: To understand the influence of pre-gamma knife tumor size on the likelihood of developing post-gamma knife acute vestibular symptoms. -To identify the increased risk of developing acute vestibular symptoms requiring vestibular rehabilitation for patients with smaller tumors.

Desired Result: We hope that physicians will consider the pre-treatment size of vestibular schwannomas when counseling patients on the likelihood of post-gamma knife vestibular symptoms.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

NEUROTOLOGY FELLOW AWARD

What Genes Can Tell: A Closer Look at Vestibular Schwannoma

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Sharon Chang, BS; Eric Kwok, BS; Nathan Tu, MD, MPH
Kyle Hurth, MD, PhD; Rick A. Friedman, MD, PhD*

Objective: Comprehensive molecular profiling of radioresistant and cystic vestibular schwannoma (VS) subtypes.

Study Design: Our study utilized somatic whole-exome sequencing (WES), RNA-sequencing, and correlated clinical data from 14 selected fresh frozen tumor samples with matched blood.

Setting: Hospital setting research facility.

Patients: Patients that were diagnosed with VS and necessitated surgery for treatment. Inclusion: Cystic, radioresistant and malignant transformation tumors matched to age and tumor volume, with solid naïve VS samples as control; Exclusion: NF-2 patients.

Intervention(s): WES was based on the custom probes for more informative copy number analysis, and probes that tile across known regions of known cancer translocations. The DNA, derived from the blood, was utilized as the internal control to reduce false-positive calling. For WES data, we achieved a mean coverage of 124X for VS and for RNA-seq, we generated an average of 80 million read pairs.

Main Outcome Measure(s): Analysis of genetic landscape of various VS subtypes by performing deep next-generation sequencing.

Results: The mutation rate of cystic, radioresistant and malignant transformation samples had drastically higher number of non-silent mutations vs the naïve ($p=0.0014$). In addition to already published data, such as frequency of 22q loss, somatic mutational analysis unraveled significantly mutated genes such as FOXD4, IGFN1, FNM2, NOTCH4 and ALK.

Conclusions: High quality, high-resolution WES allowed us to identify potential differences in the genomic and molecular landscape of cystic and radioresistant VS. Our results can help advance the understanding of the pathophysiology of these tumor subtypes and pinpoint the molecular targets for alternative treatment strategies.

Define Professional Practice Gap & Educational Need: Approximately 10% of vestibular schwannomas (VS) display either cystic and radioresistant features. These VS tumor subtypes are a different clinical entity as they are usually characterized by unpredictable biologic behavior with frequent involvement of cranial nerves and a relatively rapid rate of growth. There is a lack of knowledge in the precise etiology of these VS subtypes, even though various mechanisms have been proposed.

Learning Objective: Using high-quality, high-resolution whole-exome sequencing to evaluate molecular profiling of radioresistant and cystic VS.

Desired Result: Results from our study can help advance our understanding of the pathophysiology of these VS tumor subtypes and pinpoint the molecular targets in alternative treatments.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

Effects of Single-Fraction Radiation on Merlin-Deficient and Normal Schwann Cells in Vitro

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Christine T. Dinh, MD*

Background: Vestibular schwannomas are benign tumors of the cochleovestibular nerve that develop from *NF2* mutations leading to merlin dysfunction and/or loss. Although tumor control rates with stereotactic radiosurgery are >85% at 10 years, hearing preservation rates approach 25%. The first steps toward optimizing radiation protocols are determining the molecular and cellular effects of radiation on wild type (WT-SC) and merlin-deficient Schwann cells (MD-SC).

Hypothesis: WT-SCs are more resistant to specific dosages of single fraction (SF) radiation than MD-SCs through differential expression of apoptosis, DNA damage and repair.

Methods: Human and murine WT-SCs and MD-SCs were seeded on 96-well plates and 16-well culture slides and treated with SF-radiation (0-18 Gy). Cell-based assays were performed to assess viability, cytotoxicity, and apoptosis. Immunohistochemistry was performed to determine expression of DNA breaks and activation of DNA repair mechanisms. Statistical analysis was performed with Mann-Whitney U and Kruskal-Wallis tests.

Results: SF-radiation initiated double-strand DNA breaks in all cell-lines; however, there was differential activation of DNA repair mechanisms, cleaved caspase-3/7 expression, and loss of membrane integrity. Rat WT-SCs demonstrated remarkable resistance to SF radiation. In contrast, human WT-SCs demonstrated dose-dependent reductions in viabilities. Viabilities, however, were significantly better than human and mouse MD-SCs at several radiation dosages.

Conclusion: MD-SCs are more susceptible to SF-radiation-induced loss than WT-SCs. WT-SCs may activate multiple DNA repair mechanisms to evade radiation injury at specific radiation dosages. Further investigations into the radiobiology of vestibular schwannoma and normal nerve are critical in understanding and improving clinical outcomes in the future.

Define Professional Practice Gap & Educational Need: 1. The most optimal stereotactic radiosurgery protocol to maximize tumor control and hearing preservation rates in sporadic vestibular schwannoma is controversial. 2. There is a need to understand how radiation affects vestibular schwannoma and adjacent normal nerve on molecular and cellular levels to identify better radiation strategies to maximize tumor control and hearing preservation rates.

Learning Objective: Addressing both 1 and 2 above, we aim to understand the differences in radiobiological response of normal and pathological merlin-deficient Schwann cells that can potentially affect clinical outcomes when treating vestibular schwannoma.

Desired Result: - Gain in physician knowledge that radiation causes cellular injury by initiating double-strand DNA breaks at specific radiation dosages. - Gain in physician knowledge that evasion of radiation injury can occur through activation of DNA repair mechanisms. - Gain in physician knowledge of how understanding the radiobiology of vestibular schwannoma and adjacent nerve constituents can aid in identifying radiation protocols that can improve clinical outcomes.

Level of Evidence - Does not apply-you will be asked to explain - in vitro study

Indicate IRB or IACUC Approval: Exempt

The Role of The Spiral Ligament in Sensorineural Hearing Loss in Humans: A Temporal Bone Study

Karen B. Teufert, MD; Fred H. Linthicum Jr., MD

Hypothesis: Spiral ligament fibrocyte pathology may be the primary cause of sensorineural hearing loss (SNHL).

Background: Animal studies show that cell loss in the spiral ligament precedes loss of hair cells and/or neurons, suggesting fibrocyte pathology as the primary cause of sensory cell degeneration. However, involvement of other structures confounds the role of spiral ligament.

Methods: Sixty-nine temporal bones from patients with varying degrees of SNHL or normal hearing, having normal cochlear sensorineural structures, were studied using quantitative evaluation of spiral ligament fibrocytes under light microscopy. Double staining with hematoxylin was used to quantify fibrocytes of each type. Fibrocyte quantity was compared between SNHL and normal hearing, and correlation coefficients were computed between PTA and fibrocyte counts. Expression of ion transport mediating enzymes Na,K-ATPase, CAII, CK, and connexin 26 was assessed by immunohistochemistry to evaluate fibrocyte function.

Results: All correlations between PTA and spiral ligament were negative; the fewer the fibrocytes, the poorer the hearing (higher PTA). Five of 25 comparisons achieved significance, primarily in middle cochlear turn segments. Significant correlation coefficients (all $p < .05$) were small to moderate (-.347 to -.428), increasing when including only subjects tested within two years of death (-.472 to -.558). Preliminary results using CAII antibody and double hematoxylin staining suggest functionality of fibrocytes may be a more important factor.

Conclusions: Fibrocyte quantity may be a contributing factor to hearing loss severity in humans, but explains only a portion of variability in SNHL. Fibrocyte functionality may be a more critical factor, but further study is required.

Define Professional Practice Gap & Educational Need: Lack of contemporary knowledge.

Learning Objective: Papers reporting data on animals have suggested that cell loss in the spiral ligament precedes the loss of hair cells and/or neurons in both space and time suggesting that fibrocyte pathology may be the primary cause of the hearing loss and ultimate sensory cell degeneration in animals, but this has not been shown in humans. Previous studies by our institution have suggested that the spiral ligament may play a role in sensorineural hearing loss (SNHL) but the involvement of other structures (stria vascularis, hair cells, dendrites, spiral ganglion cells, endolymphatic sac) in those cases makes it difficult to assess whether the hearing loss was caused by degeneration of those structures or if the spiral ligament pathology was the primary cause of hearing loss, as proposed by others. Therefore, the learning objective of the present study is to determine whether spiral ligament fibrocyte pathology may be a primary cause of SNHL in humans. Temporal bones from patients with varying degrees of SNHL will be selected after exclusion of other possible causes of SNHL, such as hair cell degeneration, loss of dendrites, or decreased spiral ganglion counts. Temporal bones of patients with normal hearing and normal inner ear structures will be used for comparison.

Desired Result: The study will help attendees understand the concept that spiral ligament fibrocyte pathology may be the primary cause of sensorineural hearing loss (SNHL) and that fibrocyte quantity may be a contributing factor to hearing loss severity in humans, but explains only a portion of variability in SNHL. Fibrocyte functionality may be a more critical factor, but further study is required.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Exempt

Anatomical and Functional Consequences of Microneedle Perforation of Round Window Membrane

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Hypothesis: Microneedles can create microperforations in the round window membrane (RWM) without causing anatomic or physiologic damage.

Background: A means for reliable delivery of agents into the inner ear for therapeutic purposes remains a formidable challenge. A novel approach harnesses microneedles to facilitate intracochlear access via the RWM for both diagnostic and therapeutic purposes. In this study, we investigate the anatomical and functional consequences of microneedle perforations on guinea pig RWMs in vivo.

Methods: Single 3D-printed, 100 μm diameter microneedles were used to perforate the guinea pig RWM via the postauricular sulcus (n=18). Hearing was assessed both before and after microneedle perforation using compound action potential (CAP) and distortion product otoacoustic emissions (DPOAE). Confocal microscopy was used ex vivo to examine RWM to measure the size, shape, and location of the resulting microscopic perforations and document healing at one week.

Results: The microneedles created precise perforations measuring $99.7\pm 31.7 \times 36.3\pm 19.7 \mu\text{m}$ without tearing the membrane. Compared to pre-perforation CAP and DPOAE measurements, some guinea pigs experienced temporary threshold shift immediately following RWM perforation but all guinea pigs recovered and showed no lasting hearing loss at 1 week post-perforation. At 1 week, all perforations were observed to heal.

Conclusion: Microneedles can be used to create temporary microperforation in the RWM that heal without causing anatomic or physiologic dysfunction. Microneedles have the potential to mediate safe and effective means of intracochlear delivery for inner ear therapeutics.

Define Professional Practice Gap & Educational Need: Drug delivery to the inner ear remains a challenge for the field. Microneedle perforations via the round window membrane have been proposed as a solution for gaining access to the cochlea. As such, there is a need for understanding how this procedure may affect hearing and cochlear structures.

Learning Objective: Participants will learn about microneedle perforation of the round window membrane and will gain a better understanding of the consequences of applying microperforations to round window membrane.

Desired Result: Participants may consider a new method for access to the cochlea for both diagnostic and therapeutic purposes.

Level of Evidence - Does not apply-you will be asked to explain - Basic science in vivo research

Indicate IRB or IACUC Approval: Approved

ANS TRAINEE AWARD

Neurotrophin Signaling in Various Degrees of Hearing Loss using MicroRNA Perilymph Profiling

*Matthew Shew, MD; Helena Wichova, MD; Jacob New, PhD
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Hinrich Staecker, MD, PhD*

Hypothesis: Perilymph microRNA (miRNA) profiling of the human inner ear can help predict neuronal status in the inner ear through neurotrophic factor signaling in cochlear implant (CI) candidates.

Background: Hearing loss (HL) is the most common neurodegenerative disease and we currently have no inner ear biopsy equivalent. In previous work we have shown that miRNA profiling in inner ear perilymph is feasible and may offer significant insight into what is occurring on a molecular level in humans with active inner ear disease.

Methods: We analyzed the human inner ear transcriptome and compared it perilymph microRNA expression profile in 18 CI candidates. Using bioinformatic programs, the expressed miRNAs were evaluated specifically on their ability to impact neurotrophic factor signaling.

Results: A total of 9 patients underwent hearing preservation (PTA<80dB) and 9 non-hearing preservation CI (PTA >80dB). A variety of neurotrophic factor signaling cascades were identified in active human inner ear disease. In those patients with residual hearing at time of CI placement, miRNAs related to BDNF and NT-3 signaling were differentially expressed within the scala tympani perilymph compared to individuals without residual hearing. These included miR-1207-5p, miR-103-3p, miR-100-5p, miR-221-3p, miR-200-3p.

Conclusions: Patients with residual hearing had differential expression of miRNA related to neurotrophic factor signaling, which has been strongly implicated in spiral ganglion health and can potentially be assayed through perilymph sampling. miRNA may serve as a biomarker in the perilymph to predict neuronal status of the inner ear which may serve as a therapeutic and prognostic marker for patients undergoing CI.

Define Professional Practice Gap & Educational Need: 1. Large gap in knowledge in what is occurring on a molecular level in patients with active inner ear disease, specifically various degrees of hearing loss. 2. Lack of understanding what is occurring on a cellular level in patients with and without residual hearing undergoing cochlear implantation 3. Inconsistency in ability to biopsy the inner ear in patients with active inner ear disease.

Learning Objective: To evaluate microRNA (miRNA) perilymph profiling in patients with various degrees of hearing loss while undergoing cochlear implantation. By analyzing miRNA perilymph profile we can gain significant insight to what may be occurring on a molecular level and help predict neuronal status in the inner ear through neurotrophic factor signaling in cochlear implant (CI) candidates.

Desired Result: By understanding the differential expression of miRNA related to neurotrophic factor signaling we can gain significant insight into spiral ganglion health. miRNA profiling in patients with hearing loss may serve as a biomarker in the perilymph to help predict neural status within the inner ear and serve as a promising therapeutic and prognostic marker for patients undergoing CI placement.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

NEUROTOLOGY FELLOW AWARD

Intratympanic Diltiazem-Chitosan Hydrogel as a Novel Otoprotectant Against Cisplatin-Induced Ototoxicity in a Mouse Model

*James G. Naples, MD; Michael J. Ruckenstein, MD
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Hypothesis: Intratympanic (IT) administration of the calcium-channel blocker (CCB), diltiazem, via chitosan-glycerophosphate (CGP) hydrogel vehicle will protect against cisplatin-ototoxicity.

Background: Cisplatin induces calcium-mediated apoptosis of cochlear outer hair cells (OHCs). Previous work demonstrated that IT diltiazem in solution provides otoprotection by reducing auditory brainstem response (ABR) threshold shifts in the setting of cisplatin-ototoxicity. We evaluate the role of a novel otoprotectant, IT CGP-diltiazem, against cisplatin-ototoxicity and analyze its effect on ABR and cochlear morphology.

Methods: Baseline pure-tone and click-evoked ABRs were performed in CBA/J mice. A control group (IT CGP-Saline, n=8) and treatment group (IT CGP-Diltiazem 2mg/kg, n=10) underwent baseline ABRs. A single dose of IT-CGP hydrogel was administered just prior to intraperitoneal cisplatin (14mg/kg). On Day 7, post-treatment ABRs were performed and cochleae were harvested. Specimens were dissected and hair cells were quantified using anti-myosin VIIa immunostaining.

Results: The mean threshold shifts on Day 7 was significantly reduced at all frequencies in both click- and tone-evoked ABRs in CGP-diltiazem-treated mice compared to control mice. The greatest reduction was at 24 and 32 kHz, where CGP-saline mice had a shift of 30.6 (± 7.72) and 37.5 (± 7.01)dB, respectively, compared to CGP-diltiazem mice with a shift of 7.22 (± 2.12) and 6.67 (± 2.58)dB ($p=0.0059$ and 0.0055). In the CGP-diltiazem group, preserved basal OHCs showed a significant correlation with reduced threshold shifts at 24kHz ($p=0.032$) and 32kHz ($p=0.009$).

Conclusions: This preliminary work suggests that IT CGP-diltiazem may offer otoprotection that reduces ABR threshold shifts and preserves OHC in the basal cochlea against cisplatin-induced ototoxicity.

Define Professional Practice Gap & Educational Need: Cisplatin-induced ototoxicity represents a type of acquired, permanent sensorineural hearing loss for which there is no available treatment. While there is a preponderance of research exploring potential therapies, few have translated into the clinical setting. This work aims to bridge that practice gap by providing a potentially new alternative through intratympanic diltiazem. The attempt to repurpose diltiazem offers a concept that may allow translation of this potential therapy into the clinical setting.

Learning Objective: The learning objective is that the audience understands the hypothesis and concept that underlies why the calcium-channel blocker, diltiazem, was chosen for its otoprotective potential. At the end of the presentation, the audience will understand that diltiazem has consistently reduced ABR threshold shifts in animal models, and may preserve inner ear structures. The audience should also recognize the foundational work that shows significant promise for potential translation of this idea, and how this idea can be applied to their practice in the future.

Desired Result: The desired result is that the audience learns of the potential for calcium-channel blockers and diltiazem as otoprotectants. This work can be applied as a foundation for future clinical and basic science work to explore other concepts of how to apply this class of drugs, which may have applications beyond ototoxicity for other destructive inner ear disorders.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

Neuroprotection of NIR Light in an Animal Model of Cochlear Implantation

Arne Ernst, MD, PhD; Dietmar Basta, PhD

Abstract as submitted: It is the aim of the present animal study to investigate the influence of a near-infrared light (NIR) pre-treatment on outer hair cell loss (OHC) in cochlear implantation. NIR is known to be neuroprotective in acting on the respiratory chain, i.e. cytochrome-c-oxidase, thus, reducing apoptosis, inflammation and other mechanisms of acute neurotrauma. This leads in turn to a preservation of neuronal structure and function which was shown for different models (e.g. stroke, retinal surgery)

16 guinea pigs were bilaterally implanted with a cochlear implant electrode (insertion speed 200 μm , electrode diameter 0.32 mm, insertion depth 7mm). One side was pre-treated with NIR (15 min, 808 nm, 130 mW), the other not so that it served as control.

After 3months of continuous acoustic stimulation, the animals were sacrificed and the organ of Corti was dissected and the remaining OHC analysed. With no pre-treatment, there was a complete loss of OHC. The pre-treated side showed a reduction of 26.4 % of OHC loss, i.e. about one quarter of OHC survived the insertion trauma.

In essence, NIR seems to be an alternative mechanism to preserve residual hearing by acting as non-invasive neuroprotectant. This is interesting insofar that only steroids in different application modes have been shown to effectively reduce the sequelae of electrode insertion, thus, preserving residual hearing. Human applications of NIR are underway.

Define Professional Practice Gap & Educational Need: It is the learning objective to outline possible alternative, non-pharmacological approaches to preserve neuronal (cochlear) structures which are not yet known in detail as yet. This might become interesting in the future to preserve residual hearing in cochlear Implantation.

Learning Objective: Discuss NIR as possible treatment modality in patients with residual hearing, produce awareness among the scientific community About this non-invasive Approach.

Desired Result: Attendees should become Aware of other, non-pharmacological approaches to preserve residual Hearing in cochlear implantation.

Level of Evidence - Level I - Large RCTs with clear cut results

Indicate IRB or IACUC Approval: Approved

Evaluating the Industry Relationships of Physicians Presenting at the American Neurotology Society Spring Meetings

*Milap H. Desai, BS; Darshak M. Vekaria, BS
Brian J. McKinnon, MD, MBA, MPH*

Objective: 1.) Evaluate the accuracy of Financial Conflicts of Interest (FCOI) reporting by presenters and organizers at the American Neurotology Society (ANS) Spring meetings between 2014 to 2016 2.) Tabulate the reported monetary value of undisclosed FCOI. 3.) Determine the degree of compliance by presenters and organizers to the standards of the Accreditation Council for Continuing Medical Education.

Data sources: 1) Presenters and organizers along with FCOI reporting from ANS Spring meeting programs. 2.) Financial payments from Centers for Medicare and Medicaid Services Open Payments Database and Dollars for Docs. This is an IRB EXEMPT study.

Study selection: Open Payments and Dollars for Docs were used as the two primary sources to cross-check the disclosures of every presenter, panelist, and moderator listed on the ANS Spring Meeting programs.

Data extraction: The presenters, and organizers and associated financial disclosures were extracted and compared with Open Payments Database and Dollars for Docs.

Data synthesis: Monetary amount of undisclosed payments were calculated as were median amount of undisclosed payments. In 2014, 67% of physician presenters had undisclosed FCOI, with a median value of \$2798.38. In 2015, 49% of physicians has undisclosed FCOI with a median value of \$7637.13. In 2016, 35% of physicians had undisclosed FCOI with a median value of \$4165.14.

Conclusions: A considerable percentage of presenters, organizers at the ANS Spring Meetings had undisclosed FCOI. Presenters consistently had a higher median value of undisclosed FCOI than the organizers. There is a clear upward trend in the amount of physicians fully disclosing their conflicts of interest in both groups.

Define Professional Practice Gap & Educational Need: Inconsistencies in reporting of Financial Conflicts of Interests by presenters and organizers present a significant risk in unrecognized bias or influence in medical educational. The requirement for full disclosure of any relevant FCOI is to identify such relationships and to allow the audience to form its own judgment regarding the presentation. It is considered troubling if those in position to influence educational activity may not be providing full disclosure.

Learning Objective: 1.) Evaluate the accuracy of Financial Conflicts of Interest (FCOI) reporting by presenters and organizers at the American Neurotology Society (ANS) Spring meetings between 2014 to 2016 2.) Tabulate the reported monetary value of undisclosed FCOI. 3.) Determine the degree of compliance by presenters and organizers to the standards of the Accreditation Council for Continuing Medical Education.

Desired Result: Attendees should be able to explain and discuss the significance of disclosed and undisclosed Financial Conflict of Interests of those presenting at and those organizing ANS meetings.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Exempt

Active Bone Conduction Implants Improve Patient Reported Outcomes Measures – A 12-Month Prospective Study

*Matthew G. Crowson, MD; Euna A. Hwang, MD
Julija Adamonis, MSc, Reg, CASLPO
Trung Le, MD, PhD; Vincent Y. Lin, MD
Joseph M. Chen, MD*

Objectives: To evaluate patient reported outcome measures after implantation of an active bone conduction system in adult patients with single-sided deafness (SSD) or conductive-mixed hearing loss (CMHL).

Study Design: Prospective cohort study.

Setting: Tertiary referral center.

Patients: Adults who were implanted with the Bonebridge from 2013-2017.

Outcome Measures: Objective audiometric variables and Health Utilities Index (HUI), Tinnitus Handicap index (THI), Speech Spatial Qualities Questionnaire (SSQ), and Bern Benefit in Single-Sided (BBSS) Deafness Questionnaire were collected at 1-, 6-, and 12-months postoperatively. Comparative quantitative and regression analyses were completed to evaluate variable relationships.

Results: 50 patients with 12-month follow-up were included. 33 (66%) patients were implanted for CMHL, and 17 (34%) for SSD with a mean pre-operative pure-tone average of 79.7 db. Central Institute for the Deaf (CID) auditory test, Speech-reception thresholds (SRT), HUI-hearing subdomain, and SSQ performance were all improved at 1-month with a durable result through 12-months after implantation. There was no significant improvement in BBSS, or THI at any time interval.

Conclusion: Patient reported outcomes measures are critical in determining the utility of health interventions beyond objective performance data. Our study is the largest series published to date examining patient reported outcome measures with the Bonebridge in an adult patient population. We found that the Bonebridge active bone conduction system improved both objective audiologic performance and several patient reported outcomes measures. Future work is needed to develop a sensitive health utility measure for hearing loss so that formal cost-utility analyses may be performed.

Define Professional Practice Gap & Educational Need: 1. Lack of awareness and contemporary research of the patient-reported benefits (or lack thereof) of novel active bone conduction implants.

Learning Objective: 1. To describe the performance in patient-reported outcomes measures in adult patients after implantation of an active bone conduction system. 2. To discuss the 'best' candidates for an active bone conduction system and relay potential areas for future research and intervention in potential disparities in outcomes for different indications for active bone conduction implantation.

Desired Result: It is the authors' hope that attendees will consider the utility and shortfalls of active bone conduction implants in context of patients with either single-sided deafness or conductive-mixed hearing loss.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

Subclinical Age-Related Hearing Loss is Associated with Cognitive Impairment

*Justin S. Golub, MD, MS; Adam M. Brickman, PhD
Adam J. Ciarleglio, PhD; Nicole Schupf, PhD
José A. Luchsinger, MD, MPH*

Objective: Age-related hearing loss (HL), defined by a pure-tone average (PTA) >25 dB, has been associated with cognitive impairment and dementia. The objective is to assess whether hearing thresholds under the established 25 dB cutoff are associated with cognition.

Study Design: Multicentered, cross-sectional epidemiologic study (Hispanic Community Health Study; HCHS, 2008-2011; n=4,347)

Setting Four US communities (Miami, San Diego, Chicago, Bronx)

Main Outcome Measures: Cognitive ability measured by the Digit Symbol Substitution Test, Word Frequency Test, Spanish-English Verbal Learning Test (SEVLT), and Six-Item Screener

Results: Mean age was 57.6 years (SD=5.9, range=50-75). Among those with classically defined normal adult hearing (PTA \leq 25 dB), a 10 dB increase in hearing threshold was associated with a -1.61 (95% CI = -2.18, -1.04) raw score point difference in the Digit Symbol Substitution Test, adjusting for demographics, hearing aid use, and cardiovascular disease. Similarly, a 10 dB increase in hearing threshold was associated with a -0.71 (-1.07, -0.35) point difference on the Word Frequency Test, a -0.67 (-0.95, -0.40) point difference in Spanish English Verbal Test (SEVLT) 3 trials, a -0.40 (-0.55, -0.25) point difference in SEVLT recall, and a -0.08 (-0.12, -0.03) point difference in the Six Item Screener (all models $p < 0.001$).

Conclusions: Increasing hearing thresholds were independently associated with lower cognition among adults with subclinical hearing loss (PTA \leq 25 dB). The current 25 dB threshold for defining adult HL may be too high. Studies investigating whether treating HL can prevent impaired cognition/dementia should consider a lower threshold for defining HL.

Define Professional Practice Gap & Educational Need: The association between subclinical hearing loss and cognition is unknown. It is unclear what hearing threshold should dictate a recommendation to begin amplification.

Learning Objective: Physicians will understand that increasing hearing thresholds were independently associated with lower cognition among adults with hearing better than the current normal/abnormal threshold.

Desired Result: In counseling patients on hearing loss treatment, physicians will consider that subclinical hearing loss was associated with cognitive impairment. Physicians will also recognize the need for more research in this area.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

Impact of Auditory-Motor Musical Training on Melodic Pattern Recognition in Cochlear Implant Users

*Divya A. Chari, MD; Anirrudh Patel, PhD
Karen C. Barrett, PhD; Lauren Jacobs, BS
Patpong Jiradejvong, MS; Charles J. Limb, MD*

Objective: Cochlear implant (CI) users struggle with tasks of pitch-based prosody perception. Pitch pattern recognition is vital for both music comprehension and understanding the prosody of speech, which signals emotion and intent. Research in normal-hearing individuals shows that auditory-motor training, in which participants produce the auditory pattern they are learning, is more effective than passive auditory training. We investigated whether auditory-motor training of CI users improves speech prosody perception and pitch pattern recognition compared to purely auditory training.

Study design: Prospective cohort study.

Setting: Tertiary academic center.

Patients: Fifteen post-lingually deafened adults with CIs.

Intervention(s): Participants were divided into three one-month training groups: auditory-motor (intervention), auditory-only (active control), and no training (control). Auditory-motor training was conducted with the “Contours” software program and auditory-only training was completed with the “AngelSound” software program.

Main outcome measure: Pre- and post-test examinations included tests of speech perception (CNC, HINT sentence recognition), pitch discrimination, speech prosody perception, and melodic contour identification.

Results: Participants in the auditory-motor training group performed better than the auditory-only training group in the melodic contour identification test ($p < 0.05$). The auditory-motor and auditory-only training groups performed better in speech prosody perception and melodic contour identification tasks compared to the no-training group ($p < 0.05$).

Conclusions: These data suggest that short-term auditory-motor music training of CI users impacts pitch pattern recognition and speech prosody perception. No prior studies have examined the impact of instrumental music training on pitch pattern recognition; this study offers approaches for enriching the world of complex sound in the CI user.

Define Professional Practice Gap & Educational Need: 1. Lack of contemporary knowledge about performance of cochlear implant users in tasks of pitch-based prosody perception. 2. Lack of knowledge about the effect of auditory-motor training compared to purely auditory training on cochlear implant user performance. 3. Lack of understanding about the role of pitch pattern recognition in both music comprehension as well as understanding the prosody of speech.

Learning Objective: The learning objective is to investigate whether auditory-motor training of CI users improves speech prosody perception and pitch pattern recognition compared to purely auditory training.

Desired Result: Our data suggest that short-term auditory-motor music training of CI users impacts pitch pattern recognition and speech prosody perception. Our study offers approaches for enriching the world of complex sound in the CI user through auditory-training exercises.

Level of Evidence - Level II - Small RCTs with unclear results

Indicate IRB or IACUC Approval: Approved

The Use of Artificial Intelligence in Cochlear Implant Programming

Susan B. Waltzman, PhD; David C. Kelsall, MD

Objective: Cochlear implant (CI) technology and techniques have advanced over the years. The only component which has not changed is the programming of the implant devices. The purpose of this study is to compare performance in cochlear implant subjects using an expert experienced clinician (EC) standard MAP programming methods versus an Artificial Intelligence (AI) using standard of care and direct connect psychoacoustic test metrics as well as patient satisfaction based algorithm for programming and evaluation without the need for a sound booth.

Study Design: Prospective, non-randomized, multi-center FDA study using within-subject experimental design

Setting: T Private clinics, and tertiary referral centers

Patients: 50 adult patients CI recipients with ≥ 3 months combined experience with a Nucleus 5, 6, Kanso, or 7 series sound processor.

Intervention: Diagnostic and Therapeutic

Main Outcome measures: CNC words and AzBio sentences in noise (+10dB SNR) were performed in a sound booth followed by a direct connect psychoacoustic battery (including audiometry, loudness scaling, phoneme discrimination, and speech perception with varied input levels) using the experienced expert clinician (EC) program MAP (EC). at Visit A. The Tests were repeated approximately one month later at visit B using the optimized AI program MAP. Subjective measures of patient satisfaction were also measured.

Results: Equivalent group mean performance for the EC Expert Clinician program MAP were compared to the AI program MAP for CNC words and AZ Bio sentences in noise (+10dB SNR). in preliminary analysis (Kruskal-Wallis ANOVA $P=0.934$). Group mean results revealed equivalent performance (Kruskal-Wallis ANOVA $P=0.934$) with both programming methods. Some patients had better performance with AI method while none performed more poorly. 73% The majority of subjects were very satisfied/somewhat satisfied with preferred the direct connect AI system compared to the sound booth.

Conclusion: The study demonstrated that the AI outcomes are equivalent or better to those using the traditional programming techniques. This and provides can substantially reduce the number of visits per patient allowing for increased volume, standardization across centers and a standardized approach to aftercare that reduces the need for costly booth set-up and perceived level of expertise needed to provide quality care. This may allow for more hearing health professionals to offer the technology increased access for to reach the many individuals who could benefit.

Define Professional Practice Gap & Educational Need: 1. Lack of efficiency in cochlear implant programming 2. Lack of standardization in cochlear implant programming 3. Lack of application of modern techniques to cochlear implant programming

Learning Objective: Physicians will be able to 1. Explain how artificial intelligence (AI) can be applied to cochlear implant programming 2. Discuss the benefits of using AI to program cochlear implants 3. Summarize the possible benefits of AI in terms of patient outcomes, satisfaction and efficiency

Desired Result: Attendees will 1. Be able to increase efficiency related to cochlear implant programming without sacrificing patient outcome 2. Be able to provide access to more patients in need of cochlear implant technology

Level of Evidence - Does not apply - it does apply at Level 2b

Indicate IRB or IACUC Approval: Approved

Intracochlear Pressure Transients During Cochlear Implant Electrode Insertion: Effect of Micro-mechanical Control on Limiting Pressure Trauma

*Renee M. Banakis Hartl, MD, AuD; Christopher Kaufmann, MD, MS
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Hypothesis: Use of micro-mechanical control will result in reduced number and magnitude of intracochlear pressure transients when compared with electrode insertion by hand.

Background: It has been established that large intracochlear pressure spikes can be generated during the placement of cochlear implant electrodes, which may be a cause of insertion-related trauma. Here, we examine the effect of a micro-mechanical insertion control tool on intracochlear pressure during implantation.

Methods: Electrodes from three manufacturers were placed in four cadaveric heads both with a custom micro-mechanical control tool and by hand. Insertions were performed at three different rates: 0.2 mm/s, 1.2 mm/s, and 2 mm/s (n=20 each). Fiber-optic sensors measured intracochlear pressures. The effect of electrode type, speed, and device use on pressure magnitude was calculated using an N-way ANOVA. Chi-squared analysis assessed the relative number of insertions with transients with and without the device.

Results: Electrode insertion by hand produced pressure transients in the cochlea up to an ear canal equivalent of 174 dB SPL. Average pressures were significantly lower when utilizing the insertion device compared with insertion by hand ($p < 0.001$). No difference in magnitude was noted across electrode type or speed. A significantly lower proportion of insertions contained pressure spikes when the insertion device was used ($p < 0.001$).

Conclusion: Results affirm the importance of atraumatic techniques during electrode insertion and suggest that use of a micro-mechanical insertion control system may mitigate trauma from pressure events, both by reducing the amplitude and the number of pressure spikes resulting from cochlear implant electrode insertion.

Define Professional Practice Gap & Educational Need: 1. Limited understanding of the intracochlear environment during insertion of cochlear implant electrodes. 2. Unclear benefit of the use of an electrode insertion tool on minimizing insertion-related trauma to the cochlea.

Learning Objective: 1. Better appreciate the potential for causing cochlear trauma during cochlear implant electrode insertion. 2. Learn about cochlear implant insertion tools and develop an understanding of how such devices may potentially mitigate implantation-related trauma to the cochlea.

Desired Result: 1. Participants will improve understanding of one potential cause of loss of residual hearing following cochlear implant surgery. 2. Participants will evaluate the relative benefit of a cochlear implant electrode insertion tool compared with traditional hand insertion of electrodes in mitigating implantation-related trauma to the cochlea. 3. Participants will have objective data to consider when deciding whether or not to incorporate insertion tools into clinical practice when such devices become clinically available.

Level of Evidence - Does not apply

Indicate IRB or IACUC Approval: Exempt

Electrocochleographic Patterns in Patients with Sudden Sensorineural Hearing Loss Undergoing Cochlear Implantation

*Michael S. Harris, MD; William J. Riggs, AuD
Kristin Kozloski, AuD; Oliver F. Adunka, MD*

Objective: The pathophysiology and locus of dysfunction associated with sudden sensorineural hearing loss (SSNHL) is poorly understood. The objective of this study was to quantify the electrophysiologic integrity of cochlear hair cells and the auditory nerve in patients with SSNHL undergoing cochlear implantation (CI). The central hypothesis was that the amplitude of the cochlear microphonic, reflective of cochlear hair cell function, would be greater among SSNHL patients relative to patients with gradually progressive hearing loss.

Study design: Case-control study

Setting: Two tertiary referral centers

Patients: The case cohort consisted of adult patients with SSNHL who met CI candidacy criteria. The control cohort consisted of a sample of post-lingually deaf adults with gradually progressive SNHL who met CI candidacy criteria.

Interventions: Intra-operative electrocochleography (ECochG); cochlear implantation.

Main diagnostic and outcome measures: Intra-operative ECochG recordings and post-operative speech perception testing.

Results: Intraoperative ECochG recordings were possible in all patients with SSNHL and the control cohort of patients with gradually progressive SNHL. Pre-operative demographic and audiological factors including duration of hearing loss, pre-operative pure tone averages, preoperative best-aided speech discrimination, and age at implantation were reviewed. Patterns involving the cochlear microphonic, indicative of cochlear hair cell function, and the auditory nerve neurophonic, reflective of the function of the auditory nerve, were compared between SSNHL patients and controls with gradually progressive SNHL. Post-CI speech outcomes were compared between groups. On average the SSNHL patients displayed large cochlear microphonics, reflecting significant hair cell presence, with absent or poor compound action potentials, indicating poor neural activity.

Conclusions: Intra-operative ECochG is a useful tool to study the pathophysiology and locus of dysfunction in patients with SNHL undergoing CI. Findings from this study provide insight into the poorly understood pathophysiology of SSNHL.

Define Professional Practice Gap & Educational Need: This study addresses a gap in our knowledge regarding the locus of functional impairment associated with sudden sensorineural hearing loss.

Learning Objective: This study applies use of intraoperative electrocochleography in a sample of patients undergoing cochlear implantation for sensorineural hearing loss associated with sudden sensorineural hearing loss compared to a control group of patients with gradually progressive sensorineural hearing loss.

Desired Result: From this presentation, attendees will: 1. Come away with a greater appreciation and understanding of the utility of electrocochleography to monitor and study intracochlear micromechanics and the function of the cochlear nerve. 2. Develop an understanding of how electrocochleographic patterns among sudden sensorineural hearing loss patients differ from those of progressive hearing loss patients and what implications this may have for loci of dysfunction in this group.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

Transgenic Mouse Model for Facial Nerve Synkinesis

*Mostafa Ahmed, MD; Alex Deich, BS
Grace Balfour, BS; Ark Lorin, MD
Greg Kelts, MD; Richard Williams, DMD, PhD*

Hypothesis: Our central hypothesis is that inhibition of Schwann cell de-differentiation, in the post-injury setting will impact synkinesis.

Background: No therapies exist to improve the accuracy of facial nerve regeneration. Following peripheral nerve injury, adult reactive Schwann cells de-differentiate and express glial fibrillary acidic protein (GFAP); suggesting that reactive Schwann cells impact axonal regeneration precision.

Methods: Transgenic GFAP-thymidine kinase (TK) mouse model was employed, allowing selective downregulation of reactive GFAP expressing Schwann cells through ganciclovir (GCV) delivery via osmotic pump. Adult female transgenic GFAP-TK mice had the right facial nerve transected and repaired, they then were treated with saline or GCV, allowing for 10 animals in each group. At 6 weeks post-injury, mice were exposed to at least three separate air puff events while high speed videography recorded whisker. MatLab code processed video with publicly available BIOTACT algorithm.

Results: Whisker velocity was calculated using binning and Fourier transform statistical analysis. Saline treated animals confirmed our model's ability to detect aberrant movement such that intact (left) facial nerves caused whisker retraction, while repaired (right) facial nerves had protraction. Administration of GCV increased whisker protraction compared to saline. GCV did not impact intact animal whisker movement compared.

Conclusions: Inhibition of reactive Schwann cell proliferation appears to impacts degree of synkinesis, providing important insight in a potential therapeutic target for facial nerve injury.

Define Professional Practice Gap & Educational Need: Lack of contemporary knowledge on how to treat synkinesis following facial nerve injury

Learning Objective: Explore transgenic mouse model that detects and impacts synkinesis

Desired Result: Appreciate role that Schwann cells play in synkinesis development.

Level of Evidence - Does not apply-you will be asked to explain - Basic science study

Indicate IRB or IACUC Approval: Approved

Post Traumatic Complete Facial Palsy: Comparative Analysis of Outcomes of Conservative Management vs surgical exploration: A University Hospital Study and Review of Literature

Diptarka Bhattacharyya, MD; Pravin Rajgadkar, MD

Introduction: Post traumatic facial nerve paralysis is common, being seen in up to 7-10% of blunt head trauma. Early surgical exploration is usually widely recommended, with decision making being based upon the onset, Imaging findings and Electro-diagnostic studies. However, evidence for benefit is still unclear, and is usually based on institutional protocols.

Materials and Methods: Retrospective anonymized single institutional study. Patient charts from 2010-2015 were reviewed. All patients were treated with systemic steroids.

Inclusion criteria:

1. Post traumatic complete Unilateral facial nerve palsy
2. Duration of onset known
3. Unfavorable Electroneuronography (<5%) and EMG

Exclusion criteria:

1. Displaced temporal bone fractures
2. No follow up data to 1 year, or documented recovery

Results: A total of 43 patients met the inclusion criteria. 41 patients had an identified temporal bone fracture (6 transverse, 35 patients had mixed/longitudinal). 19 patients underwent surgery within 4 weeks. 17 patients recovered in this group (95%). 24 patients initially declined surgery. 14 of them went on to NOT have surgery. Recovery rate was 92% in this group. 10 patients underwent delayed surgery, ranging from 4 weeks to 28 weeks. Recovery rate was 90%

Discussion and Conclusion: In this series of patients with undisplaced temporal bone fractures with complete facial palsy, conservative management, early and late surgery all appear to have the same recovery rate. None of the patients had a complete transection of the nerve. The utility and role of surgical treatment in this sub-group of patients needs to be carefully reviewed with larger studies

Define Professional Practice Gap & Educational Need: There is lack of clear evidence of benefit in early surgical exploration in Post traumatic complete unilateral facial palsy. The perceived improvement noted in some case series may simply be the natural history. In fact, the largest recovery of nerve function in any unilateral neuropathy, irrespective of intervention is expected within 4 weeks, so the perceived poorer outcomes from delayed exploration is susceptible to selection bias, and hence needs to be clearly reviewed.

Learning Objective: To reassess and analyse the role of early facial nerve decompression in patients with post traumatic unilateral complete facial nerve palsy, and consider that conservative medical management may provide equal outcomes.

Desired Result: 1. Assess temporal bone fractures and understand that in transverse temporal bone fractures, early surgical intervention may be indicated 2. Consider that improvement in Post traumatic Unilateral Facial Palsy often happens later than 4 weeks- extending up to 28 weeks; however, chances of spontaneous recovery decreases with time 3. The timing of facial nerve decompression does not appear to change outcomes

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

Association between Metformin Usage and Tumor Growth Rate in Vestibular Schwannoma Patients

*Austin Y. Feng, MD; Ali Kouhi, MD
Alejandro Enriquez-Marulanda, MD
Justin M. Moore, MD, PhD; Yona Vaisbuch, MD*

Objective: Laboratory work has suggested Metformin may possess novel anti-neoplastic properties. This study aims to assess the effect of Metformin on vestibular schwannoma growth rate

Study Design: Retrospective cohort comparison study

Settings: Stanford Hospital, a tertiary referral center, USA

Patients: Patients presenting with radiologically confirmed Vestibular schwannoma to Stanford medical center between January 1990 to October 2018. Patients who were received Metformin during the follow-up period were included and were compared to the control group who were not receiving Metformin.

Interventions: Treatment with Metformin.

Main outcome measures: Tumor growth.

Results: A total of 149 patients were analyzed, with 42 patients receiving Metformin. The mean age at presentation was 69.6 (± 11.7) years. There were 69 (46.3%) females and 80 (53.7%) males and there was no significant age difference between the groups. Tumor size at presentation was similar between two groups, 8 mm (4-13) in control group and 7.5 mm (4-14) in Metformin group.

The follow up period was 34.2 month (18.3-57.8) and 30.3 month (13.6 – 69.8) in the Metformin and control cohorts respectively and this was not significant different.

Tumor growth was significantly less common in Metformin cohort during follow up (33.3% vs 51.4%).

Conclusions: This preliminary result suggests Metformin may reduce vestibular schwannoma tumor growth rate and shows promise as a novel chemotherapeutic agent. Further studies are needed to validate this finding.

Define Professional Practice Gap & Educational Need: Lack of awareness regarding the potential effect of Metformin on vestibular schwannoma growth rate

Learning Objective: Demonstrate the effect of metformin therapy on vestibular schwannoma tumor growth rate.

Desired Result: The attendee will be able to discuss the potential utilization of metformin in follow up of vestibular schwannoma patients.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

Delayed Tumor Growth in Vestibular Schwannoma: An Argument for Lifelong Surveillance

*Robert J. Macielak, MD; Neil S. Patel, MD
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John P. Marinelli, BS; Matthew L. Carlson, MD*

Objective: Previous research has shown that tumor growth during observation of small-to-medium sized sporadic vestibular schwannomas (VS) occurs almost exclusively within 3 to 5 years. This has led some to consider ending surveillance after this interval. This study seeks to characterize a cohort of patients with tumors that exhibited late growth.

Study Design: Retrospective case review.

Setting: Tertiary referral center.

Patients: Adults with VSs who underwent MRI surveillance.

Intervention(s): None.

Main outcome measure(s): Linear tumor growth was measured in accordance with AAO-HNS guidelines. Delayed growth was defined as growth 5 years or more from the initial MRI.

Results: Of 361 patients with available data, 172 (47.6%) experienced tumor growth. Fourteen of these 172 patients (8.1%) experienced delayed growth, with the highest growth rate after the delay being 7.90 mm/year and the longest delay being 11.1 years. Additional treatment was recommended for 6 (43%) delayed growth patients. Of 68 tumors that remained in the IAC, 11 (16.2%) exhibited delayed growth. Of 66 tumors that presented in the CPA, 2 (3.0%) demonstrated delayed growth. Initial size was smaller for those exhibiting delayed growth compared to those with early growth (4.85 vs. 7.90 mm). For tumors within the IAC, those with early growth had a significantly higher growth rate than those with delayed growth (1.40 vs. 0.45 mm/year, $p = 0.001$)

Conclusions: Delayed growth was observed in 8.1% of growing VSs. Patient factors that predict delayed growth remain elusive. These findings support lifelong surveillance to detect growth that may impact management and outcome.

Define Professional Practice Gap & Educational Need: Lack of awareness regarding the proper length of vestibular schwannoma surveillance if serial imaging is the selected management

Learning Objective: Understand that lifelong surveillance of vestibular schwannomas is recommended given the delayed growth identified in our cohort and the potential for altered treatment outcomes due to this

Desired Result: Clinicians will prolong their MRI surveillance windows of vestibular schwannomas to identify patients that may have delayed growth, which can affect later treatment outcomes

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

Rate of Initial Hearing Loss Predicts Risk of Non-Serviceable Hearing Among Observed Sporadic Vestibular Schwannoma

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Objective: To evaluate the association between rate of initial hearing loss and development of non-serviceable hearing in patients with sporadic vestibular schwannoma (VS) who elect initial observation.

Setting: Two tertiary care centers.

Patients: VS patients with serviceable hearing who underwent at least three audiograms before intervention or loss to follow-up. The rate of change in pure tone average (PTA) was calculated as the PTA from the second audiogram minus the PTA from the first audiogram, divided by the duration in months between the two.

Main outcome measure(s): Serviceable hearing, defined as the PTA ≤ 50 dB HL and word recognition score (WRS) $\geq 50\%$.

Results: Among 264 patients meeting inclusion criteria, 56 developed non-serviceable hearing during follow-up. Kaplan-Meier estimated rates of maintaining serviceable hearing (95% CI; number still at risk) at 1, 3, 5, 7, and 10 years were 97% (95-99; 203), 77% (70-84; 97), 66% (58-76; 38), 56% (45-70; 16), and 40% (25-63; 2), respectively. In a univariable setting, each 1-unit increase in the rate of initial PTA change was associated with a 73% increased likelihood of non-serviceable hearing (hazard ratio 1.73; 95% CI 1.31-2.28; $p < 0.001$). This difference persisted after adjusting for initial presenting PTA (hazard ratio 2.22; 95% CI 1.61-3.07; $p < 0.001$) and after adjusting for both PTA and WRS at the first audiogram (hazard ratio 2.27; 95% CI 1.67-3.09; $p < 0.001$).

Conclusions: Rate of initial PTA decline is a novel strong predictor of non-serviceable hearing in patients with observed VS and may be used to guide patient counseling and optimize management.

Define Professional Practice Gap & Educational Need: Lack of awareness regarding predictors of hearing decline in patients with sporadic vestibular schwannoma

Learning Objective: To describe a novel strong predictor of non-serviceable hearing in patients with sporadic vestibular schwannoma

Desired Result: This information can be used to guide patient counseling and optimize care.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

Factors Associated with Cranial Neuropathy following Gamma Knife for Vestibular Schwannoma

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Objective: Evaluate the incidence of and potential contributory factors to cranial neuropathy (CN) following Gamma Knife (GK) for primary treatment of vestibular schwannoma (VS).

Study design: A retrospective chart review was performed for all patients undergoing GK for VS at a single institution from 2005 to 2018.

Setting: Tertiary referral center.

Patients: All patients receiving primary GK treatment for VS were evaluated. Patients with NF2 or prior surgery were excluded from analysis.

Intervention: GK surgery.

Main outcome measures: The incidence of new onset sudden sensorineural hearing loss (SSNHL) requiring steroids, trigeminal paresthesia, facial nerve paresis, dysphagia, and vocal cord dysfunction was evaluated. Vestibular symptoms were excluded from analysis due to lack of objective assessments. Secondary end-points include association of CN with patient demographics, tumor characteristics, and radiation received.

Results: 134 patients with VS received primary GK therapy. Post-treatment CN developed in 34 patients (25.4%). 12 patients (9%) developed SSNHL requiring steroids, 11 experienced trigeminal paresthesia (8.2%), and 7 (5.2%) demonstrated facial paresis. The mean maximum cochlear dose was 15.49 Gy in patients with facial paresis compared to 12.42 Gy in patients who did not ($p=0.032$). Subjects with facial paresis were more likely to have a lateral tumor without a fundal cap on MRI (71%) compared to subjects without facial paresis (43%, $p=0.70$)

Conclusions: In the treatment of VS with GK, elevated maximum cochlear dose and lack of a fundal cap on MRI were associated with facial paresis. These factors should be considered during GK treatment planning for VS.

Define Professional Practice Gap & Educational Need: 1. Lack of knowledge regarding incidence of acute cranial neuropathy following gamma knife for acoustic neuroma 2. Lack of knowledge regarding predisposing factors for acute cranial neuropathy following gamma knife for acoustic neuroma

Learning Objective: Evaluate the incidence of and predisposing factors towards development of acute cranial neuropathy following gamma knife for acoustic neuroma.

Desired Result: Attendees will be able to better counsel patients regarding the relative risks of gamma knife treatment for acoustic neuroma and identify those at a higher risk of developing facial paresis in the short-term.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

SELECTED ABSTRACTS

***POSTER
PRESENTATIONS***



54th Annual Spring Meeting

AMERICAN NEUROTOLOGY SOCIETY

***May 3-4, 2019
JW Marriott Austin
Austin, TX***

Cochlear Implantation in Patients with Neurofibromatosis Type-2

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Objective: To describe cochlear implant outcomes in patients with neurofibromatosis type 2 (NF2).

Study Design: Retrospective case series.

Setting: A multidisciplinary NF2 clinic at a university hospital.

Patients/Interventions: Patients with NF2 who underwent cochlear implantation.

Main Outcome Measures: Pre-implantation and post-implantation audiometric data, including pure-tone average (PTA) and AzBio Sentence scores.

Results: Seven patients with NF2 underwent cochlear implantation. The median age at implantation was 22 years (range: 17-63 years) and six were female. The median length of deafness prior to implantation was 1.5 years (range: 0.3-10 years). Two patients underwent prior microsurgical resection via middle fossa craniotomy and one patient was treated with stereotactic radiotherapy prior to cochlear implantation. Two tumors were growing at the time of cochlear implantation, four tumors were not growing for a median period of 4 years (range 0.5-6 years), and one tumor had undergone prior gross total resection. Median preoperative PTA was 115 dB (range: 45-115 dB) and all preoperative AzBio scores were 0%. These improved to a median postoperative PTA of 30 dB (range: 12.5-33.75 dB) and median postoperative AzBio score of 20% (range: 0-82%). Data logging data demonstrated that four patients were daily cochlear implant users, one was an intermittent user, and two were non-users, one of whom had normal hearing in the contralateral ear.

Conclusions: Cochlear implantation is an effective option for rehabilitating hearing loss in patients with NF2 in some patients; however, patients with normal contralateral hearing or poor follow-up do not perform as well.

Define Professional Practice Gap & Educational Need: Incomplete understanding of the efficacy of cochlear implantation in patients with neurofibromatosis type-2.

Learning Objective: To provide audiometric outcomes of neurofibromatosis type-2 patients rehabilitated with cochlear implants from a large university based program.

Desired Result: Understand the challenges, pitfalls, and potential "ideal" candidates for cochlear implantation in patients with neurofibromatosis type-2.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

A Retrospective Matched Comparison of Endolymphatic Shunt Surgery and Intratympanic Gentamicin for Meniere's Disease

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Objective: To report audiovestibular outcomes of endolymphatic shunt surgery (ELS) and intratympanic gentamicin injections (ITG) in patients with Meniere's disease (MD).

Study Design: Retrospective matched cohort study

Setting: Tertiary referral center

Patients: Patients with MD refractory to medical management between 2004 and 2017 were reviewed: 47 patients underwent ELS and 44 had outcomes available, while 33 patients underwent ITG and 27 had outcomes available. Mean follow-up durations for the ELS and ITG groups were 39.1 and 43.3 months, respectively. Twenty-six patients from the ELS group and 24 patients from the ITG group were then included in a pre-treatment hearing- and age-matched analysis.

Intervention: ELS or ITG

Main Outcome Measures: Successful control of vertigo, pure-tone average (PTA; 0.5, 1, 2 and 4 kHz), word recognition score (WRS), and treatment complications.

Results: A matched analysis showed vertigo control rates of 88.5% in the ELS group and 66.8% in the ITG group, which were not significantly different ($p = 0.091$). The change in PTA following treatment was statistically similar between the ELS group (6.2 dB) and ITG group (4.6 dB) ($p = 0.521$), while the change in WRS for the ELS group (+3.9 %) was significantly more favorable than the ITG group (-13.6 %) ($p = 0.046$). Chronic post-treatment unsteadiness was reported in 25.0% of the ITG group and was not encountered in the ELS group ($p = 0.009$).

Conclusion: ELS provided successful vertigo control at least as well as ITG with a lower incidence of audiovestibular complications.

Define Professional Practice Gap & Educational Need: 1. Controversies regarding the efficacy of endolymphatic shunt surgery (ELS) for the treatment of Meniere's disease continue to exist and demonstrate a need for additional data. 2. Despite its efficacy and less-invasive nature, intratympanic gentamicin (ITG) injections for the treatment of Meniere's disease can be hazardous to hearing and can have significant long-term vestibular sequelae. Additional information is needed to examine outcomes of this procedure compared to other treatments options. 3. Whether a patient receives ELS or ITG often depends on their clinician. Studies comparing the outcomes of these procedures are needed to enable clinicians to be better informed about the efficacy and audiovestibular complications of these treatment options.

Learning Objective: 1. Understand the evidence supporting ELS as an effective treatment for medically refractory Meniere's disease with a low incidence of audiovestibular complications. 2. Appreciate that while ITG is also provides successful vertigo control in patients with Meniere's disease, it can have a higher incidence of audiovestibular complications. 3. Gain additional information to aid in the decision to recommend either ELS or ITG to patients with medically refractory Meniere's disease.

Desired Result: Attendees will use the knowledge they gain from this presentation to make a more informed decision regarding the use of ELS versus ITG to treat patients with Meniere's disease. They will also be able to include information related to the audiovestibular complications in the informed consent for these procedures.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

National 30-Day Readmission and Prolonged Length of Stay after Vestibular Schwannoma Surgery: Analysis of the Nationwide Readmissions Database

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George B. Wanna, MD*

Objectives: To determine the risk factors for unanticipated readmission and prolonged index admission after vestibular schwannoma surgery.

Study design: Retrospective cohort study.

Setting: Large, national database.

Patients: Those undergoing surgery for vestibular schwannoma were identified in the Nationwide Readmissions Database (2013-2014).

Main outcome measures: readmission rate, length of stay

Results: There were 4,586 cases identified. The overall unanticipated readmission rate was 7.5%, and 7.9% had a prolonged length of stay (LOS) of >8 days. Mean and median LOS were 4.48 and 4.00 days, respectively, and >90% of patients were discharged after 7 days. Disposition to a facility occurred in 6.4% of cases. Modified Charlson score of 1 (odds ratio [OR] 1.60, $p=.001$), large hospital size (OR 0.37, $p<.001$), and prolonged LOS (OR 2.42, $p<.001$) were independently associated with unintended readmission. Variables independently associated with prolonged index admission include high-volume facility (OR 0.33, $p<.001$), disposition to a facility (OR 10.06, $p<.001$), and insurance consisting of Medicaid (OR 3.96, $p<.001$) or none (OR 6.90, $p<.001$). The most common readmission diagnoses included “other nervous system complications” (2.8%), “other postoperative infection” (1.3%), meningitis (1.2%), and cerebrospinal fluid leak (1.2%).

Conclusions: Unanticipated readmission and prolonged LOS following vestibular schwannoma surgery are common, with varied sociodemographic, hospital, and patient factors independently associated with each. Further studies are needed to investigate targeted interventions aimed at minimizing readmission and prolonged LOS using the factors outlined above.

Define Professional Practice Gap & Educational Need: 1. Lack of awareness in independent risk factors for readmission following hospitalization for vestibular schwannoma resection. 2. Lack of awareness of independent risk factors for prolonged hospitalization after vestibular schwannoma resection.

Learning Objective: To identify independent risk factors for unintended readmission and prolonged length of stay in patients undergoing vestibular schwannoma resection.

Desired Result: We hope that neurotologic surgeons who perform vestibular schwannoma resection will use the risk factors for readmission and prolonged length of stay to predict outcomes for their own patients and target interventionable variables.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Exempt

**Completion of an Individualized Learning Plan (ILP) for
Otology-Related Milestone Sub-competencies Leads to Improved
Otology Section OTE Scores**

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Objective: To examine the relationships among self-assessment of knowledge in otology via an individualized learning plan (ILP), otology milestone achievement rate, and OTE otology scores.

Study Design: Prospective study.

Setting: One otolaryngology residency covering a tertiary care facility, trauma and hospital center, outpatient ambulatory surgery center, and outpatient clinics.

Participants: Twenty otolaryngology residents, four from each class.

Methods: Residents identified four milestones from otology-related sub-competencies to achieve in a 3-month rotation via an ILP. During the same rotation, the residents sat for the OTE, and their overall and otology scores were analyzed.

Main Outcome Measures: Completion of an ILP prior to and at the end of the rotation, self-reported achievement of otology milestones, and OTE score components including total percent correct, scaled score, group stanine, national stanine and residency group weighted scores.

Results: Group stanine OTE otology scores were higher for those residents who completed pre- and post-rotation ILPs compared with those who did not, $4.0(\pm 0.348)$ vs. $2.75(\pm 0.453)$, respectively ($p=0.04$). Residents who self-reported achieving all four otology milestones had significantly higher otology group stanine scores than the residents who achieved less, $4.1(\pm 0.348)$ vs. 2.9 ± 0.433 , respectively ($p=0.045$). Residents who performed well in their PGY program cohort on the otology OTE one year were less inclined to complete an ILP for otology in the subsequent year (Pearson correlation -0.528 , $p=0.035$).

Conclusion: In the otology subspecialty, residents who completed ILPs scored better on OTE exams independent of resident class. Consequently, programs may find ILPs useful in other otolaryngology subspecialties and across residencies.

Define Professional Practice Gap & Educational Need: 1. Lack of active learning implementation in resident education. 2. Lack of contemporary knowledge of short-term and long-term benefits of active learning in resident education. 3. Lack of awareness of how to implement active learning into residency education. 4. Lack of awareness of alternative learning strategies to resident education outside of traditional didactics and passive learning.

Learning Objective: 1. Educate the learner about implementing active learning into resident education and why it is important. 2. Provide the learner with evidence that active learning strategies have short-term benefits (increased exam scores and ACGME-milestone achievement rates) and long-term benefits (increased chance of passing board exams, promotion of lifelong active-learning strategies in all fields) for resident physicians. 3. Offer the learner an example of active learning in resident education: the individualized learning plan (ILP), and discussing its use and benefits. 4. Describe the components of an individualized learning plan (ILP), and describing how it was implemented in a particular otolaryngology residency program.

Desired Result: Attendees and learners can take the knowledge from this abstract and study, and learn about the individualized learning plan (ILP) as an effective form of active learning for resident education, realize and discuss the benefits of the ILP in terms of improved career readiness for residents, and explore ILPs, ILP components, or inspiration for other forms of active learning to incorporate into their own practice or residency program. Ultimately, this information can be used to improve education for otolaryngology residencies across the U.S.A.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Exempt

Involvement of the Cochlear Aqueduct by Jugular Paraganglioma Is Associated with Sensorineural Hearing Loss

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Objective: The etiology of sensorineural hearing loss (SNHL) in patients with jugular paraganglioma (JP) whose tumors lack inner ear fistulae or vestibulocochlear nerve involvement is unknown. Recent literature has proposed that occlusion of the inferior cochlear vein may be causative. Herein, we assess the association between radiologic involvement of the cochlear aqueduct (CA) and the development of SNHL.

Study design: Blinded, retrospective review of imaging and audiometry.

Setting: Tertiary center

Patients: Adults with JP

Intervention(s): None

Main outcome measure(s): Asymmetric SNHL was assessed continuously as the difference in bone conduction pure-tone average (BCPTA) between ears and as a categorical variable (≥ 15 dB difference at two consecutive frequencies, or a difference in speech discrimination score of $\geq 15\%$). Involvement of the CA was considered present if there was evidence of medial T2 fluid signal loss, contrast enhancement, or bony erosion/expansion.

Results: Of 29 patients meeting inclusion criteria, 15 (52%) had asymmetric SNHL. Cochlear aqueduct involvement was observed in 87% of patients with asymmetric SNHL compared to 17% in those with symmetric hearing ($p < 0.001$). The median difference in BCPTA between ears in patients with CA involvement was 21.3 dB HL compared to 1.9 dB HL in those without CA involvement ($p < 0.0001$). Adjusting for age and tumor volume, CA involvement was a significant predictor of SNHL ($p = 0.006$). Age, sex, and tumor volume were not associated with SNHL.

Conclusions: Cochlear aqueduct involvement by JP is associated with SNHL. Correlation with operative findings or histopathologic evidence of tumor involvement may validate this intriguing imaging finding.

Define Professional Practice Gap & Educational Need: 1. Lack of contemporary knowledge of the mechanism of sensorineural hearing loss in patients with jugular paraganglioma 2. Insufficient data regarding baseline hearing function in patients with jugular paraganglioma

Learning Objective: To report the association between cochlear aqueduct involvement by jugular paraganglioma and sensorineural hearing loss

Desired Result: Utilize this intriguing imaging finding to better understand the etiology of hearing loss in jugular paraganglioma and counsel patients regarding the risk of hearing loss from tumor progression.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

Utilizing Migraine Prophylaxis to Improve the Vertigo Symptoms of Patients with Vestibular Migraine

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Objectives: To evaluate the efficacy of using migraine prophylaxis, including modifications of lifestyle, diet, and pharmacotherapy, in managing the vertigo symptoms of patients with vestibular migraine (VM).

Study Design: Prospective review.

Setting: Ambulatory setting at a tertiary care medical center.

Patients: Patients who were diagnosed with VM based on clinical history and the International Classification of Headache Disorders (ICHD) criteria for VM were included in this study.

Interventions: Patients were managed with migraine prophylaxis including lifestyle changes and medications that include nortriptyline, verapamil, topiramate, or a combination thereof using a standard protocol. All patients were asked to take magnesium and riboflavin supplements.

Main outcome measure: Questionnaires evaluating duration and frequency of dizziness symptoms, as well as migraine and vertigo related symptoms were distributed to patients before treatment and approximately one year after. A composite score was calculated based on the duration and frequency of dizziness symptoms to measure changes in dizziness severity before and after treatment.

Results: Forty-one patients were diagnosed with VM with a preponderance of females (59%) and a mean age of 55 ± 15 years. After treatment with migraine prophylaxis, thirty-six (89%) improved their dizziness symptoms. The mean dizziness severity improved from 55.7 min/day before treatment to 11.8 min/day after treatment ($P = .027$; 95% CI, 5.4 to 82.2).

Conclusion: Managing vestibular symptoms of VM with migraine prophylaxis is an effective method. Future placebo-controlled clinical trials are needed to confirm the efficacy of these medications.

Define Professional Practice Gap & Educational Need: Lack of knowledge of treatments for vestibular migraine and the potential of migraine prophylaxis for managing the vertigo symptoms of vestibular migraine.

Learning Objective: To evaluate the efficacy of using migraine prophylaxis, including modifications of lifestyle, diet, and pharmacotherapy, in managing the vertigo symptoms of patients with vestibular migraine.

Desired Result: After this presentation, attendees will hopefully consider the use of migraine prophylaxis as part of their treatment plans for their patients with vestibular migraine.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

Sigmoid Sinus Occlusion after Translabyrinthine Resection of Acoustic Neuroma

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Objective: Assess the frequency of sigmoid sinus occlusion (SSO) after translabyrinthine resection of acoustic neuroma (AN).

Study Design: Retrospective chart review.

Setting: Tertiary referral center.

Patients: Consecutive adult (18 years or older) patients underwent translabyrinthine resection of AN and post-operative imaging between November 2017 and August 2018. Patients with neurofibromatosis 2 or previous surgical resection were excluded.

Interventions: All patients underwent postoperative magnetic resonance imaging (MRI) of the posterior fossa to document extent of resection or for routine follow-up. MRI studies were reviewed by a single neuroradiologist blinded to patients' clinical and operative details.

Main outcome measures: Presence/absence of MRI evidence of SSO.

Results: Twenty-six MRI studies of 20 patients were analyzed. Mean age was 49(+/-14.7) years. Mean tumor diameter was 29.9(+/-10.6) millimeters. SSO was identified in five patients (25%). Occlusion occurred in two codominant and three non-dominant sinuses. In one patient, SSO was noted following evacuation of a postoperative epidural hematoma. Four patients demonstrated no associated neurologic symptoms. Severe narrowing in one dominant sinus resulted in stroke-like symptoms. There was no difference in age or tumor size between patients with and without SSO. Sigmoid sinus patency was preserved in all tumors <15 millimeters.

Conclusion: SSO is common after translabyrinthine resection of AN but may be asymptomatic, particularly when the affected sinus is non-dominant or co-dominant. Conversely, even partial occlusion of a dominant sigmoid sinus may manifest with neurologic changes. Sigmoid sinus patency was universally preserved when tumor size was <15 millimeters.

Define Professional Practice Gap & Educational Need: Lack of awareness regarding the frequency and clinical significance of sigmoid sinus occlusion after translabyrinthine resection of acoustic neuroma.

Learning Objective: Describe the frequency and clinical significance of sigmoid sinus occlusion after translabyrinthine resection of acoustic neuroma.

Desired Result: The presentation will present attendees with information that will influence the degree of caution exercised when operating in proximity to the sigmoid sinus during translabyrinthine surgery.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

Validated Questionnaire to Measure the Severity of Persistent Postural-Perceptual Dizziness (PPPD)

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Objective: To establish the questionnaire to measure the severity of persistent postural-perceptual dizziness (PPPD).

Study Design: Retrospective chart review.

Patients: Fifty PPPD patients and 50 consecutive patients with other vestibular disorders as controls.

Main Outcome Measures: Patients were asked to answer the questionnaire on three exacerbating factors of PPPD (upright/walking, motion, visual stimulation). Somatic distress was evaluated by the visual analog scale (VAS). Reliability of the questionnaire was tested by the Cronbach's coefficient alpha. The questionnaire was validated by examining the differences in total scores, score for each factor, and VAS between PPPD and controls. Area under the curve (AUC) of receiver operating characteristics (ROC) curve for each factor was calculated. Existence of subtypes according to the exacerbating factor was tested by factor analysis.

Results: Cronbach's coefficient alpha for all factors was higher than 0.8 except for motion subscale (=0.75). Total scores as well as score for each factor were higher in PPPD patients than controls, while there was no significant difference in VAS. AUC was widest for visual stimulation factor (0.83), while it was narrowest for upright/walking factor (0.68). Factor analysis revealed that motion factor was divided into active and passive motion-inducement and that the PPPD had two subtypes based on the exacerbating factor: upright/walking plus active motion subtype and visual stimulation plus passive motion subtype.

Conclusion: We report here the questionnaire as a measure of PPPD that shows high reliability and validity. Visual stimulation factor may be most characteristic for PPPD. PPPD could be divided into two subtypes.

Define Professional Practice Gap & Educational Need: 1. Lack of a method of measuring the severity of persistent postural-perceptual dizziness (PPPD), which is classified as a new chronic vestibular disorder. 2. Lack of contemporary knowledge on the characteristic to distinguish PPPD from other vestibular disorders. 3. Lack of data on the existence of subtypes of PPPD.

Learning Objective: 1. Describe how to measure the severity of PPPD and distinguish it from other vestibular disorders. 2. Recognize the exacerbating factors of PPPD and its subtypes.

Desired Result: 1. Improve the differential diagnosis for chronic vestibular disorders. 2. Discuss the pathology of the PPPD.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

Hearing Preservation Outcomes Using a Precurved Electrode Array Inserted Using an External Sheath

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Objectives: Describe audiologic outcomes in hearing preservation cochlear implantation (CI) using a precurved electrode array inserted using an external sheath and evaluate association of electrode positioning and preservation of residual hearing.

Study Design: Retrospective review.

Setting: Tertiary referral center.

Patients: Twenty-two adult patients who underwent hearing preservation CI with precurved electrode array.

Interventions: CI, intraoperative computed tomography (CT)

Outcome measures: Audiologic measures (AzBio sentences, residual hearing thresholds) and electrode imaging (scalar location, mean modiolar distance, angular insertion depth).

Results: Twenty-two adults with <80dB threshold at 250Hz were implanted with a precurved electrode array; 11 underwent intraoperative CT. Preoperative hearing thresholds at 125Hz, 250Hz, and 500Hz were 52.1dB, 56.5dB, and 66.8dB, respectively; mean AzBio scores were 10%. Imaging revealed one translocation and no instances of tip fold-over. At activation, there was no statistically significant threshold shift at 125Hz (61.6dB, $p=0.13$), 250Hz (68.4dB, $p=0.6$), or 500Hz (79.8dB, $p=0.8$), while at 6 months, hearing thresholds were 67.8dB ($p=0.01$), 79.1dB ($p<0.01$), and 91.3dB ($p<0.01$), respectively. At 6 months, mean AzBio scores were 63%. Electrode proximity to the modiulus was significantly correlated with improved AzBio scores at 6 months ($r=0.4$, $p=0.04$). Angular insertion depth was not correlated with postoperative threshold shift ($r=0.005$, $p=0.8$) or AzBio scores ($r=0.2$, $p=0.4$) at 6 months.

Conclusions: A low rate of translocation allows a precurved electrode array inserted using an external sheath to maintain hearing preservation rates comparable to straight/lateral wall electrodes. With scala tympani insertion, proximity to the modiulus is a positive marker of improved speech performance postoperatively.

Define Professional Practice Gap & Educational Need: Lack of knowledge regarding hearing preservation and speech understanding outcomes as related to electrode positioning in the slim perimodiolar non-stylet electrode.

Learning Objective: Present hearing preservation and audiologic outcomes as related to electrode positioning determined by post-insertion imaging.

Desired Result: Attendees will learn that the slim perimodiolar electrode has excellent hearing preservation rates related to minimal translocation, and will be able to apply this knowledge to decision-making around electrode selection for patients with preoperative residual low-frequency hearing.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

**Natural History of Facial Weakness following Acoustic Surgery:
A Tertiary Care Cohort**

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Christopher A. Schutt, MD*

Objective: Facial nerve function is a key outcome in acoustic surgery. This study aims to describe the evolution of facial nerve function following acoustic surgery.

Study design: Retrospective case series.

Setting: Multiple tertiary otology referral centers.

Patients: Patients undergoing acoustic surgery for tumor extirpation from 2003 to 2017 with pre-operatively normal facial nerve function without subsequent additional open surgery or stereotactic radiosurgery.

Intervention(s): Removal of acoustic tumor with serial facial nerve examinations.

Main outcome measure(s): Serial facial nerve examinations measured using the House-Brackmann (HB) scale.

Results: Of 347 patients examined, 170 (49%) had documented facial weakness post-operatively, and 76% of these were noted within 24 hours post-operatively. Of patients with HB1 function immediately post-operatively, 95% had HB1 function and 100% had HB3 or better function at their ultimate visits. Conversely, of patients with HB4 or worse function immediately post-operatively, 20% ultimately achieved HB1 function and 73% ultimately achieved HB3 or better function. Eighty five percent of patients with facial weakness achieved their ultimate facial function by one year post-operatively. Final facial function poorer than HB3 was associated with subtotal resection (12% vs. 7% for near total and 2% for gross total resection, $p = 0.02$) and aspirin use (13.5% vs 3.4%, $p = 0.002$).

Conclusions: An analysis of facial nerve function over time following acoustic surgery is presented. While post-operative facial function correlates with future function, this correlation is imperfect and significant improvement or worsening is common. These data inform patient counseling following acoustic surgery.

Define Professional Practice Gap & Educational Need: 1. Absence of data on natural history of facial nerve weakness after acoustic surgery 2. Inability to provide accurate counseling to patients regarding chances and expected degree of facial function recovery after acoustic surgery resulting in facial weakness

Learning Objective: To understand the expected course of facial function following acoustic surgery with post-operative facial weakness

Desired Result: Attendees will be able to accurately counsel patients with facial nerve weakness after acoustic surgery about the chances and expected degree of recovery over time.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

Associations of Vestibular Tests with Penn Acoustic Neuroma Quality of Life Scores after Resection of Vestibular Schwannoma

*C. Scott Brown, MD (primary); Matthew W. Cooper, MD
David M. Kaylie, MD (presenter)*

Objective: Determine associations between preoperative caloric testing (CT) and video head impulse testing (vHIT) with baseline and postoperative Penn Acoustic Neuroma Quality of Life (PANQOL) scores following resection of vestibular schwannoma (VS).

Study design: Retrospective case series

Setting: Two tertiary referral hospitals

Patients: Adult patients with unilateral VS, preoperative CT and vHIT testing, and postoperative PANQOL scores.

Interventions: Surgical resection of VS and postoperative surveys.

Main outcome measures: PANQOL scores

Results: Forty-three patients were included (58.1% women) with a median age of 54 years (range, 28–82). Mean tumor size was 14.8 mm ($\sigma=8.6$), and 28 (65.1%) were right-sided. Average gain on preoperative vHIT was 0.7 ($\sigma = 0.3$). Covert and overt saccades were present in 8 (25%) and 14 (42.4%) patients, respectively. Average preoperative unilateral weakness was 47% ($\sigma = 33.2$). Translabyrinthine approach was performed in 26 (60.5%) patients. No significant difference of PANQOL scores was noted at baseline or over time between patients with normal (>0.8) or abnormal (<0.8) gain. Patients with more unilateral weakness ($>50\%$) had significantly higher baseline PANQOL scores compared to those with $<25\%$ or $25\%-50\%$ ($p=0.016$), but had significant improvement in scores over time ($p=0.012$). Presence of both overt and covert saccades at baseline was associated with better PANQOL scores at all timepoints ($p=0.03$). Higher preoperative dizziness handicap inventory (DHI) preoperatively was significantly associated with worse PANQOL scores at all timepoints ($\beta=0.57$, $p=0.0064$). No differences in PANQOL scores amongst surgical approaches were observed.

Conclusions: Preoperative vestibular testing with vHIT, CT, and DHI may allow for patient counseling regarding postoperative quality of life over time.

Define Professional Practice Gap & Educational Need: 1. Lack of standardization of preoperative vestibular assessment for patients with vestibular schwannoma due to the lack of objective utility of each of these studies. 2. Current assumptions regarding preoperative vestibular weakness and postoperative outcomes following vestibular schwannoma resection exist. Validation of Penn Acoustic Neuroma Quality of Life scores, though Dizziness Handicap inventory is non-specific for vestibular schwannoma and often used for assessment.

Learning Objective: Determine associations between preoperative caloric testing (CT) and video head impulse testing (vHIT) with baseline and postoperative Penn Acoustic Neuroma Quality of Life (PANQOL) scores following resection of vestibular schwannoma (VS).

Desired Result: Attendees will better understand the role of preoperative vestibular testing and how it may be used to counsel patients regarding their postoperative course and quality of life.

Level of Evidence: Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

Evaluating the Effect of Inter-Implant Time for Bilateral Cochlear Implants in Adults

*Timothy K. Koo; Loren J. Bartels, MD
Kyle P. Allen, MD; Daniel T. Segarra, MS
Christopher J. Danner, MD*

Objective: Determine the relationship between time elapsed between sequential bilateral cochlear implantation (BiCI) and speech intelligibility scores in post-lingually deafened adults

Study Design: Retrospective case review

Setting: Ambulatory tertiary referral center

Patients: Post-lingually deafened adults who received bilateral cochlear implantation between January 1, 2011 and January 1, 2018.

Interventions: Bilateral cochlear implantation

Main Outcome Measures: Bilateral AzBio score in quiet, and difference between unilateral AzBio scores in quiet of first and second cochlear implants (CI Difference).

Results: 113 patients (226 cochlear implants) were initially reviewed, with 56 patients (112 implants) being included in the final analysis. Median inter-implant interval was 187.5 days (*IQ range* 54.25 – 346.5). Maximum interval was 1787 days. Mean age at first implant was 60.66 ± 13.37 . Bilateral AzBio score in quiet and inter-implant interval showed no significant correlation ($r = 0.034$, $p = 0.815$). There was no significant difference in mean bilateral AzBio scores in quiet between the simultaneous and sequential implantation groups ($p = 0.22$). Similar non-significant results were seen when examining the correlation between CI Difference and inter-implant interval ($r = -0.07$, $p = 0.66$). No significant result between mean CI Difference of simultaneous and sequential implant recipients was found ($p = 0.06$).

Conclusions: For the inter-implant intervals examined, there seems to be no significant decline in speech intelligibility scores for patients receiving sequential bilateral cochlear implants compared to simultaneously implanted patients. There was no significant correlation noted between inter-implant interval and speech intelligibility scores.

Define Professional Practice Gap & Educational Need: Lack of knowledge of whether timing between bilateral cochlear implants can effect hearing outcomes in adults 2. Lack of knowledge of trends and current practices in bilateral cochlear implantation

Learning Objective: Learn the relationship between inter-implant interval and hearing outcomes in patients receiving bilateral cochlear implants 2. Provide information about trends in demographic information, typical inter-implant intervals, and hearing outcomes in bilateral cochlear implantation

Desired Result: Better ability to council patients on how long they can wait between cochlear implantation procedures 2. Better ability to predict what kinds of hearing results patients can expect from bilateral cochlear implantation

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Exempt

Modified Electrodiagnostic Testing for Acute Facial Nerve Paralysis

*Nicholas S. Andresen, MD; Vivian Zhu, BS
Marlan R. Hansen, MD; Bruce J. Gantz, MD
Daniel Q. Sun, MD*

Objective: Divergent practice patterns exist between neurologists and neurotologists in the modality of electroneurography (ENoG) used for facial nerve electrodiagnostic testing. We evaluated the accuracy and prognostic value of nasalis muscle compared to nasolabial fold ENoG in patients with acute facial nerve paralysis.

Setting: Academic tertiary care center.

Patients: Forty-nine patients who presented with traumatic or non-traumatic acute facial paralysis (House-Brackmann-HB grade 6/6) between 2008-2017.

Intervention: nasalis muscle and nasolabial fold ENoG testing.

Main outcome measures: Percent degeneration of ipsilateral facial nerve as measured by compound muscle action potential amplitudes on nasalis muscle and nasolabial fold ENoG, and HB score at one year post-paralysis.

Results: Extent of facial nerve degeneration as measured by nasalis and nasolabial fold ENoGs were highly correlated ($r=0.88$, 95% CI 0.79-0.93). When performed, serial ENoGs to assess trajectory of degeneration were also similar between modalities. For each ENoG modality, increased percent degeneration on ENoG was similarly associated with worse HB outcome at 1 year (nasalis $P\leq 0.01$, nasolabial fold $P\leq 0.01$). When stratified by non-surgical versus surgical management of facial paralysis, no significant difference (non-surgical $P=0.88$; surgical $P=0.93$) existed in prognostic values for final HB score between ENoG modalities. .

Conclusion: Nasalis testing may be a valid and comparable method to nasolabial fold ENoG for predicting the recovery of facial nerve function in acute paralysis. As nasalis testing is more broadly practiced in clinical electrophysiology, this presents an opportunity for increased penetration of electrodiagnostic testing in appropriate patients presenting with acute facial nerve paralysis.

Define Professional Practice Gap & Educational Need: Electrodiagnostic testing is seldom used by neurotologists in the setting of acute facial nerve paralysis, as nasolabial fold electroneurography (ENoG) is considered the standard, but is available at few centers. 2. Nasalis muscle ENoG testing is widely practiced, but rarely utilized by neurotologists.

Learning Objective: To describe and compare the ability of nasalis muscle and nasolabial fold ENoG testing to predict facial nerve function (HB score) at one year following acute facial paralysis.

Desired Result: Increased use of nasalis muscle ENoG and more widespread use of electrodiagnostic testing for acute facial nerve paralysis.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

Surveillance with High-Resolution T2 MRI after Resection of Vestibular Schwannoma: Volumetric Comparison

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Matthew O'Malley, MD; Alejandro Rivas, MD
David S. Haynes, MD*

Objective: Volumetrically compare high-resolution T2 (HRT2) magnetic resonance imaging (MRI) with contrast-enhanced T1 MRI (T1WI) for surveillance after resection of vestibular schwannoma (VS).

Study Design: Retrospective chart review

Setting: Tertiary neurotologic center

Patients: Adult patients with VS who had regrowth or recurrence detected with MRI.

Outcome measures: Comparison of HRT2 versus T1WI in assessing volumetric progression of VS after microsurgical resection.

Results: Between 2010 and 2017, 14 patients (64.3 % female, mean age 44.5 - range 28-60 years) were identified who had either recurrence or growth of tumor remnant after subtotal microsurgical resection of VS requiring additional treatment. Translabyrinthine approach was used in 10 (71.4%). Mean pre-treatment tumor volume (TV) was 12.4 cm³(SD 8.7). Sub-total (STR) was performed in 8 (57.1%), near total (NTR) in 5 (35.7%) and gross total (GTR) in 1 (7.1%) case. Progression was first identified at mean follow-up of 16.2 (range 6.5-30.3 months). Mean TV of the remnant using T1WI was 2.2 cm³(SD 1.8) and mean TV using HRT2 was 2.1 cm³(SD 1.8). Volumetric analyses of HRT2 and T1WI were not significantly different (Paired t test p=0.08) with high correlation (Pearson, r=0.99, p<0.001). A Bland-Altman plot of difference and mean volume showed stability of measures (bias 0.11; SD =0.22, 95% limits of agreement [-0.32-.54]).

Conclusions: HRT2 based volumetric assessment of tumor remnant is comparable and non-inferior to T1WI. The use of HRT2 for surveillance after resection of VS is effective at diagnosing tumor progression and prevents the unnecessary use of contrast in these patients.

Define Professional Practice Gap & Educational Need: Currently, surveillance after resection of Vestibular Schwannoma is largely based on contrasted MRI scans. There is limited knowledge with regards to the accuracy of T2 based sequences in detecting progression after prior resection.

Learning Objective: Compare T2 based volumetric analysis of tumor remnant and its accuracy with T1 based analysis.

Desired Result: Potentially substitute contrast-based imaging to high-resolution T2 weight sequences to decrease cost and potential side effects of contrast.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

Cochlear Implant Mapping Through Telemedicine – A Non-Inferiority Study

*Jacob I. Tower, MD; Jessica Preston, AuD
Adam Burkland, AuD; Cyndi E. Trueheart, AuD
Douglas M. Hildrew, MD*

Objective: To prove that cochlear implant (CI) mapping in remote locations via telemedicine is non-inferior to mapping performed via conventional in-person visits.

Study Design: Cohort-matched retrospective analysis of patients engaged in a CI telemedicine program.

Setting: A regional healthcare network with a centralized CI center and satellite audiology clinics (maximum 283 miles away).

Patients: CI recipients who live out-of-state from the CI center and engaged in telemedicine audiology.

Intervention: All patients underwent implantation and activation at the main institution. Subsequent mapping was done either via in-person audiology visits at the main institution, or via telemedicine sessions at satellite audiology clinics.

Main outcome measure(s): AzBio sentence test scores were compared between CI patients mapped via in-person encounters and remote telemedicine encounters. Patient satisfaction scores from a post-programming survey were also analyzed.

Results: CI recipients with AzBio scores prior to and during telemedicine mapping were included in the analysis; all device manufacturers were represented. Mean age at implantation and first telemedicine encounter was 66.0 and 68.9 years, respectively. Mean post-implantation follow-up was 1042 days in-person, and 186 days via telemedicine. There was no significant difference between conventional in-person mapping and telemedicine mapping in average AzBio test scores (48.5% versus 82.5% correct in CI-only condition, respectively; $P=0.07$).

Conclusions: This cohort-matched, non-inferiority study shows that CI mapping via telemedicine at remote locations is non-inferior to conventional in-person mapping. Survey responses indicate a positive patient experience with advantages of convenience and cost-efficiency. Telemedicine is a promising tool to reach patients that live in remote areas.

Define Professional Practice Gap & Educational Need: 1. Lack of awareness of telemedicine in neurotology, specifically as it applies to a cochlear implant practice. 2. Lack of knowledge of whether telemedicine cochlear implant mapping is as good as conventional in-person mapping. 3. Lack of knowledge whether cochlear implant patients have a positive or negative experience with telemedicine.

Learning Objective: The learning objective of this presentation is to understand that telemedicine cochlear implant mapping is efficacious and non-inferior in comparison to traditional, in-person mapping.

Desired Result: Attendees will learn that telemedicine is an effective tool for reaching cochlear implant patients in remote areas, and may consider adding this tool to their clinical practice.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Exempt

Impact of Obstructive Sleep Apnea and Obesity on Outcomes of Lateral Skull Base Cerebrospinal Fluid Leak Repair

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Marc L. Bennett, MD, MMHC*

Objective: To investigate the prevalence and impact of obstructive sleep apnea (OSA) and obesity in lateral skull base cerebrospinal fluid leak repair (LSBR).

Study Design: Retrospective case series.

Setting: Tertiary skull base center.

Patients: Consecutive adults undergoing repair between 2012-2018 with at least 6-month follow-up.

Interventions: LSBR via transmastoid, middle cranial fossa, or combined approach.

Outcome measures: radiology, presence of intracranial hypertension (ICH), surgical outcomes.

Results: 91 patients (65.2% female, mean age 53.2 ± 13.1 years) underwent repair for spontaneous (sCSFL, 45.1%) and other etiology (oCSFL) leaks. oCSFL served as a comparison group consisting of leaks status-post lateral skull base surgery, temporal bone fractures, and chronic ear disease. Elevated BMI ($p=.005$), ipsilateral (92.7%, OR=12.67) and contralateral tegmen thinning (22%, OR=4.5), empty sella (22%, OR=13.78), and superior canal dehiscence (15.8%, OR=8.57) were more common in sCSFL. Patients with tegmen thinning had higher BMIs ($p<.0001$) and increased rates of comorbid OSA (OR=6.7, $p=.002$). Those with multiple defects had higher BMIs ($p=.0003$). Three (2.2%) required surgical revision for recurrence, and six (6.6%) resolved with shunting.

Conclusions: Obesity was associated with tegmen thinning and multiple defects and may predispose to sCSFL. Contralateral disease was infrequent, suggesting the role for additional, potentially local factors. While ICH is believed to contribute to sCSF development, shunting and revision rates were low in this series. Combined approach with multilayer repair is safe and effective with respect to outcomes and need for revision, regardless of leak etiology or presence of OSA and obesity.

Define Professional Practice Gap & Educational Need: Inconsistencies within published data of failure rates following repair of spontaneous cerebrospinal fluid leaks.

Learning Objective: To review the patient variables thought to contribute to spontaneous cerebrospinal fluid leaks and their outcomes following a autologous multilayer repair, primarily via combined transmastoid-middle cranial fossa approach.

Desired Result: Our data is consistent with the current literature in identifying obesity as a possible predisposing condition for spontaneous cerebrospinal fluid leaks. However, these patients can be repaired safely via a combined approach with multilayer repair without rare need for revision surgery. Additionally, while a few patients did require shunts, the majority of patients did not require intervention to address intracranial hypertension. This data may be useful in patient counseling, expectations regarding surgical outcomes and deciding the surgical approach and repair.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

The Cost of Skull Base Surgery for the Resection of Vestibular Schwannomas

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Marc S. Schwartz, MD; Quyen T. Nguyen, MD, PhD
Rick A. Friedman, MD, PhD*

Objective: To determine the surgical costs associated with the translabyrinthine (TL), retrosigmoid (RS) and middle cranial fossa (MCF) approaches for the microsurgical excision of vestibular schwannoma (VS).

Study Design: Retrospective cost analysis study.

Setting: Tertiary referral center.

Patients: Twenty-one consecutive adult patients underwent microsurgical excision of VS by either TL (n=7), RS (n=7) or MCF (n=7) approach. Tumors were restricted to size between 1-2.5 cm. Patients with a history of neurofibromatosis 2, preoperative radiosurgery, or previous surgical resection were excluded.

Interventions: Patients underwent microsurgical excision of VS by one of the three major approaches. Surgical receipts were collected for each patient. Analysis of variance was performed to compare surgical costs between approaches.

Main outcome measures: Surgical supply costs (US\$), total room time (minutes) and skin-to-skin operating time (minutes).

Results: The mean surgical supply cost was lowest for MCF and highest for RS (\$3013.85 and \$7966.39, respectively, $p=0.003$). Mean supply cost was \$4295.51 for the TL approach. The items associated with the highest average cost per case were the surgical aspirator (\$1020), drill burs (\$930.80) and titanium implants (\$620). There was redundancy in multiple surgical items such as drill burs and hemostatic agents. On average, total room time for all approaches was 85.8 min longer than skin-to-skin time.

Conclusion: This study is the first to examine the surgical expenses associated with VS resection. Reduction in supply redundancy provides the opportunity for decreasing surgical costs and waste. Future analyses will include total surgical day costs, intensive care unit and total admission costs.

Define Professional Practice Gap & Educational Need: Lack of awareness of surgical costs associated with lateral skull base approaches

Learning Objective: To compare and break down the surgical costs associated with the translabyrinthine, retrosigmoid and middle cranial fossa approaches for the microsurgical excision of vestibular schwannoma. Ultimately the long term goal is to reduce surgical costs and surgical waste.

Desired Result: Increase their awareness about the costs of surgical supplies, and potentially have more conservative requests in their upcoming cases.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

The Opioid Crisis: Are We Part of the Problem?

*Kathryn Y. Noonan, MD; Anne K. Maxwell, MD
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Objective: The United States is experiencing an opioid overdose crisis. Many of these drugs are prescribed by physicians. According to the NIH, prescription opioids were responsible for 33% of over-dose related deaths in 2015. This study seeks to quantify post-operative pain after otologic outpatient surgery and track prescription usage.

Study Design: Prospective investigation of pain control in otologic surgical patients using a pain survey and phone interviews.

Setting: Tertiary-referral otology practice

Patients: Sixty-five patients who underwent outpatient otologic surgery

Interventions: Hydrocodone-acetaminophen (20 pills prescribed) and over-the-counter (OTC) pain medications

Main outcome measures: Pain as measured on the 1-10 pain scale and use of prescription and OTC pain medications.

Results: There was a wide range of prescription use habits with 30% of post-operative patients using no prescription pain medications and 22% using most or all of their medications. The majority of patient reported steady improvement in pain levels after surgery however almost 20% report their pain was the most severe on post-operative days one to two. There was no difference in pain levels between male and female patients ($p=0.83$). One patient required a refill. Sixty-five percent used OTC analgesics. There was no statistical difference between reported pain levels in patient that used OTC medications and those that did not ($p=0.27$). Over 60% of prescribed pills were unused. The majority of patient (70%) reported saving additional medications for possible future needs.

Conclusions: Post-operative pain is subjective and varies widely between patients. Further recommendations to improve prescribing practices will be discussed.

Define Professional Practice Gap & Educational Need: In 2017 the opioid crisis was declared a "Nationwide Public Health Crisis" which is in part fueled by physician prescriptions. This stems from a significant lack of awareness and inconsistencies in prescribing habits. Pain is subjective and varies between people making it difficult to predict the required amount of necessary medications after surgery. This presentation will review patient reported pain levels and use of prescriptions medications and how this varies between different types of otologic surgeries. 1. Lack of awareness of postoperative pain levels and ideal amount of medications 2. Inconsistencies in prescribing habits

Learning Objective: Quantify patient pain levels after surgery Illustrate pain medication use in post-surgical patients and track excess pills Stratify modifying factors that predict pain levels

Desired Result: Improved prescribing habits after otology surgery Increased awareness of surgeons' contribution to the opioid crisis

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

Middle Fossa BONEBRIDGE Implantation with Self-Drilling Screws - Audiometric Outcomes in Conductive and Mixed Hearing Loss

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Sumit K. Agrawal, MD*

Objectives: To present audiometric outcomes of patients implanted with the BONEBRIDGE bone-conduction device using the novel middle fossa surgical approach with self-drilling screws.

Study design: Retrospective case series

Setting: Tertiary referral center

Patients: Adult patients who received BONEBRIDGE implantation using the middle fossa approach from Jan 2014 to May 2018 with audiological testing at activation and three months post-operatively.

Intervention: Middle fossa BONEBRIDGE implantation with self-drilling screws.

Main outcome measures: Unaided pure-tone air conduction and bone conduction thresholds were measured using standard audiometric techniques pre-operatively. Post-operatively, bone conduction thresholds were measured in sound field with the patient's BONEBRIDGE device in place. Masking of the non-implanted ear was completed as required using standard masking protocols. Average air-bone gap and functional gain values were calculated.

Results: Thirty-seven patients with either conductive or mixed hearing loss met inclusion criteria (15 males, 22 females; average age 47 years). Post-operative air-bone gap closure was seen in all cases (mean 4.69 dB), and overclosure in some cases. The average functional gain was 17.3 dB for all patients. At the time of data collection, there had been no complications. Data was collected at a mean follow-up time of 26 months (range 3-53months).

Conclusion: Audiometric outcomes of patients implanted with the BONEBRIDGE via the middle fossa approach with self-drilling screws were comparable to those previously reported in the literature using the mastoid or retrosigmoid approaches with the standard self-tapping screws. The middle fossa BONEBRIDGE implantation is therefore a viable option for patients with conductive or mixed hearing loss.

Define Professional Practice Gap & Educational Need: There is a lack of contemporary knowledge regarding the middle fossa surgical approach to BONEBRIDGE bone-conduction device implantation and associated surgical and audiological outcomes for the treatment of mixed and conductive hearing loss.

Learning Objective: At the end of this presentation, physicians and trainees should be able to describe the middle fossa surgical technique using self-drilling screws for BONEBRIDGE bone-conduction device implantation and discuss the associated outcomes as they compare to other surgical techniques.

Desired Result: This presentation will improve competence of physicians and trainees by providing education on an efficacious surgical technique for implanting the BONEBRIDGE bone-conduction device, which may in turn improve practice performance and patient outcomes.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Exempt

Assessment of the Role of Gender on Early Postoperative Cochlear Implant Outcomes

*Mallory J. Raymond, MD; Samir Ballestas Naissir, MD
Esther X. Vivas, MD*

Objective: To determine the presence of gender differences in cochlear implant outcomes

Study design: Retrospective chart review

Setting: Tertiary referral center

Patients: Adults who underwent standard cochlear implantation from 2009 until 2017 with 3-month post-implantation hearing outcomes

Intervention(s): Standard electrode length cochlear implantation

Main outcome measure(s): AzBio scores at the 3-month post-activation visit

Results: Of 57 patients with complete preoperative characteristics and 3-month postoperative cochlear implant speech recognition testing, 42% were male. The average age of the cohort at implantation was 64 ± 14.5 years and there was no significant difference between genders. Female gender predicted improved early post-activation AzBio scores compared to male gender ($73.6 \pm 20.8\%$ vs $47.7 \pm 26.1\%$, $p < 0.0002$), however the duration of hearing loss differed significantly between females and males (18.4 ± 14 vs 28.9 ± 21 , $p < 0.04$). After controlling for age at time of surgery, implant manufacturer, electrode type, duration of hearing loss, etiology of hearing loss and preoperative AzBio scores, the effect of gender remained significant ($p < 0.002$).

Conclusions: Gender may play a role in early cochlear implant outcomes.

Define Professional Practice Gap & Educational Need: Lack of knowledge on the role of gender in hearing restoration outcomes

Learning Objective: The objective is to demonstrate a potential role of gender on early postoperative cochlear implantation speech recognition.

Desired Result: Attendees will be aware of the potential role of gender on cochlear implant outcomes and design larger studies to further investigate the effect size.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

Validation of High-Frequency Ovemp Testing in the Evaluation of Possible Superior Semicircular Canal Dehiscence

*Kenny Lin, MD (primary); Ryan Lahey
Rachel Beckley, AuD; Dennis Bojrab, MD (presenter)
Brent Wilkerson, MD; Emily Johnson, DO; Robert Hong, MD*

Objective: Cervical and ocular vestibular evoked myogenic potentials (cVEMP and oVEMP) are diagnostic tests employed in the evaluation of possible superior semicircular canal dehiscence (SSCD). Manzani et al published previously that the presence of the n10 component of oVEMP at 4 kHz was diagnostic of SSCD with sensitivity and specificity of 1.0. This study reviewed 233 consecutive patients who underwent oVEMP testing to validate the diagnostic accuracy of high frequency oVEMP testing.

Study Design: Retrospective case review.

Setting: Ambulatory neurotology private practice.

Patients: 233 consecutive patients.

Intervention: oVEMP testing as well as high-resolution CT imaging of the temporal bone.

Main outcome measures: The presence or absence of CT-verified SSCD was identified from the imaging report and verified by the lead author. The presence or absence of the oVEMP n10 component at 4 kHz was identified.

Results: A total of 87 patients had CT imaging findings consistent with SSCD. 36 (41.3%) of these patients also demonstrated the n10 component on oVEMP testing. The oVEMP n10 component was present in 67 patients, of which 36 (53.7%) also had findings consistent with SSCD on CT imaging. The corresponding sensitivity is 0.41, specificity is 0.77, positive predictive value is 0.54, and negative predictive value is 0.67.

Conclusions: A consecutive series of 233 patients undergoing oVEMP testing found that the presence of the n10 component at 4 kHz was mildly predictive of CT-verified SSCD with sensitivity of 0.41, specificity of 0.77, positive predictive value of 0.54, and negative predictive value of 0.67.

Define Professional Practice Gap & Educational Need: Lack of contemporary knowledge on the usefulness of the n10 response at 4000 Hz on oVEMP testing. It was previously published that the presence of this waveform was diagnostic of superior semicircular canal dehiscence. This finding has not been verified in the literature.

Learning Objective: To present data evaluating the diagnostic accuracy of the n10 response at 4000 Hz on oVEMP testing, which was previously published as being 100% accurate.

Desired Result: The audience will have a better understanding of the utility of oVEMP testing in the diagnosis of superior semicircular canal dehiscence.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Exempt

Comparison of Presentation of Spontaneous Temporal Bone Cerebrospinal Fluid Leaks from the Middle and Posterior Fossa and Management of Posterior Fossa Leaks

*Timothy Cooper, MD; Matthew H. Choy, BA
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Andrew A. McCall, MD*

Objectives: To compare patients surgically managed for spontaneous cerebrospinal fluid (CSF) leaks of the temporal bone arising from the middle cranial fossa (MCF) and posterior cranial fossa (PCF) and to describe the surgical management of posterior fossa CSF leaks.

Study Design: Retrospective case review

Setting: Academic tertiary center

Patients: Adult patients presenting with spontaneous temporal bone CSF leaks undergoing operative repair between January 2010 and August 2018. Patients with a history of trauma, prior mastoid surgery, and iatrogenic CSF leaks were excluded.

Intervention: Transmastoid or MCF CSF leak repair.

Main Outcome Measures: Patient demographics, body mass index (BMI), comorbidities, presenting features, and lumbar puncture opening pressures were compared between groups and the management of the PCF CSF leaks described.

Results: Forty-four patients (27 females, 17 males) were included. The mean age at the time of repair was 57.8 ± 13.0 years (\pm SD). The origin of the CSF leak was from the PCF in 3 patients and MCF in 41 patients. All three patients with PCF leaks presented with a history of meningitis compared to only six in the MCF group. This difference was statistically significant ($p < 0.01$, Fisher's Exact Test). There were no statistically significant differences in age, gender, BMI, or lumbar puncture opening pressures. The PCF leaks were repaired using a transmastoid approach with multilayer closure of the bony defect and fat graft obliteration of the mastoid.

Conclusions: Spontaneous CSF leaks arising from the PCF are rare and may more commonly present with meningitis. Identification requires careful review of imaging.

Define Professional Practice Gap & Educational Need: Spontaneous temporal bone CSF leaks arising from the PCF are an uncommon presentation. More commonly, defects in the tegmen communicating with the MCF are the cause of spontaneous CSF leaks involving the temporal bone. The etiology of posterior fossa CSF leaks is hypothesized to be secondary to bony defects created by erosion from arachnoid granulations. These patients may present with conductive hearing loss, CSF otorrhea or rhinorrhea, chronic middle ear effusions, or meningitis. Due to the rarity of this presentation, description of patient demographics, presenting features, and management is limited in the literature.

Learning Objective: At the conclusion of this activity, the learner will be able to: 1. Identify the PCF as an uncommon site for spontaneous temporal bone CSF leaks. 2. Characterize patients presenting with PCF CSF leaks in comparison to those with MCF CSF leaks. 3. Describe a technique for the surgical repair of spontaneous temporal bone CSF leaks originating from the posterior fossa.

Desired Result: To stimulate discussion on the patient characteristics and management of the rare presentation of spontaneous temporal bone CSF leaks arising from the PCF. The attendees will apply this knowledge when evaluating and managing patients with CSF leaks. Attendees may choose to use described operative techniques to repair PCF CSF leaks.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

Intraoperative Cochlear Physiology During Translabyrinthine Approaches

*Kevin Zhan, MD; William J. Riggs, AuD
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Aaron C. Moberly, MD; Edward E. Dodson, MD
Oliver F. Adunka, MD*

Objective: To evaluate whether reduction in speech recognition performance is due to sensory or neural impairments in patients with tumors of the vestibulocochlear nerve

Study design: Prospectively enrolled single-arm study

Setting: Tertiary academic hospital

Patients: Adult patients undergoing translabyrinthine tumor resection

Main outcome measure(s): Audiometric thresholds, word recognition, and electrocochleography total response (ECochG-TR)

Results: ECochG-TR data was recorded from the round window in a prospectively enrolled cohort of 34 adult patients undergoing lateral skull base tumor resection. 54% were female. Mean age was 55.7 years (range 18-77). Mean tumor size in maximum dimension was 24.5mm (range 3-56mm). 95% of tumors were vestibular schwannoma, with 1 hemangiopericytoma and 1 follicular lymphoma. Average three-tone pure tone average (PTA) was 59.4 dB HL (SD 30.6) and mean word recognition score (WRS) was 44.2% (SD 35.1). In linear regression, PTA alone accounted for 58.6% of the variance in WRS. In a combined model, PTA and ECochG TR accounted for 70.8% of speech perception. Age and maximum tumor dimension were not predictive in a multiple regression.

Conclusions: Our preliminary data suggest that reduction in WRS seen in patients with tumors of the vestibulocochlear nerve are due primarily to loss of sensory function of the cochlea.

Define Professional Practice Gap & Educational Need: Lack of physiologic evidence to explain etiology of hearing loss in patients with lateral skull base tumors.

Learning Objective: Learner will appreciate novel technique in evaluating hearing loss in patients with lateral skull base tumors.

Desired Result: Learners may consider applying this approach to evaluating etiology of hearing loss in patients with lateral skull base tumors

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

Cochlear Enhancement Precedes Cochlear Obliteration after Excision of Vestibular Schwannoma

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Dwayne Anderson, MD; Leslie S. Son, PhD
Moises A. Arriaga, MD*

Objective: Cochlear obliteration after vestibular schwannoma excision has been noted, with implications on cochlear implantation. MRI radiographic findings before obliteration have been observed and are described here.

Study design: Retrospective case review

Setting: Tertiary referral center, ambulatory

Patients: Patients receiving vestibular schwannoma excision surgery by the senior author performed at one institution between January 2015 to July 2017 with post-operative MRIs.

Intervention: Diagnostic

Main outcome measure(s): The imaging characteristics on post-operative MRIs examined were loss of fluid signal on post-operative T2 images and cochlear enhancement on gadolinium enhanced T1 images. In the patient receiving labyrinthine sparing procedures, presence of post-operative hearing was evaluated.

Results: Of the 40 patients evaluated, 22 received the translabyrinthine approach and 18 received a labyrinth sparing surgery. Twenty-eight had evidence of cochlear enhancement on T1 with gadolinium contrast, and 26 had evidence of cochlear obliteration on T2 images. The odds ratio of patients with cochlear enhancement having obliteration is 13.8:1 ($p < 0.001$). Intense cochlear enhance ($n=17$) appeared on average 166 days after surgery, and complete or near complete obliteration ($n=18$) appeared on average 476 days after surgery, a statistically significant difference ($p < 0.001$). Within the labyrinth sparing group, loss of hearing was correlated with cochlear obliteration, with an odds ratio of 10.6:1 ($p < 0.05$), but the correlation between hearing loss and cochlear enhancement was not statistically significant.

Conclusions: Cochlear enhancement is correlated with cochlear obliteration, and it appears to precede it.

Define Professional Practice Gap & Educational Need: Lack of contemporary knowledge of MRI imaging characteristics of the cochlea after vestibular schwannoma excision

Learning Objective: Identify cochlear enhancement and cochlear obliteration on post-operative MRIs 2. Recognize timing of cochlear enhancement as it relates to cochlear obliteration 3. Recognize that cochlear obliteration may complicate cochlear implantation

Desired Result: In patients who have received vestibular schwannoma excision, recognizing that cochlear enhancement precedes cochlear obliteration may help identify patients who would be candidates for early cochlear implantation.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

**Analysis of Intraoperative Electrocochleography in Patients
with Meniere's Disease Undergoing Endolymphatic
Decompression and Shunt Surgery**

*Jameson K. Mattingly, MD; Kevin Y. Zhan, MD
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Aaron C. Moberly, MD; Oliver F. Adunka, MD
William J. Riggs, AuD*

Hypothesis: Objective physiologic changes measured by electrocochleography at the round window (ECochGRW) will be seen during endolymphatic sac decompression and shunt surgery (ELS).

Background: Limited effective treatment options are available to patients with Meniere's disease (MD) with substantial residual hearing who have failed conservative management and experience persistent vertigo symptoms. ELS is a feasible option for these patients. However, the efficacy of this procedure has been questioned, and objective measures assessing inner ear physiologic alterations are lacking.

Methods: ECochGRW was measured in patients with recalcitrant MD undergoing ELS. Stimuli consisted of tone bursts (0.25, 0.5, 1, 2, 4 kHz) and 100 μ s broadband clicks at various intensities (60-90 dB nHL). Cochlear microphonic (CM) harmonic distortions, the summing potential (SP), compound action potential (AP), and SP:AP ratio were measured.

Results: ECochGRW was recorded from 18 patients. Mean SP magnitude at 0.5 kHz changed significantly from -8.7 μ V before to -6.8 μ V after ELS ($p < 0.05$). Mean SP/AP ratio did not significantly change (0.61 pre- and 0.62 post-ELS $p = 0.90$). CM harmonic magnitudes remained unchanged from pre- to post-ELS across all frequencies. The 1st harmonic CM saturation point of the 0.5 kHz response was identified to be between 70- 80dB nHL.

Conclusion: ECochGRW during ELS allows for analysis of acute physiologic changes. Our results indicate small changes in the low frequency SP (.5 kHz) after ELS. Further changes may be identified within the post-operative period that cannot be captured intraoperatively. Significant changes to overall CM magnitude and harmonic distortions were not observed.

Define Professional Practice Gap & Educational Need: 1) Lack of an objective physiologic measure after vestibular surgeries, such as endolymphatic decompression and sac surgery 2) Inconsistencies within the literature regarding the efficacy of endolymphatic decompression and sac surgery

Learning Objective: To provide a better understanding of physiologic measures of the inner ear (i.e. electrocochleography) in response to an intervention, such as with endolymphatic decompression and sac surgery.

Desired Result: To better understand objective changes in vestibular physiology as a result of endolymphatic decompression and sac surgery.

Level of Evidence - Level III - Cohort and case-control studies

Indicate IRB or IACUC Approval: Approved

Hearing Loss Associated with Osteoradionecrosis of the Temporal Bone

*Paul W. Gidley, MD; Marc-Elie Nader, MD, MSc
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Objective: Describe the hearing loss associated with osteoradionecrosis (ORN) of the temporal bone.

Study design: Retrospective case review

Setting: Tertiary referral center

Patients: Fifty-eight patients who developed exposed bone in the ear canal following radiotherapy.

Intervention(s): Audiograms.

Main outcome measure(s): Hearing levels and radiation dosages in patients with temporal bone ORN.

Results: Sixty-four ears with osteoradionecrosis of the temporal bone were identified. The average patient age was 60.2 years (range 23-91 years). The most common primary tumors were parotid (37.9%), nasopharynx (19.0%), and periauricular skin (10.3%). Radiation technique included intensity modulated radiation therapy (IMRT) in 58.8% and appositional fields in 29.4%. Total radiation dosages to the primary tumor varied from 30 to 129 Gy (mean = 60.4, STD=16.5 Gy). The average mean dose was 44.9 Gy, 50.5 Gy, and 59.0 Gy to the cochlea, ear canal, and mastoid tip, respectively. The mean time between completing radiotherapy and diagnosis of ORN was 93 months. An air conduction pure tone average (PTA) was 47.1 dB in the ears with ORN versus 29.6 dB in the non-ORN ears ($p < 0.0001$). The average air-bone PTA gap for ORN ears was 14.8 dB versus 3.1 dB in non-ORN ears ($p < 0.001$).

Conclusions: This is the largest single institution study of hearing loss in patients with ORN. ORN is associated with significant mixed hearing loss in the affected ear.

Define Professional Practice Gap & Educational Need: Hearing loss associated with osteoradionecrosis of the temporal bone has not been well described in the literature, and this represents a lack of contemporary knowledge.

Learning Objective: To describe the hearing loss associated with osteoradionecrosis of the temporal bone.

Desired Result: Attendees will learn the degree and type of hearing loss associated with osteoradionecrosis of the temporal bone.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

Is Longer Surgery More Dangerous? Operative Duration Not Associated with Complications after Vestibular Schwannoma Resection

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Joseph T. Breen, MD*

Objectives: To examine the association between operative duration and complications after vestibular schwannoma (VS) surgery

Study Design: Retrospective chart review

Setting: Tertiary referral center

Patients: 148 patients undergoing vestibular schwannoma resection in a single institution

Intervention: Vestibular schwannoma resection

Main outcome measures: Operative duration, surgical approach, tumor size and postoperative complications

Results: Forty-one patients underwent middle cranial fossa (MCF) approach, 46 underwent translabyrinthine (TL) approach and sixty-one underwent retrosigmoid (RS) approach. The mean operative duration overall was 407 minutes (MCF – 339 minutes, TL – 450 minutes, RS 420 minutes). When controlling for tumor size, there was no difference in procedure duration by approach (OR 0.92, CI 0.82 – 1.02, p=0.11). When controlling for approach, there was a significant increase in procedure duration by tumor size (OR 1.36, CI 1.23 – 1.50, p<0.0001). Increased procedure duration was not associated with 30-day readmission (p=0.83), cerebrospinal fluid leak (CSF) (p=0.81), CSF leak requiring surgical repair (p=0.36), return to the operating room (p=0.73), postoperative myocardial infarction (p=0.51), postoperative deep vein thrombosis (p=1.0), postoperative stroke (p=0.21) or postoperative wound complications (p=0.69). Increased procedure duration was associated with increased hospital length of stay (p=0.03). However, when controlling for tumor size and surgical approach, hospital length of stay was no longer associated with increased procedure duration (OR 1.15, CI 0.98 – 1.33, p=0.053).

Conclusion: Increased operative duration was associated with larger tumor size, however contrary to previous reports, increased operative duration was not associated with postoperative complications.

Define Professional Practice Gap & Educational Need: Data on the impact of operative time on surgical outcome and complication is scarce. 2. Data on the association between operative time and complications in lateral skull base surgery is mostly based on national database analysis and not institutional data with patient specific characteristics.

Learning Objective: 1. Discuss the current literature on the association between operative duration and postoperative complications. 2. Discuss study's findings on the association of operative duration with surgical outcome and complications.

Desired Result: Findings may mitigate concerns related to longer operative duration and the risk for complications.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

**Detection Rates of Cholesteatoma with Preoperative Non-Echo
Planar Diffusion-Weighted MRI in Patients
Who Underwent Tympanomastoidectomy**

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Rahul Mehta, MD; Dwayne T. Anderson, MD
Alexander B.G. Sevy, MD*

Objective: The purpose of this study is to evaluate the diagnostic performance of Non-Echo Planar DWMRI in the detection of cholesteatoma in patients who underwent mastoidectomy.

Study Design: This study was a retrospective chart review of patients who underwent mastoidectomy. Non-Echo Planar DWMRI was performed on all patients prior to mastoid surgery. Radiological findings were correlated with intraoperative findings.

Setting: Surgery was performed by one of three Otolaryngology/Neurotology fellowship trained surgeons at a tertiary referral center.

Patients: Patients in this study had preoperative imaging with Non-Echo Planar DWMRI prior to undergoing mastoidectomy.

Interventions: Patients underwent a diagnostic Non-Echo Planar MRI and a therapeutic mastoidectomy.

Main Outcome Measures: This study evaluated the reliability of Non-Echo Planar imaging based on sensitivity, specificity, positive predictive value, and negative predictive value.

Results: Non-Echo Planar DWMRI correctly identified the presence or absence of cholesteatoma in 74 out of 92 cases. The sensitivity was determined to be 75% (39/52) while the specificity was 87.5% (35/40). The positive predictive value was 88.6% (39/44) while the negative predictive value was 72.9% (35/48).

Conclusions: Non-Echo Planar imaging continues to show high specificity in diagnosing cholesteatoma prior to mastoidectomy, but due to the presence of false negatives, we believe that a negative test result should not exclude the possibility of cholesteatoma. These patients should be followed closely with routine monitoring of symptoms and regular follow up to prevent complications of cholesteatoma.

Define Professional Practice Gap & Educational Need: There are currently inconsistencies in the way providers manage patients with suspected cholesteatoma as well as in the postoperative course in those patients that have undergone mastoidectomy.

Learning Objective: We seek to determine the clinical utility of Non-Echo Planar imaging in the preoperative evaluation of patients with suspected cholesteatoma prior to mastoidectomy. We hope this can spare patients from the costly and sometimes complicated second look procedures.

Desired Result: We hope attendees will apply this knowledge to their practice to both save patients a second operation if not necessary while also performing mastoidectomy to remove pathology in those that otherwise may have gone undetected.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

Trends in Age of Cochlear Implant Recipients and the Impact on Complication Rates

*Shayan Fakurnejad; Daniel Vail
Yohan Song, MD; Jennifer C. Alyono, MD
Nikolas H. Blevins, MD*

Objective: To examine trends in the age of patients receiving cochlear implantation, and to determine the effect of age on the rate of postoperative complications.

Study design: Retrospective analysis of de-identified administrative claims data from a US commercial insurance database (Optum), which includes medical and demographic information for nearly 53 million unique members.

Patients: Individuals undergoing cochlear implantation between 2003-2016.

Setting: US hospital and outpatient facilities serving commercially insured patients

Intervention: Cochlear implantation

Main outcome measures: age at implantation, incidence of complications within 30 postoperative days identified by ICD9/10 codes including device failure, myocardial infarction, stroke, venous thromboembolism, cellulitis, meningitis, stroke, cerebrospinal fluid leak, and facial weakness.

Results: Between 2003-2016, 4,148 patients underwent cochlear implantation. The number of implants per year increased annually from 154 surgeries in 2003 to 556 in 2016, with the greatest growth demonstrated in those aged 60-89. The average age of adults undergoing implantation increased annually from an average of 44.1 to 65.2 years ($p < 0.001$). The proportion of patients undergoing implantation who were >60 and >80 years increased from 23.1% and 2.5% among the first 7 years of analysis, respectively, to 50.5% and 14.3% in the subsequent 7 years ($p < 0.001$). No significant differences in 30-day complication rate were found between patients when grouped by age in decades, except for device related failures, which was significantly higher in younger patients (<29 years).

Conclusions: Over the past decade and a half, cochlear implantation is more frequently being performed, and in an increasingly aging population. This trend does not seem to alter the risk of perioperative complications.

Define Professional Practice Gap & Educational Need: Lack of awareness of the trends in age at the time of cochlear implantation, and the implications in regards to patient safety, due to a lack of large, claims-based studies

Learning Objective: To better understand the trends in incidence of cochlear implantation, in particular in elderly patients, and to determine what impact this trend may have on patients safety in regards to postoperative complications amongst the different age groups.

Desired Result: To demonstrate that cochlear implantation is an increasingly common procedure in an increasingly aging population, but nevertheless remains a safe procedure. As such, cochlear implantation should be considered in all age groups, including the elderly.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Exempt

**Treating the Individual Ear in Children:
Results of Cochlear Implantation in Children
with Asymmetric Sensory Hearing Loss**

*Elizabeth Perkins, MD; Michelle Nguyen, BS
Lisa R. Park, AuD; Erika Gagnon, AuD
Jennifer Woodard, AuD; Elizabeth Preston, AuD
Kevin D. Brown, MD, PhD*

Objective: Determine speech outcomes of children undergoing cochlear implantation with severe to profound hearing loss in the implanted ear and moderate or better hearing loss in non-implanted ear.

Study design: Retrospective chart review

Setting: Tertiary referral center

Patients: 49 children with severe to profound hearing loss in the ear to be implanted (pure tone average-PTA), and no worse than moderate hearing loss in the non-implant ear.

Intervention: Subjects underwent cochlear implantation from 2007-2017 in the ear with severe to profound hearing loss.

Main outcome measures: Consonant Nucleus Consonant or Phonetically Balanced Kindergarten word scores pre- and post-operatively were compared in both the implanted ear and binaural setting. The word score list compared pre- and post-operatively was consistent within each study subject.

Results: The average PTA for the implant ear was 92 ± 13 and 55 ± 12 in the non-implant ear. Word scores for the implant ear increased an average of 58 ($\pm 27\%$) following cochlear implantation at 12 months and 62 ($\pm 20\%$) at 24 months. Binaural best-aided word scores increased an average of 36 ($\pm 29\%$) at 12 months and 49 ($\pm 24\%$) at 24 months.

Conclusion: Children with asymmetric sensory hearing loss should have each ear treated individually as significant benefits can be gained not only in the implanted ear, but also in binaural hearing.

Define Professional Practice Gap & Educational Need: Current FDA criteria for cochlear implantation in children is bilateral severe to profound hearing loss. Expanding indications have permitted cochlear implantation in children with higher levels of hearing in the non-implant ear, although speech outcomes following cochlear implantation in this population are not well described.

Learning Objective: To gain knowledge in the expanding indications of cochlear implantation in children. To understand the potential benefits of cochlear implantation in children with asymmetric hearing loss that may not meet the standard, currently approved FDA criteria. To learn that unilateral cochlear implantation in children with asymmetric hearing loss is beneficial in both the implanted ear and binaural setting.

Desired Result: The attendee may begin to offer cochlear implantation to the non-traditional pediatric candidate with the goal of expanding current FDA criteria.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

Electrode Type and its Impact on Impedance Fluctuations and Loss of Residual Hearing in Cochlear Implantation

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Hypothesis/Objective: Determine variables associated with electrode impedance fluctuations and loss of residual hearing in cochlear implant recipients.

Background: Postoperative low-frequency hearing preservation is routinely possible, resulting in improved speech perception with acoustic plus electric stimulation. Recent reports have suggested a relationship between fluctuations in electrode impedance and loss of residual hearing. Variables affecting this relationship have yet to be determined.

Methods: Review of pediatric and adult cochlear implant recipients from 2013-2016 with postoperative hearing preservation. The correlation between impedance change and change in residual low frequency hearing at 12 months was determined. Regression analysis evaluating the effect of array type (lateral wall vs. perimodiolar), manufacturer, age, and pre-operative hearing on impedance was determined.

Results: Ninety-four cochlear implant recipients presented with postoperative hearing preservation. An association between change in impedance and loss of residual hearing was observed, however differed between manufacturers ($R^2=0.30$, $P = 0.01$ vs. $R^2=0.01$, $P =0.77$). Average absolute impedance changes were higher for a slim electrode inserted to 20mm vs. a flexible electrode inserted to 24mm; approaching significance ($p=0.08$). A multivariate regression analysis demonstrated a statistically significant association between preoperative low-frequency pure-tone average ($p=0.048$), device manufacturer ($p=0.012$), and array type ($p=0.02$) on impedance changes. There was no effect of patient age.

Conclusion: Impedance fluctuations appear to be a marker for delayed loss of residual hearing for some electrode array types and manufacturers but not others. Specific electrode arrays may affect the cochlear microenvironment differently, resulting in a local reaction with subsequent negative impact on postoperative hearing preservation.

Define Professional Practice Gap & Educational Need: Lack of awareness of the association between electrode impedance fluctuations and loss of residual hearing in cochlear implantation. 2. Lack of contemporary knowledge regarding the variables that affect the relationship between electrode impedance and loss of residual hearing in cochlear implantation.

Learning Objective: To determine variables affecting the relationship between electrode impedance fluctuations and loss of residual hearing in cochlear implantation.

Desired Result: Attendees will better understand the relationship between electrode impedance fluctuations and loss of residual hearing after cochlear implantation and begin to critically think about factors that may influence this relationship and long-term hearing outcomes after implantation.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Approved

Custom Mastoid-Fitting Templates to Improve Cochlear Implant Electrode Insertion Trajectory

*William G. Morrel, MD; Katherine E. Riojas
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Jack H. Noble, PhD; Robert F. Labadie, MD, PhD*

Hypothesis: Intracochlear positioning of cochlear implant (CI) electrode arrays (EAs) can be improved using custom templates to specify ideal insertion trajectory.

Background: Insertion trajectory affects final intracochlear CI positioning. Limited information is available intraoperatively regarding ideal insertion trajectory.

Methods: After IRB exemption, 3D reconstructions were created from CT scans of three cadaveric temporal bones. Trajectories co-planar with each cochlea's basal turn were considered ideal. Templates were designed to fit against the mastoid and demonstrate ideal insertion trajectory with a hollow cylinder. Templates were 3D printed using stereolithography. Mastoidectomy was performed on all bones. A custom, roller-based insertion tool was used to constrain electrode insertions to intended trajectories. Insertions were performed with MED-EL Standard electrodes in three bones with three conditions: ideal trajectory with tool, non-ideal trajectory with tool, and ideal trajectory with forceps. For the final condition, the template was used to mark the mastoid as a trajectory guide. Insertion was stopped when buckling occurred.

Results: Insertions along ideal vs non-ideal trajectories averaged more intracochlear electrodes (ideal: 9, 8, 8; non-ideal: 7, 7, 8) and greater angular insertion depths (AID) (ideal: 377°, 341°, 320°; non-ideal: 278°, 302°, 290°). Insertions performed with forceps but using templates as a guide also achieved excellent results (intracochlear electrodes: 10, 7, 8; AID: 478°, 318°, 333°). No scalar translocations occurred.

Conclusions: Custom mastoid-fitting templates reliably specify a trajectory co-planar with the cochlea's basal turn and provide sufficient information for recreation of that trajectory with manual insertion after template removal. Secondly, our roller-based insertion tool achieves results comparable to manual insertion.

Define Professional Practice Gap & Educational Need: Lack on intraoperative tools for cochlear implant insertion trajectory 2. Lack of awareness of the importance of cochlear implant insertion trajectory

Learning Objective: Identify methods to improve insertion trajectory for cochlear implant electrodes

Desired Result: Understand the importance of insertion trajectory and utilize tools to improve trajectory as they become available

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Exempt

**Impact of Cochlear Implantation on Speech Perception,
Health Utility, and Cognition in Elderly Adults,
Results From a Multi-Center Trial**

*Cameron C. Wick, MD; Jonathan L. McJunkin, MD
Nedim Durakovic, MD; Jacques A. Herzog, MD
Craig A. Buchman, MD*

Objective: To measure the impact of cochlear implantation (CI) on speech perception, cognition, and health related quality of life (HRQL) in adults 65 years and older.

Study Design: Prospective, non-randomized, multi-center study using within-subject experimental design. Post hoc analysis of data for subjects 65 years and older.

Setting: Tertiary referral centers (N = 13)

Patients: Adults \geq 65 years of age

Intervention: Cochlear implantation using a slim, modiolar array

Main Outcome Measures: All tests were performed at pre-op and 6 months post-activation. Speech perception was measured with consonant-nucleus-consonant (CNC) words and AzBio sentences in noise (+ 10 dB SNR). HRQL was measured by Health Utility Index Mark 3 (HUI3), and Speech, Spatial, Qualities of Hearing Scale (SSQ). Cognition was measured with the Montreal Cognitive Assessment (MoCA).

Results: Of 55 CI patients with 6-month data, 39 were 65 years or older (range: 65 – 91 years). Significant improvements were observed for all group outcome measures ($p < 0.001$). Using the implant alone, the mean improvement in CNC words and AzBio sentences in noise was 45% and 26%, respectively. The mean HUI3 total and hearing sub-score improved by 0.18 and 0.28 respectively; both well above the 0.03 clinically meaningful difference. Significant improvements in each SSQ subscale were also observed. For all 55 patients (mean age: 67.3 years \pm 14.2), 43% improved their MOCA by 2-points or more after 6-months.

Conclusion: Importantly, elderly patients experience substantial improvements in speech perception, cognition, and HRQL following CI.

Define Professional Practice Gap & Educational Need: Poor understanding of cochlear implant performance in the elderly.

Learning Objective: 1. Establish expected outcomes of a new perimodiolar electrode in patients 65 years and older. 2. Understand the degree of benefit regarding speech perception outcomes and health related quality of life measures following cochlear implantation. 3. Explore possible benefits of cochlear implantation on cognition.

Desired Result: The information in this presentation will help physicians counsel and screen patients 65 years and older through the cochlear implant process. The data will provide objective numbers to stratify expected results in speech perception and health related quality of life. Finally, we hope the information will shed light on possible cognitive benefits derived from cochlear implantation.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

Insertion Depth of Pre-Curved Cochlear Implant Electrodes

*Rueben A. Banalagay; Robert F. Labadie, MD, PhD
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Hypothesis: Generic guidelines for insertion depth of pre-curved electrodes are sub-optimal for many individuals.

Background: Insertion depths that are too shallow result in decreased cochlear coverage, and ones that are too deep lift electrodes away from the modiolus and degrade the electro-neural interface. Guidelines for insertion depth are generic and based on a depth marker (DM) at the round window entry point (EP) or a facial recess (FR) marker.

Methods: Using published methods¹, we determined the position and insertion depth where a pre-curved external sheath electrode array best fits the cochlea for each patient in an IRB approved, N=243 CT database. We measured the distance from the EP to the ideal DM location and to the FR.

Results: The distance from EP to the center of the FR was 6.74mm +/- 0.57mm and from EP to the ideal DM position was 0.52mm +/- 0.28mm. If the array was positioned by placing the FR marker medial (lateral) to the facial nerve, the difference with ideal depth on average would be 0.88mm +/- 0.57mm (1.26mm +/- .65mm). Poor outcomes (>1mm difference to ideal depth) would occur for 9, 91, and 155 cases where depth is determined using DM, medial FR, and lateral FR placement, respectively.

Conclusions: Studies show depth within 1mm from ideal permits perimodiolar positioning¹. These data suggest that the DM is a better marker for positioning than the FR. Further, marker positions are not ideal for the average cochlea (bias of 0.51mm for DM, 0.77mm for FR).

Define Professional Practice Gap & Educational Need: Lack of awareness that generic guidelines for insertion depth of pre-curved electrodes are sub-optimal for many individuals

Learning Objective: Attendees will learn improved guidelines for achieving optimum insertion depth

Desired Result: Attendees will gain awareness and knowledge of optimal insertion depth to improve electrode placement

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

Characterizing Mechanisms of Intracochlear Pressure Spikes During Cochlear Implantation via Simultaneous Cochlear Fluoroscopy and Intracochlear Pressure Measurements

*Joseph R. Gonzalez, MD; Renee M. Banakis Hartl, MD, AuD
John Peacock, PhD; Stephen P. Cass, MD, MPH
Nathaniel T. Greene, PhD*

Background: Combined electrical-acoustical stimulation has gained interest as patients with greater degrees of residual hearing are undergoing cochlear implantation (CI) and demonstrating improved outcomes, but loss of residual hearing continues to occur in a subset of patients for unclear reasons. Several mechanisms have been proposed for this hearing loss. We have previously described the generation of large amplitude pressure transients, equivalent to high-level noise exposures, in the inner ear during electrode insertion; however, the source of these events has not been identified.

Methods: Cadaveric human heads were surgically prepared with an extended facial recess approach. Fiber-optic pressure sensors were inserted into the scala vestibuli and scala tympani to measure intracochlear pressures. Three CI electrodes (straight and perimodiolar styles) from a single manufacturer were inserted while measuring intracochlear pressures under time-synched video and fluoroscopy.

Results: CI electrode insertions produced pressure transients in the cochlea up to 160-170 dB peak SPL equivalent, consistent with results from previous studies. The electrode position within the cochlea (particularly electrode contact with either the medial or lateral walls), design-related electrode dynamics, and poor surgical technique were associated with increased rates of pressure transient generation.

Conclusions: These results elucidate the risk of generating injurious pressure changes during CI electrode insertion by simultaneously correlating pressure transients with observed trauma on fluoroscopy. As the first confirmation of potential transient source, the results could be used by both CI manufacturers to improve electrode design and surgeons to improve “soft” surgical techniques with the aim of improving hearing preservation outcomes.

Define Professional Practice Gap & Educational Need: Limited understanding of the mechanisms leading to loss of residual hearing during insertion of cochlear implant electrodes.

Learning Objective: 1. Identify possible mechanisms of previously observed pressure transients during cochlear implant electrode insertion. 2. Develop an understanding of mitigation strategies to avoid undesired trauma to the cochlea during electrode insertion.

Desired Result: 1. Participants will improve understanding of potential intraoperative trauma mechanisms leading to loss of residual hearing. 2. Participants will appreciate the utility of fluoroscopy for the evaluation of electrode dynamics in cochlear implant research.

Level of Evidence - Does not apply-This is a basic science translational project aimed at examining the potential mechanism of cochlear trauma in cochlear implant surgery that cannot be randomized or blinded in a traditional sense.

Indicate IRB or IACUC Approval: Exempt

**Time-Based Assessment of Hearing Preservation Rates
after Microsurgical Resection of Vestibular Schwannomas:
Systematic Review and Treatment Comparison**

*Anastasia Hunt, BS; Nathan D. Cass, MD
Adam R. Coughlin, MD; Samuel P. Gubbels, MD*

Objective: To determine hearing preservation rates after microsurgical resection of vestibular schwannoma (VS).

Data Sources: Systematic review of the Ovid, Cochrane, EMBASE, and Web of Science databases.

Study Selection: This study was restricted to full text English language articles detailing VS resection via the middle cranial fossa (MCF) or retrosigmoid (RS) approach. Documentation of pre- and post-treatment hearing outcomes with AAO-HNS, Gardner-Robertson (GR), or word recognition score (WRS) scales, as well as time to follow up were required. Duplicate data sets, studies with >10% of patients with Neurofibromatosis 2, prior or non-surgical VS treatment, case reports with <5 patients, or studies detailing decompressive surgery were excluded.

Data Extraction: Two authors independently performed full text reviews to determine study eligibility. Discrepancies were settled by consensus. "Class A/B, I/II" hearing was defined as AAO-HNS Class A or B, GR Class 1 or 2, or PTA \leq 50 dB with WRS \geq 50% on audiogram.

Data Synthesis: Pooled estimates of preserved Class A/B, I/II hearing at last post-operative follow-up.

Conclusions: Of 1,323 reports, 18 met inclusion criteria. Fourteen were utilized in analyses yielding data from 2977 patients. Mean follow-up was 52.5 months (SD = 19.9). Class A/B, 1/2 hearing was preserved at last follow-up in 57% of patients. Meta-regression revealed female gender and resection through the MCF were associated with preservation of serviceable hearing. Thus, hearing preservation is possible with microsurgical resection in select patients with VS who have class A/B, 1/2 hearing preoperatively and when preserved, appears to be stable over time.

Define Professional Practice Gap & Educational Need: There is great variability in quoted hearing preservation rates after microsurgical resection and other modalities of management for vestibular schwannoma; thus, patients are not provided with consistent information on available therapies with which to engage in shared decision making.

Learning Objective: Participants will comprehend the existing literature and complexities in reporting of hearing preservation after microsurgical resection of vestibular schwannoma.

Desired Result: Participants will discuss with patients hearing preservation rates after microsurgical resection of vestibular schwannoma with improved accuracy, allowing improved shared decision making.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Exempt

**Understanding the Dizziness Handicap Inventory (DHI):
A Cross Sectional Analysis of Symptom Factors that
Contribute to DHI Variance**

*Eric J. Formeister, MD; Roseanne Krauter, FNP-BC
Laura Kirk, PA-C; Habib Rizk, MD
Jeffrey D. Sharon, MD*

Objective: Dizziness Handicap Inventory (DHI) is the most commonly used quality of life (QOL) measure for vestibular disorders. However, there is wide variability in scores, and we don't fully understand which variables contribute to dizziness related QOL. Our goal was to investigate the key demographic and symptom related factors to determine which ones account for DHI variance.

Study design: Cross sectional survey

Setting: Tertiary care dizziness clinic

Patients: Adults with dizziness

Intervention(s): none

Main outcome measure(s): DHI variance explained by multiple linear regression modelling.

Results: 67 subjects were included in our study. We performed univariate analysis on numerous demographic and dizziness related factors, and constructed a multivariate model based on explaining the highest variance in the data with the least number of independent variables. Multiple linear regression model showed that number of days per month of dizziness (0 to 30), number of dizziness descriptors (spinning, lightheadedness, disequilibrium, etc.), and the number of dizziness triggers (loud sounds, stress, riding in a car, etc.) all were associated with increased DHI. Together, this accounted for 56% of the variability in the DHI, $p = <0.0001$). Adding an index of depression, as measured by the Patient Health Questionnaire 9 (PHQ-9), to the model increased the adjusted R-squared to 64% ($p = <0.0001$).

Conclusions: By understanding the factors that contribute to variability in DHI scores, we may be better able to improve QOL for patients with dizziness.

Define Professional Practice Gap & Educational Need: Lack of contemporary knowledge: Dizziness Handicap Inventory (DHI) is the most commonly used quality of life (QOL) measure for vestibular disorders. However, there is wide variability in scores, and we don't fully understand which variables contribute to dizziness related QOL.

Learning Objective: Determination of the key demographic and symptom related factors to determine which ones account for DHI variance.

Desired Result: By understanding the factors that contribute to variability in DHI scores, attendees may be better able to implement more effective diagnostic and therapeutic strategies to improve quality of life for patients with dizziness.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

**Mechanical Energy Dissipation through the Ossicular Chain
and Vestibular Organ Using Laser Doppler Vibrometer
Measurement of Round Window Velocity**

*John W. Lally, MD; Sophie Higgins, BS
Mostafa Ahmed, MD; Alex Diech, BS
Samuel A. Spear, MD; Carlos Esquivel, MD*

Objective. Understand impact of mechanical energy transmission and dissipation through the ossicular chain and vestibular organ through incus, stapes, and round window velocity measurements in response to sound stimulus.

Methods. Thawed human temporal bones with intact ossicular chain and tympanic membrane underwent complete mastoidectomy with facial recess approach. Laser Doppler Vibrometry (LDV) was mounted on operating microscope to measure vibration of incus, stapes, and round window in response to a sound stimulus within the external auditory canal. Frequencies of sound stimulus ranged from 0.5 to 4 kHz. The stimulus across all frequencies measured sound pressure 90 dB SPL.

Results. Five temporal bones were studied with each incus, stapes, and round window vibration velocity measured across the frequency range. Vibration curves obtained over the frequency range were similar between bones with a notable resonant frequency around 2 kHz. Amplitude of incus and stapes curves were nearly identical. The round window measurements demonstrated an earlier drop in amplitude around 6.5kHz with reduced vibratory velocity across the higher frequencies.

Conclusions. The similarity of vibration curves obtained between the incus and stapes measurements indicates that minimal mechanical energy is dissipated through the ossicular chain. The drop in round window velocity measurements at higher frequencies suggests a loss of mechanical energy within this range through the vestibular organ. A complete and thorough understanding of the biophysical properties of the middle and inner ear are critical for optimal ossiculoplasty outcomes and the development of future ossicular prosthetics.

Define Professional Practice Gap & Educational Need: There currently has not been a documented velocity study quantifying the loss of mechanical energy through ossicular chain components and the vestibular organ. This model provides a accurate model for studying maximal conductive hearing loss and quantifying the loss of mechanical energy through this organ system with the ultimate goal of optimizing ossiculoplasty outcomes.

Learning Objective: Understand impact of mechanical energy transmission and dissipation through the ossicular chain and vestibular organ through incus, stapes, and round window velocity measurements in response to sound stimulus.

Desired Result: Attendees will consider and apply these physical outcome measurements when selecting, implanting, and developing prosthetic material for middle ear ossiculoplasty. They will also leave with a better understanding of the order of magnitude of energy that is dissipated through a healthy vestibular organ or through a situation of ossicular discontinuity and what this may mean for their patients with conductive hearing loss.

Level of Evidence - Does not apply-basic science study using correlational analysis of ossicular velocity

Indicate IRB or IACUC Approval: Approved

Hearing Preservation in Elderly Cochlear Implant Recipients

*Holden D. Sanders, BS; Stephanie Bourn, AuD (presenter)
MaryRose Goldstein, AuD; Abraham Jacob, MD*

Objective: Examine hearing preservation rates in cochlear implant recipients over age 72 years.

Study design: Retrospective case series

Setting: Tertiary otology/neurotology practice

Patients: Cochlear implant recipients April 2017 to June 2018

Intervention: Surgical/rehabilitative

Main outcome measure(s): Residual hearing outcomes were measured 3 and 6-months after cochlear implantation. Hearing preservation was defined as a low frequency PTA of 85 dB or better. Between April 2017 and June 2018, 123 cochlear implant operations were performed by the senior author (AJ). Out of a cohort of 45 cochlear implant recipients, 32 were eligible for hearing preservation. Of the 32 patients eligible for hearing preservation, 17 were 72 years or older. Overall, hearing was preserved in 60% of patients. Of those patients older than 72 years of age, 71% had hearing preservation. This suggests that the vast majority of patients, including an elderly cohort can benefit from soft surgery techniques. Despite concerns about cochlear fragility in elderly patients, preservation of residual hearing is feasible in cochlear implant recipients age 72 years and older.

Conclusion: Despite concerns about cochlear fragility in elderly patients, preservation of residual hearing is feasible in cochlear implant recipients age 72 years and older.

Define Professional Practice Gap & Educational Need: Lack of awareness of the potential for hearing preservation in elderly cochlear implant recipients

Learning Objective: Understand hearing preservation is possible in the majority of patients with residual hearing prior to cochlear implantation, including among elderly cochlear implant recipients.

Desired Result: Begin or continue to use soft surgery techniques for cochlear implant recipients, including elderly patients. Use this information to counsel elderly cochlear implant recipients on expected outcomes following cochlear implantation with soft surgery techniques.

Level of Evidence - Level IV - Historical cohort or case-control studies

Indicate IRB or IACUC Approval: Exempt

Factors Affecting Cochlear Patency after Retrosigmoid Surgery

*Sachin Gupta, MD; Anthony Nguyen, BS
Timothy E. Hullar, MD; Bronwyn Hamilton, MD*

Objective: To determine predictive factors for cochlear patency after retrosigmoid approaches for posterior fossa tumors.

Study Design: Retrospective chart review.

Setting: Tertiary referral center.

Subjects and Methods: In total, 319 patients were reviewed, resulting in 107 patients who underwent retrosigmoid approaches between October 2005 and November 2017, with adequate, postoperative heavily T2-weighted MRI. Postoperative, heavily T2-weighted surveillance MRI was obtained a median of 391 days after surgery, and reviewed for cochlear patency. Tumor size, preoperative audiograms, and postoperative audiograms were also compared between patients with cochlear patency and cochlear obliteration.

Results: One hundred seven patients underwent retrosigmoid craniotomy. Of 87 patients who underwent retrosigmoid craniotomy with drilling of the internal auditory canal, 52 patients (60%) retained cochlear patency. Of 20 patients who underwent retrosigmoid craniotomy without drilling of the internal auditory canal, 15 patients (75%) retained cochlear patency. Tumor pathology was comprised of 98 vestibular schwannomas (92%) and 9 meningiomas (8%). When comparing patients who retained cochlear patency with those who had cochlear obliteration, there were no significant differences between the two groups in terms of tumor size, preoperative speech reception thresholds (SRT) and speech discrimination scores (SDS), and postoperative SRT and SDS scores.

Conclusion: In retrosigmoid approaches without drilling of the internal auditory canal, 75% of patients retain cochlear patency. When the internal auditory canal is entered, cochlear patency decreases to 60%. Tumor size and preoperative hearing performance do not predict postoperative cochlear patency. This may have important implications when considering cochlear implantation for unilateral deafness after tumor resection.

Define Professional Practice Gap & Educational Need: Lack of large studies studying cochlear patency after retrosigmoid approaches to posterior fossa tumors

Learning Objective: Describe factors affecting cochlear patency after retrosigmoid approaches to posterior fossa tumor resection.

Desired Result: Attendees will gain further knowledge about cochlear patency after retrosigmoid approaches, helping them understand the potential for cochlear implantation after tumor resection.

Level of Evidence - Level V - Case series, studies with no controls

Indicate IRB or IACUC Approval: Approved

**RECIPIENTS OF AWARDS
& NAMED LECTURERS**

In honor of the 50th anniversary of the American Neurotology Society, 1965 - 2015, the House/Hitselberger Lifetime Achievement Award was established to honor the legacy of two giants in the field of neurotology, Dr. William F. House and Dr. William E. Hitselberger. The award recognizes those individuals who have demonstrated superb surgical skills and patient care, a commitment toward education and cumulative scientific contributions that have profoundly impacted the field of neurotology. At the 50th Annual Fall meeting in Dallas, TX on September 26, 2015, the first awards were presented to nine neurotologists from the USA and Europe.

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Gruppo Otologico, Piacenza-Rome, Italy

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D. Bradley Welling, MD, PhD - 2013, Orlando, FL
Yehoash Raphael, PhD - 2014, Las Vegas, NV
Noel L. Cohen, MD - 2015, Boston, MA
Per Cayé-Thomasen, MD, DMSc - 2016, Chicago, IL
Professor Gerard M. O'Donoghue, FRCS 2017, San Diego, CA
Robert F. Labadie, MD, PhD, MMHC – 2018, National Harbor, MD

WILLIAM E. HITSELBERGER MEMORIAL LECTURE

William E. Hitselberger, MD - 1999, Palm Desert, CA

Peter Dallos, PhD - 2000, Orlando, FL

James Battey, MD, PhD - 2001, Palm Desert, CA

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William W. M. Lo, MD - 2005, Los Angeles, CA

G. Michael Halmagyi, MD - 2006, Toronto, Canada

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D. Bradley Welling, MD, PhD - 2008, Chicago, IL

Philip H. Gutin, MD - 2009, San Diego, CA

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George T. Hashisaki, MD - 2011, San Francisco, CA

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Marcus Atlas, MBBS, FRACS – 2017, San Diego, CA

Robert K. Jackler, MD - 2018, National Harbor, MD

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Ebenezer Yamoah, PhD - 2008, Chicago, IL

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Richard L. Goode, MD - 2012, Washington, DC

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Karen B. Avraham, PhD - 2014, Orlando, FL

Professor Mario Sanna - 2015, Dallas, TX

Thomas Lenarz, Prof. Dr.med - 2016, San Diego, CA

Jennifer J. Lentz, PhD – 2017, Chicago, IL

Craig A. Buchman, MD – 2018, Atlanta, GA

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R. Mark Wiet, MD - 2008, Orlando, FL

Kevin D. Brown, MD, PhD - 2009, Phoenix, AZ

Jerry W. Lin, MD, PhD - 2009, Phoenix, AZ

John C. Goddard, MD - 2010, Las Vegas, NV

Matthew L. Bush, MD - 2011, Chicago, IL

Felipe Santos, MD - 2011, Chicago, IL

Alicia Quesnel, MD - 2012, San Diego, CA

Mia Miller, MD - 2013, Orlando, FL

Peter L. Santa Maria, MBBS, PhD - 2014, Las Vegas, NV

Christine T. Dinh, MD - 2015, Boston, MA

Seth E. Pross, MD - 2016, Chicago, IL

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Kathryn Y. Noonan, MD - 2018, National Harbor, MD

Enrique Perez, MD - 2018, National Harbor, MD

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USAF Medical Center, Lackland AFB, TX

Eric Tallan, MD - 1992, Palm Desert, CA
Mayo Clinic, Rochester, MN

Mark E. Reiber, MD - 1993, Los Angeles, CA
Vanderbilt University Medical Center, Nashville, TN

Gary B. Coleman, MD - 1994, Palm Beach, FL
University of Michigan, Ann Arbor, MI

Donald D. Robertson, MD - 1995, Palm Desert, CA
University of Manitoba, Winnipeg, Manitoba Canada

Greg A. Krempl, MD - 1997, Scottsdale, AZ
University of Texas, San Antonio, TX

Bac H. Nguyen, MD - 1998, Palm Beach, FL
University of Minnesota, Minneapolis, MN

Jennifer L. Maw, MD - 1999, Palm Desert, CA
Hearing Institute for Children & Adults, San Jose, CA
Wayne E. Berryhill, MD - 2000, Orlando, FL
University of Minnesota, Minneapolis, MN

Dmitriy Niyazov - 2001, Palm Desert, CA
Medical Student, Los Angeles, CA

Stacey L. Halum, MD - 2003, Nashville, TN
Medical College of Wisconsin

Norman N. Ge, MD - 2004, Phoenix, AZ
Davis Medical Center, Sacramento, CA

Ritvik P. Mehta, MD - 2005, Boca Raton, FL
Massachusetts Eye & Ear; Harvard Medical School

Wade Chien, MD - 2006, Chicago, IL
Massachusetts Eye & Ear, Harvard Medical School

Hideko Heidi Nakajima, MD, PhD - 2009, Phoenix, AZ
Massachusetts Eye & Ear; Harvard Medical School

Yuri Agrawal, MD - 2012, San Diego, CA
Johns Hopkins University, Baltimore, MD

Samuel A. Spear - 2013, Orlando, FL
The Ohio State University, Columbus, OH

Christine T. Dinh, MD - 2014, Las Vegas, NV
University of Miami, Miami, FL

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University of Connecticut, Farmington, CT

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Vanderbilt University, Nashville, TN

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University of Minnesota, Minneapolis, MN

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Baylor College of Medicine, Houston, TX

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UCLA School of Medicine, Los Angeles, CA

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University of California, San Francisco, CA

Lloyd B. Minor, MD - 1999, Palm Desert, FL
Johns Hopkins University, Baltimore, MD

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Northwestern University Medical School, Chicago, IL

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The Ohio State University, Columbus, OH

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Johns Hopkins University, Baltimore, MD

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Loyola University Medical Center, Chicago, IL

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The Cleveland Clinic, Cleveland, OH

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The Ohio State University - Columbus, OH

Rahul Mehta, MD - 2014, Las Vegas, NV
Louisiana State University - New Orleans, LA

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University of Rochester Medical Center - Rochester, NY

Jeffrey D. Sharon, MD - 2016, Chicago, IL
Johns Hopkins University - Baltimore, MD

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\$25,000 annual award established in 2014

Funding provided by the American Neurotology Society

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"Cochlear Irradiation and Dosimetry: Apoptosis, Necrosis, and Hearing Loss"

University of Miami, Miami, FL

Harrison Lin, MD - 2016

"Chronic Implantation of the Facial Nerve for Selective Facial Muscle Contraction"

University of California-Irvine, Orange, CA

Michael S. Harris, MD -2017

"Verbal Memory as Outcome Predictor in Adults Receiving Cochlear Implants"

Medical College of Wisconsin, Milwaukee, WI

Ksenia A. Aaron, MD - 2018

"Modelling and Restoring Hearing and Vestibular Deficit of Non-Syndromic Deafness"

University of California-Los Angeles, CA

The purpose of the American Neurotology Society (ANS) Research Grant is to encourage and support academic research in sciences related to the investigation of otology and neurotology. Appropriate areas of research include diagnosis, management, and pathogenesis of diseases of the ear and/or skull base. Grants that focus on addressing clinical gaps are especially encouraged. Grants may involve cell/molecular studies, animal research, or human subjects research.

The maximum award request is \$25,000 per year (US dollars) and is annually renewable on a competitive basis. Indirect costs (overhead) are not allowed. Grants are available to physician investigators in the United States and Canada only. We particularly encourage those individuals without a history of K08, R03, R21, or R01 funding to apply.

SAVE THE DATE!

If you would like to submit a grant application, the deadline is March 1st.

Applications should be sent via email to Dr. Ronna Hertzano, RHertzano@smail.umaryland.edu, Chair of the ANS Research Committee. Full instructions and the application form can be found at the ANS website.

ANS RESEARCH COMMITTEE 2018-19

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American Neurotology Society

Fellowship Grant Funding Period: 7/1/2018 – 6/30/2019

Progress Report Date: 2/1/2019

Principal Investigator: Ksenia Aaron, MD

Project Title: “Modelling and Restoring Hearing and Vestibular Deficit of Non-Syndromic Deafness”

AIM 1 Defining histological and physiological phenotype of *Tmprss3*^{tm1Lex} knock out mouse model

Challenge: The underlying molecular mechanisms of *TMPRSS3* mutation remain to be characterized.

Approach: We will define the auditory and vestibular phenotype by characterizing functional and histological consequences of *Tmprss3* genetic mutations in a *Tmprss3* targeted mutation (*Tmprss3*^{tm1Lex}) mouse model. Given that human mutation has both congenital and progressive hearing, we will evaluate expression of *Tmprss3* in the developing inner ear of wild-type and homozygous mice at several postnatal day (P) periods: (1) P5, prior to onset of hearing; (2) P12, at onset of hearing; (3) P30, maturation of mouse cochlea; and (4) P90, point previously show to have loss of spiral ganglion neurons.^[25] Defining histological phenotype, we will focus on *Tmprss3* and its effect on PI3K signaling pathway by immunostaining for PI3K p85 α and p-AKT expression. Based on the pattern of expression of *Tmprss3*,^[20-22] we will examine the effect of mutation both quantitatively (cell counting) and qualitatively (cell ultrastructure), at a cellular and synaptic level by co-immunolabeling organ of Corti and vestibular (utricle and saccule) end organ sensory hair cells (MYO7A, phalloidin), supporting cells (Sox2), synaptic ribbons (CTBP2), stria vascularis (claudin-4, occludin) as well as spiral ganglion (Tuj-1) and vestibular ganglion neurons (neurofilament 200kD). To assess audiovestibular function, we will evaluate auditory brainstem responses and vestibular evoked potentials (thresholds, P1 amplitude, and latency) and distortion product otoacoustic emissions.

Impact: We will delineate the functional and histological consequences, and the time window in which the cell degeneration occurs in *Tmprss3*^{tm1Lex} mice. These data will provide insights about *Tmprss3* gene, its underlying molecular changes, and provide a host of benchmarks to evaluate the success of gene therapy. We predict that compared with wild-type, *Tmprss3*^{tm1Lex} mice will show an absence of *Tmprss3* expression correlating with a decrease in PI3K expression, which will be comparable with morphological changes on multiple cellular and synaptic levels and will be associated with a decrease in auditory and vestibular function.

AIM 2 Rescue of auditory deafness and vestibular dysfunction in *Tmprss3* mutants

Challenge: *Tmprss3* is a unique model as it affects multiple cells types of the inner ear. Currently, no study exists that has demonstrated the ability of a gene therapy to successfully rescue multiple different cell types.

Approach: To rescue the phenotype of *Tmprss3* mutation we will use AAV-DJ construct vector-mediated gene therapy, in a mutant and wild-type mouse to deliver a coding sequence of the gene into the inner ear using a posterior canalostomy approach. Preliminary data from our laboratory show that AAV-DJ vector construct transfects multiple cell types with high efficacy. The AAV-DJ-*Tmprss3* gene vector will be injected at P1-2 and animals will be examined using histological and functional tests as described in Aims 1. Animals will be evaluated at (1) P12, for the efficiency of transfection; (2) P30, for early effects of transfection; (3) P90, and (4) P180, to assess long-term effects and sustained results of transfection. Based on the time frame at which the cell degeneration occurs (Aims 1), we anticipate testing our gene therapy further in an adult animal model.

Impact: We anticipate addressing the gaps in knowledge of gene therapy for the rescue of a histological and phenotypical deficit on a level of multiple cell types of the inner ear. These results will provide support for the success of gene therapy in the model of progressive hearing loss and its implication in future clinical trials.

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1976-79 Michael Glasscock III, MD
1979-85 Robert Keim, MD
1985-88 Shokri Radpour, MD
1988-92 Charles M. Luetje II, MD
1992-95 Jack M. Kartush, MD
1995-98 Richard J. Wiet, MD
1998-01 Newton J. Coker, MD
2001-04 Debara L. Tucci, MD
2004-07 Karen J. Doyle, MD, PhD
2007-10 Jeffrey T. Vrabec, MD
2010-13 Anil K. Lalwani, MD
2013-16 Moisés A. Arriaga, MD, MBA
2016-19 Bradley W. Kesser, MD

ANS MEMBERSHIP

Membership applications are accepted thru November 15th of each calendar year. Selected Candidates are inducted at the following Spring Business meeting. ANS Trainee applications are accepted throughout the year.

All Applications may be found on the ANS website. <https://www.americanneurotologysociety.com/how-to-apply>

Congratulations to the following ANS Associates who
UPGRADED to FELLOW in 2018:

(by way of Neurotology board certification)

Sameer Ahmed, MD
Jason A. Brant, MD
Joseph T. Breen, MD
Brian S. Chen, MD
David R. Friedmann, MD
Michael S. Harris, MD
Douglas M. Hildrew, MD
Candace E. Hobson, MD
Jacob B. Hunter, MD
Elizabeth A. Kelly, MD
Ruwan Kiringoda, MD
Beth N. McNulty, MD
Brendan P. O'Connell
Angela S.Y. Peng, MD
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Seth E. Pross, MD
Aaron K. Remenschneider, MD
Daniel S. Roberts, MD
Joseph P. Roche, MD
Brian C. Rodgers, MD
Douglas S. Ruhl, MD
Joshua M. Sappington, MD
Alexander B.G. Sevy, MD
Jeffrey D. Sharon, MD
Shawn M. Stevens, MD
Cameron C. Wick, MD

(by way of application)

Guyan A. Channer, MBBS, DM
Takao Imai, MD, PhD
Paul F. Shea, MD
Peter G. Volsky, MD

Associate members are expected to upgrade to Fellow status after completion of (5) five years of practice *post training* or face a \$100 increase in membership dues. *Sub certification in neurotology will automatically upgrade an Associate member to Fellow; those not certified in neurotology must complete application and submit required materials.* Fellow status brings many advantages, such as holding office, Committee appointments, voting privileges, attending Executive sessions, and the honor of endorsing prospective ANS Candidates. *If you feel you are an exception, please contact the ANS office. PhD's are not required to upgrade.*

AMERICAN NEUROTOLOGY SOCIETY

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*(includes new members inducted at
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Oliver F. Adunka, MD - Fellow
Columbus, OH

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Baltimore, MD

Sameer Ahmed, MD - Fellow
Downey, CA

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Irvine, CA

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Sao Paulo, Brasil

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George Alexiades, MD - Fellow
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Kyle P. Allen, MD - Fellow
Tampa, FL

Sean R. Althaus, MD - Emeritus
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Jennifer Alyono, MD - Associate
Stanford, CA

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James Andrews, MD - Fellow
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The following qualifications are required for Trainee Membership in the American Neurotology Society.

1. The candidate shall have earned a Medical Degree of MD, DO, PhD, or the equivalent.
2. In training in a field of study related to the field of Neurotology (Otolaryngology-Head and Neck Surgery Residency, Neurotology Fellowship or post doctoral research position).
3. Special interest in the field of Neurotology
4. Highest ethical and moral standards

TO APPLY AS A TRAINEE: Complete the online application and attach letter from Department Chair and/or Fellowship/Program Director validating Trainee status including Certification of Trainee status and the duration of the program.

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in Memoriam

The ANS Administrative office was notified of the following members death since the last Spring meeting.

Please take a moment of silence to remember these outstanding colleagues & friends
(in alphabetical order)

Sidney N. Busis, MD

Noel L. Cohen, MD

C. Gary Jackson, MD

Ruediger Thalmann, MD

Galdino E. Valvassori, MD

David F. Wilson, MD