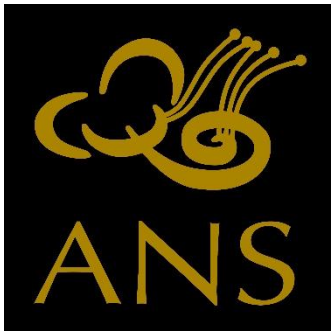

PROGRAM and ABSTRACTS

of the

AMERICAN NEUROTOLOGY SOCIETY

57th Annual Spring Meeting

April 29 - May 1, 2022
Hyatt Regency
Dallas, TX

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(ANS 2022 Program Book)

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AMERICAN NEUROTOLOGY SOCIETY
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American Neurotology Society Mission Statement

Purpose

The American Neurotology Society (ANS) is committed to improving public health care related to disorders of the ear, hearing and balance primarily through the provision of high-quality continuing medical education (CME) to our members. The overall goals of the ANS educational programs are to organize CME activities addressing the knowledge gaps and enhancing 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.

Furthermore, the ANS is committed to fulfilling its purpose by encouraging and funding research that promotes the health and wellness of our patients, members, and their communities. Novel information, such as that presented at the annual conferences, as well as solicited and unsolicited manuscripts, are considered for publication in the ANS supported, peer reviewed and evidence-based content of the *Otology & Neurotology* (original and open access) Journals. The focus on the scientific advances in the field of neurotology is translated into approaches to quality care that are consistent with ACGME/ABMS general

competency areas and the Institute of Medicine recommendations.

The ANS fully supports a culture of both unbiased, civil dialogue among its members and diversity in all aspects of the field, including education, research and clinical practice. Equally important to our mission is equity of access to the highest quality neurotological healthcare for all patients requiring our services. Our society considers the needs of trainees at all levels interested in learning neurotology in order to develop the next generation of practitioners from among the best and brightest among their peers with the broadest representation of all backgrounds and personal characteristics.

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 and Otology/Neurotology Open)
- The Otology & Neurotology Journal, and the Otology/Neurotology Open Access publications, provide additional vehicles 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.

Continuing Medical Education Credit Information

CONTINUING MEDICAL EDUCATION CREDIT INFORMATION

Accreditation

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of American College of Surgeons and American Neurotology Society. The American College of Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

AMA PRA Category 1 Credits™

The American College of Surgeons designates this live activity for a maximum of **7.25** *AMA PRA Category 1 Credits™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

ABOHNS MOC Recognition Statement

Successful completion of this CME activity, which includes participation in the evaluation component, enables the participant to meet the expectations of the American Board of Otolaryngology's Maintenance of Certification (MOC) program. It is the American College of Surgeon's (the CME provider) responsibility to submit participant completion information to ACCME for the purpose of recognizing participation.

ABOHNS MOC Participant Data Privacy Information

If you are a Diplomate of the American Board of Otolaryngology-Head and Neck Surgery (ABOHNS) and would like to claim CME for MOC points for this educational activity (optional), you will be asked to provide personal information (Diplomate ID, first and last name, and month and day of birth) as part of the registration and/or evaluation process. The American College of Surgeons will only use this information to transmit your CME for MOC points to the ACCME on your behalf, upon successful completion of the activity.

IMPORTANT: **Completion of the ANS CME certificate must be done by June 5, 2022.** Registered attendees will receive an email from the ANS website with instructions for completing the evaluation and downloading a certificate of completion after the COSM meeting takes place. You must be registered for ANS to earn CME/MOC credit.

Program Objectives Educational Activity Details

What are the practice or patient care problems being addressed by this activity?

Overall this activity addresses gaps in knowledge and practice that reflect evolving understanding and perspectives in the diagnosis and management of health conditions of the ear and skull base. These sessions highlight the core principles of standard practice while challenging commonly held assumptions that create opportunities for further clarification or research. The scope of the gaps addressed by the following activities are indicated:

Lecture: "The History of Acoustic Neuroma Surgery": This lecture will assess gaps in knowledge about the evolution of the multiple surgical techniques that are currently being used for the removal of skull base tumors such as acoustic neuromas.

Cochlear Implant Scientific Sessions – With broadening candidacy criteria, cochlear implant has become a viable option for management of hearing loss in newer disease categories such as single side deafness associated with acoustic neuroma removal. A growing experience by presenting clinicians will provide early and preliminary experience and results in similar new and complex clinical scenarios.

Panel-New Frontiers in Hearing Research – This panel will showcase evolving research on hearing loss in an aging society and new technologies for hearing restoration.

Panel-Tomorrow's Cochlear Implant Program – This panel will vision what the future cochlear implant program may look like. The panelists will discuss strategies around device and service delivery; new technologies and possible impact on patient-performance and satisfaction. They will also discuss economic hurdles and consequences that are relevant to the future success of these programs.

Skull Base Tumors Scientific Session – This session will address knowledge gaps in long-term functional and tumor control outcomes, which influence candidacy and patient counseling regarding appropriate expectations.

Lecture: "Vestibular Implantation - Neurotology's Next Big Contribution to Sensory Restoration": This lecture will assess gaps in knowledge about a new category of surgical implant – the vestibular implant – specifically with respect to ongoing trial data, candidacy criteria, technical information, and potential for functional restoration.

Vestibular Disorders Scientific Sessions – This session will address knowledge gaps in the diagnosis of vestibular disorders, including a nosology of disorders, and new testing techniques.

Panel- Where Are You Mom? What To Do About the Child with Unilateral Hearing Loss!– This panel will highlight the latest impact of and treatment for single sided deafness in children, including the provision of reconstructive surgery or auditory devices and the timing of these interventions. Experts will discuss the merits and controversies around these various issues.

How will this activity improve the learners' competence (knowledge in action), performance (skill set) and/or patient outcomes (impact of care)?

Competence: The educational program is designed to address the topics identified as practice gaps through individual presentations and in-depth panel discussions. The panels will emphasize case-based learning and opportunity to demonstrate the application of core principles and new information to clinical decision making.
Performance: All activities will review established knowledge, present areas of controversy and define skills that require additional development within our field or in consultation with other disciplines. Means by which these skills can be acquired or improved will also be presented.
Patient Outcomes: The impact of clinical decision making, professionalism and health system structures on clinical outcomes will be presented and discussed with assistance of the moderators. Improvement in recognizing, diagnosing, and managing disorders of the inner ear.

State the learning objectives for this activity:

1. To describe the evolution of technology and clinical knowledge that have led to advances in acoustic neuroma surgery and the current surgical treatment modalities used by neurotologic surgeons.

2. To demonstrate and discuss the implementation of expanded CI candidacy in the clinical management of sensorineural hearing loss

3. To draw from the latest clinical experience and cutting-edge research when managing patients, particularly older patients, who present with sensorineural hearing loss.

4. To explain the future directions of cochlear implant device and service delivery; new technologies and possible impact on patient-performance and satisfaction.

5. To examine the latest approaches in managing skull base tumors, including intra-operative imaging, and long-term outcomes of different approaches.

6. To identify progress in the development of the vestibular implant to assist with patient counseling about potential indications and availability.

7. To assess new techniques for the diagnosis of vestibular disorders, and to differentiate among vestibular disorders with overlapping features.

8. To evaluate and manage single-sided deafness in the children, discussing with families the consequences of and treatment options for this disorder.

Disclosure Information

In accordance with the ACCME Accreditation Criteria, the American College of Surgeons must ensure that anyone in a position to control the content of the educational activity (planners and speakers/authors/discussants/moderators) has disclosed all financial relationships with any commercial interest (termed by the ACCME as "ineligible companies", defined below) held in the last 24 months (see below for definitions). Please note that first authors were required to collect and submit disclosure information on behalf all other authors/contributors, if applicable.

Ineligible Company: The ACCME defines an "ineligible company" as any entity producing, marketing, re-selling, or distributing health care goods or services used on or consumed by patients. Providers of clinical services directly to patients are NOT included in this definition.
Financial Relationships: Relationships in which the individual benefits by receiving a salary, royalty, intellectual property rights, consulting fee, honoraria, ownership interest (e.g., stocks, stock options or other ownership interest, excluding diversified mutual funds), or other financial benefit. Financial benefits are usually associated with roles such as employment, management position, independent contractor (including contracted research), consulting, speaking and teaching, membership on advisory committees or review panels, board membership, and other activities from which remuneration is received, or expected. ACCME considers relationships of the person involved in the CME activity to include financial relationships of a spouse or partner.
Conflict of Interest: Circumstances create a conflict of interest when an individual has an opportunity to affect CME content about products or services of a ineligible company with which he/she has a financial relationship.

The ACCME also requires that ACS manage any reported conflict and eliminate the potential for bias during the educational activity. Any conflicts noted below have been managed to our satisfaction. The disclosure information is intended to identify any commercial relationships and allow learners to form their own judgments. However, if you perceive a bias during the educational activity, please report it on the evaluation.

In accordance with the ACCME Accreditation Criteria, the American College of Surgeons must ensure that anyone in a position to control the content of the educational activity (planners and speakers/authors/discussants/moderators) has disclosed all financial relationships with any ineligible company held in the last 24 months. Please note that first authors were required to collect and submit disclosure information on behalf all other authors/contributors, if applicable.

You may view the ANS Speaker COI/Disclosure list on the **ANS website** or COSM program.

THE AMERICAN NEUROTOLOGY SOCIETY WOULD LIKE TO THANK THE FOLLOWING MEMBERS FOR THEIR CONTRIBUTION TO THE 2022 ANS SCIENTIFIC PROGRAM

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(As Socio-Economic Chair)

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Poster Judges

Vivek Kanumuri, MD
Ana H. Kim, MD
Brian D. Nicholas, MD
Emily Z. Stucken, MD

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

PUBLICATION STATEMENT: The material in these abstracts must not have been published or presented previously at another national or international meeting and may not be under consideration for presentation at another national or international meeting including another COSM society. The study detailed in these abstracts *may be submitted* for consideration for publication to *Otology & Neurotology* at any time after this call for papers begins. However, should the abstract be selected as a poster or an oral presentation, publication of the manuscript will be delayed until after the 2022 COSM meeting takes place. If this policy is violated, the ANS will prohibit presentation at the COSM meeting and the manuscript will be withdrawn from publication in print or online. The penalty for any duplicate presentation/publication is prohibition of the author from presenting at a COSM society meeting for up to three years. Duplicate submission to AOS or another participating COSM Society will disqualify your abstract immediately.

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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 Editorial Manager site:
https://www.editorialmanager.com/on/

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.

MARK YOUR CALENDAR!
The 57th Annual ANS Fall Meeting
"SUPER SATURDAY"
September 10, 2022
Philadelphia, PA

The Abstract deadline for the ANS 58th Annual Spring meeting in Boston, May 5-7 is Thursday, October 15, 2022.
Abstract Instructions and submission form will be available on website in August.

For Society business, please forward all inquiries to:
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AMERICAN NEUROTOLOGY SOCIETY
57th Annual Meeting
PRELIMINARY PROGRAM
April 30 - May 1, 2022
Dallas, TX
ANS Posters will be displayed on Friday & Saturday, April 29-30, 2022

SATURDAY, APRIL 30, 2022

1:00 BUSINESS MEETING *(Treasurer's report/New member induction)*
(Members Only)

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

1:30 WELCOME & OPENING REMARKS BY THE PRESIDENT
Craig A. Buchman, MD

1:33 PRESIDENTIAL CITATIONS
Eugene N. Myers, MD
Charles D. Bluestone, MD
Douglas A. Chen, MD
Derald E. Brackmann, MD
Harold C. Pillsbury III, MD
Patricia A. Roush, AuD

1:41 3rd ANNUAL NOEL L. COHEN AWARD FOR SIGNIFICANT CONTRIBUTIONS TO OTOLOGY AND NEUROTOLOGY

1:49 INTRODUCTION OF WILLIAM E. HITSELBERGER LECTURE
Craig A. Buchman, MD

1:50 WILLIAM E. HITSELBERGER MEMORIAL LECTURE
"Trends in Computational Audiology as Guidelines for Emerging Medical Practices"
Dennis Barbour, MD, PhD
Associate Professor and Director of Master's Studies
Department of Biomedical Engineering
Washington University - St. Louis, MO

2:15 INTRODUCTION OF ABSTRACTS - COCHLEAR IMPLANTS PART 1
Jay T. Rubinstein, MD - Moderator

2:17 NEUROTOLOGY FELLOW AWARD
Cochlear Implantation for Single Sided Deafness: Speech Outcomes, Quality of Life, and Effects on Tinnitus
Nathan R. Lindquist, MD
Ankita Patro, MD
Jourdan T. Holder, AuD, PhD
Elizabeth L. Perkins, MD

2:24 Cochlear Implantation Outcomes in Adults with Single-Sided Deafness: A Systematic Review and Meta-analysis
Ghazal S. Daher, MD
Armine Kocharyan, MD
Margaret T. Dillon, AuD
Matthew L. Carlson, MD

2:31 NEUROTOLOGY FELLOW AWARD
Do Cognitive Impairment Screening Scores Correlate with Cochlear Implant Speech Outcomes?
Mallory J. Raymond, MD
Cheng Ma, BS
Kara Leyzac, AuD, PhD, CCC-A
Elizabeth L. Camposeo, AuD, CCC-A
Shaun A. Nguyen, MD
Ted A. Meyer, MD, PhD
Theodore R. McRackan, MD, MSCR

2:38 Further Evidence for Individual Ear Consideration in Cochlear Implant Candidacy Evaluation
Ankita Patro, MD, MS
Nathan R. Lindquist, MD
Jourdan T. Holder, AuD, PhD
Kareem O. Tawfik, MD
David S. Haynes, MD, MMHC
Rene H. Gifford, PhD
Elizabeth L. Perkins, MD

2:45 ANS TRAINEE AWARD
Promontory Electrocochleography Recordings to Predict Speech-Perception Performance in Cochlear Implant Recipients
Amit Walia, MD
Matthew A. Shew, MD
Shannon M. Lefler, AuD
Cameron C. Wick, MD
Nedim Durakovic, MD
Jacques A. Herzog, MD
Craig A. Buchman, MD

2:52 Prospective, Observational Assessment of Factors Influencing Improvement of Quality of Life after Cochlear Implantation
Amit Walia, MD
James Bao, BS
Noel Dwyer, AuD
Susan Rathgeb, AuD
Jacques A. Herzog, MD
Craig A. Buchman, MD
Cameron C. Wick, MD

2:59 DISCUSSION

3:04 BREAK WITH EXHIBITORS

3:35 INTRODUCTION OF ABSTRACTS - HEARING LOSS
John S. Oghalai, MD – Moderator

3:37 In Silico Localization of Perilymph Proteins Enriched in Meniere's Disease Using Mammalian Cochlear Single Cell Transcriptomics
Alexandra M. Arambula, MD
Shoujun Gu, PhD
Athanasia Warnecke, MD
Hinrich Staecker, MD, PhD
Michael Hoa, MD

3:44 Hearing Aid Prevalence and Reported Hearing Difficulty in Americans with Subclinical Hearing Loss
Jacqueline M. Dragon, BA
Alexandria L. Irace, BA
Maeher R. Grewal, BS
Justin S. Golub, MD, MS

3:51 Otologic Manifestations after COVID-19 Vaccination: Long-term Symptomatic and Audiometric Follow-up
Helena Wichova, MD
Mia E. Miller, MD
John W. House, MD
M. Jennifer Derebery, MD

3:58 White Matter Hyperintensities in Patients with Sudden Sensorineural Hearing Loss
Mehdi Abouzari, MD, PhD
Arash Abiri, BS
Ariel Lee, BS
Kotaro Tsutsumi, BA
Meleeka Akbarpour, MS
Beenish Patel, MS
Hamid R. Djalilian, MD

4:05 DISCUSSION

4:10 PANEL
American Auditory Society Panel: "New Frontiers in Hearing Research"
Charles Limb, MD, Moderator
Carmen Brewer, PhD
Rene H. Gifford, PhD
Sumit Dhar, PhD

5:10 CLOSING REMARKS/ADJOURNMENT
Craig A. Buchman, MD

SUNDAY, MAY 1, 2022

7:00 BUSINESS MEETING *(O&N/Committee Reports)*
(Members Only)

7:25 SCIENTIFIC SESSION
(Open to registered Members and Non-members – Badge required for admittance)

7:25 WELCOME & OPENING REMARKS BY THE PRESIDENT
Craig A. Buchman, MD

7:27 INTRODUCTION OF ABSTRACTS - COCHLEAR IMPLANTS PART 2
Tina C. Huang, MD, Moderator

7:29 Cochlear Implantation and Programing Considerations in Children with Abnormal Cochleovestibular Nerves: The Project Talk Experience
Briana K. Ortega, MD
Alexander D. Claussen, MD (presenter)
Omid Moshtaghi, MD, MS
Eric Y. Du, BS
Joan Hewitt, AuD
Elina Kari, MD

7:36 HiRes Ultra Series Recall: Failure Rates and Revision Speech Recognition Outcomes
Nathan R. Lindquist, MD
Nathan D. Cass, MD
Ankita Patro, MD
Rene H. Gifford, PhD
David S. Haynes, MD, MMHC
Elizabeth L. Perkins, MD
Jourdan T. Holder, AuD, PhD

7:43 Image Quality and MRI Artifact Reduction of a Multi-Magnet Cochlear Implant
Arianna R. Winchester, MD
Emily Kay-Rivest, MD, MSc
Mary Bruno
Mari Hagiwara, MD
Daniel Jethanamest, MD, MSc

7:50 Twelve-Month Outcomes of Simultaneous Translabyrinthine Resection and Cochlear Implantation
Karl W. Doerfer, MD
Christian G. Fritz
Sandra L. Porps, AuD
Christopher A. Schutt, MD
Robert S. Hong, MD, PhD
Jeffrey T. Jacob, MD
Seilesh C. Babu, MD

7:57 DISCUSSION

8:02 PANEL
"Tomorrow's Cochlear Implant Program"
Oliver F. Adunka, MD, Moderator
Douglas D. Backous, MD
Patti Trautwein, MA, AuD

John L. Dornhoffer, MD
Matthew A. Shew, MD

8:57 INTRODUCTION OF ABSTRACTS - SKULL BASE TUMORS
Brandon Isaacson, MD, Moderator

8:59 Fluorescein-guided Microsurgical Resection of Vestibular Schwannoma: A Prospective Feasibility Study
Stephen A. Chan, MD
Robert J. Macielak, MD
Brian A. Neff, MD
Colin L.W. Driscoll, MD
Jamie J. Van Gompel, MD
Michael J. Link, MD
Matthew L. Carlson, MD

9:06 Spontaneous Volumetric Tumor Regression During Wait-and-Scan Management of 952 Sporadic Vestibular Schwannomas
John P. Marinelli, MD
Daniel E. Killeen, MD
Zane Schnurman, MD
Jacob B. Hunter, MD
Christine M. Lohse, MS
Douglas Kondziolka, MD, MSc
Matthew L. Carlson, MD

9:13 Systematic Review and Meta-Analysis for Surgery Versus Stereotactic Radiosurgery for Jugular Paragangliomas
James C. Campbell, MD
Jessica W. Lee, MD
Leila Ledbetter, MLIS, AHIP
Tracy Truong, MS
Hwanhee Hong, PhD
Maragatha Kuchibhatla, PhD
David M. Kaylie, MD

9:20 DISCUSSION

9:25 MID-MORNING BREAK

9:45 INTRODUCTION OF WILLIAM F. HOUSE LECTURE
Craig A. Buchman, MD

9:46 WILLIAM F. HOUSE MEMORIAL LECTURE
"Vestibular Implantation - Neurotology's Next Big Contribution to Sensory Restoration"
Charles C. Della Santina, PhD, MD
Professor of Otolaryngology - Head & Neck Surgery and Biomedical Engineering
Director, Vestibular NeuroEngineering Lab
Director, Johns Hopkins Cochlear Implant Center
Johns Hopkins School of Medicine
Baltimore, MD

10:11 INTRODUCTION OF ABSTRACTS – VESTIBULAR DISORDERS
Barry E. Hirsch, MD, Moderator

10:13 Electrically Evoked Vestibulo-ocular Reflex in a Patient with a 23-year History of Bilateral Vestibular Hypofunction
Desi P. Schoo, MD
Andrianna I. Ayiotis, BS
Margaret R. Chow, PhD
Kelly E. Lane
Celia Fernandez Brillet, BS
John P. Carey, MD
Charles C. Della Santina, MD PhD

10:20 ANS TRAINEE AWARD
Examination of Saccade Patterns in Compensated and Uncompensated Unilateral Vestibular Hypofunction
Hunter L. Elms, MD
Kristal M. Riska, PhD, AuD

10:27 NICHOLAS TOROK VESTIBULAR AWARD
Vestibular Migraine Confounds Management of Superior Canal Dehiscence Syndrome
Miriam R. Smetak, MD, MS
Nathan D. Cass, MD
Nauman F. Manzoor, MD
Kelsey Hatton, AuD, CCC-A
Matthew R. O'Malley, MD
Marc L. Bennett, MD, MMHC
David S. Haynes, MD, MMHC

10:34 Different Phenotypes of Vestibular Migraine Based on Visually Enhanced Vestibulo-Ocular Reflex (VVOR) Results
Eric K. Kim, BA
Lauren Pasquesi, AuD
Roseanne Krauter, FNP-BC
Natalie Sienko, BS
Adam Gardi, BS
Jeffrey D. Sharon, MD

10:41 Fixation Stability during Moving Visual Stimulation in Persistent Postural-Perceptual Dizziness
Chihiro Yagi, MD
Yuka Morita, MD, PhD
Tatsuya Yamagishi, MD, PhD
Shinsuke Ohshima, MD, PhD
Shuji Izumi, MD, PhD
Kuniyuki Takahashi, MD, PhD
Arata Horii, MD, PhD

10:48 Comparison of vHIT with Caloric and Rotary Chair Measurements in Adult Patients with Balance Complaints
Emma De Ravin, BS
Tiffany P. Hwa, MD
Alexandra E. Quimby, MD

Douglas C. Bigelow, MD
Jason A. Brant, MD
Michael J. Ruckenstein, MD
Steven J. Eliades, MD PhD

10:55 Visuospatial Cognitive Deficits in Patients with Vestibular Disorders
Maimuna Ahmad, BS
Susan King, BS
Lukasz Bola, PhD
Alfonso Caramazza, PhD
Richard F. Lewis, MD
Divya A. Chari, MD

11:02 DISCUSSION

11:07 PANEL
"Where Are You Mom? What To Do About the Child with Unilateral Hearing Loss!"
Bradley W. Kesser, MD, Moderator
Nancy M. Young, MD
Daniel I. Choo, MD
Margaret A. Kenna, MD, MPH
Judith E. C. Lieu, MD, MSPH

11:57 INTRODUCTION INCOMING PRESIDENT
Fred F. Telischi, MD

12:00 CLOSING REMARKS/ADJOURNMENT
Craig A. Buchman, MD

SELECTED ABSTRACTS

in order of presentation

ORAL PRESENTATIONS

57th Annual Spring Meeting

AMERICAN NEUROTOLOGY SOCIETY

April 30 - May 1, 2022
Hyatt Regency Dallas
Dallas, TX

Posters will be viewed on Friday & Saturday, April 29-30. Oral presentations are Saturday & Sunday, April 30-May 1.

NEUROTOLOGY FELLOW AWARD

Cochlear Implantation for Single Sided Deafness: Speech Outcomes, Quality of Life, and Effects on Tinnitus

Nathan R. Lindquist, MD; Ankita Patro, MD
Jourdan T. Holder, AuD, PhD; Elizabeth L. Perkins, MD

Objective: To report our experience for adults undergoing cochlear implantation (CI) for single-sided deafness (SSD).

Study Design: Retrospective case series.

Setting: Tertiary referral center.

Patients: Adults cochlear implantation recipients for SSD between 2013 and 2021.

Interventions: Unilateral CI.

Main Outcome Measures: Tinnitus handicap inventory (THI), speech, spatial and qualities of hearing scale (SSQ-12), CT mean modiolar distance (MMD), CNC and AzBio speech recognition scores.

Results: 67 adults underwent CI for SSD (mean 50.6 years, SD = 15.9 years). Mean CNC word recognition scores were 8% (SD = 12%) pre-operatively and 45% (SD = 26%) at 6 months post-activation (p = 0.0001). 23 patients (35.4%) received perimodiolar electrodes (MMD 0.45, SD = 0.35 mm) while 44 patients (65.7%) had lateral wall electrodes (MMD 1.12, SD = 0.13 mm, p = 0.0001). There was no significant difference in CNC scores between perimodiolar (47%, SD = 28%) and lateral wall (44%, SD = 25%) electrodes at 6 months (p = 0.6982). Patients did demonstrate significant improvement in SSQ-12 scores in 'speech' and 'spatial' sections but not in the 'qualities' domain at six months. THI was significantly improved from a mean score of 55 ± 24 preoperatively to 21 ± 23 at 6 months ($p < 0.0001$).

Conclusions: Herein, we present the largest cohort of patients with SSD treated with CI to date. This group demonstrates significant benefit with regards to speech recognition scores, tinnitus measures, and quality of life metrics including speech in noise and spatial subdomains as early as 6 months post-operatively.

***Professional Practice Gap & Educational Need:** CI for patients with SSD is a relatively recent trend, with many prior implantations occurring outside of FDA approval. Increased data surrounding the speech recognition outcomes, quality of life metrics, and importance of electrode type for these patients will help guide patient counseling and decision-making for patients, surgeons, and audiologists.

***Learning Objective:**
For patients undergoing CI for SSD

1. Describe speech recognition scores, tinnitus measures, and quality of life metrics for these patients, and
2. Understand how this may translate to clinical guidance, counseling, and expectations for this cohort.

***Desired Result:** Increased data surrounding the speech recognition outcomes, quality of life metrics, and importance of electrode type for these patients will help guide patient counseling and decision-making for patients, surgeons, and audiologists.

***Level of Evidence -** Level IV

***Indicate IRB or IACUC :** Vanderbilt University Medical Center IRB# 211355

Cochlear Implantation Outcomes in Adults with Single-Sided Deafness: A Systematic Review and Meta-analysis

Ghazal S. Daher, MD; Armine Kocharyan, MD
Margaret T. Dillon, AuD; Matthew L. Carlson, MD

Objective: Assess hearing, tinnitus, and quality-of-life outcomes in adults with single-sided deafness (SSD) who underwent cochlear implantation.

Data Sources: PubMed, MEDLINE, Embase, Cochrane Central Register of Controlled Trials, Web of Science, and Scopus databases were searched from January 2008 to September 2021 following PRISMA guidelines.

Study Selection: Studies reporting hearing, tinnitus, and quality-of-life outcomes in adult patients (≥18 years old) with SSD were evaluated.

Data Extraction: Study characteristics, demographic data, hearing (speech recognition in quiet and noise, sound source localization), tinnitus, and quality-of-life outcomes were collected.

Data Synthesis: From an initial search of 1147 articles, 42 studies that evaluated cochlear implant (CI) use in 906 unique adults with SSD (50.6 ± 23.3 years age of implantation) were included. The mean duration of deafness was 6.3 ± 9.6 years. Most adults showed 43% (95% CI, 39.7 to 47.3, P< 0.001, CNC) to 48% (95% CI, 42.4 to 53.2, P< 0.001, AzBio) improvement in speech recognition in quiet and 19-24% (P<0.001) in noise with significant variation in target-to-masker configurations. Sound source localization, quantified as root-mean-squared error, improved with CI use (Mean difference [MD] -17.6º; 95% CI, -20.3º to -14.9º, P<0.001). Patients experienced a significant reduction in Tinnitus Handicap Inventory scores (MD -28.5; 95% CI -34.2 to -22.8, P<0.001) and improvements in Spatial, Speech, and Qualities of Hearing scores (MD 2.1; 95% CI, -1.7 to 2.5, P<0.001).

Conclusions: Cochlear implantation offers significant reduction in tinnitus severity and enhancement of speech recognition in quiet and noise, sound source localization, and perceived quality-of-life in adults with SSD.

***Professional Practice Gap & Educational Need:** 1) Lack of comprehensive and up-to-date systematic review of the existing literature on outcomes of CI use in adults with SSD. 2) Most studies reporting outcomes of CI in SSD are non-randomized trials with a small sample size which interferes with the generalizability of the data and recommendations. 3) Need for well-defined clinical guidelines.

***Learning Objective:** 1) Attendees will understand the hearing benefits of cochlear implantation in adults with single sided deafness, particularly speech recognition in noise and sound localization. 2) Attendees will understand the benefits of cochlear implantation in improving tinnitus and quality of life associated with SSD.

***Desired Result:** To conduct a systematic review of existing literature and perform a meta-analysis of the pooled data on outcomes of CI in SSD, particularly CI effect on speech recognition in noise, sound localization, tinnitus suppression, and improvement of quality of life.

***Level of Evidence** – Level II

***Indicate IRB or IACUC**: Exempt.

NEUROTOLOGY FELLOW AWARD

Do Cognitive Impairment Screening Scores Correlate with Cochlear Implant Speech Outcomes?

Mallory J. Raymond, MD; Cheng Ma, BS.; Kara Leyzac, AuD, PhD, CCC-A
Elizabeth L. Camposeo, AuD, CCC-A; Shaun A. Nguyen, MD
Ted A. Meyer, MD, PhD; Theodore R. McRackan, MD, MSCR

Objective: Because age-related hearing loss is associated with cognitive impairment, many cochlear implant (CI) centers screen patients for cognitive impairment as part of the CI evaluation process. It is unknown if these screening results can validly be used to counsel patients regarding CI outcomes. This study seeks to determine whether there is a correlation between cognitive screening scores and post-operative CI speech recognition improvement.

Study Design: Retrospective review

Setting: Tertiary cochlear implant center

Patients: Seventy-seven adult CI recipients (aged 36-92)

Interventions: Cochlear implantation for patients with bilateral moderate to profound hearing loss

Main Outcome Measures: Preoperative Montreal Cognitive Assessment (MoCA) scores; pre-CI (aided) to 12-month post-CI CNC word/phoneme and AzBio sentences in quiet score improvement

Results: The mean MoCA score for the cohort was 25.1±3.6 (range:13-30). Thirty-five patients (45.5%) had scores suggesting mild cognitive impairment and three (3.9%) suggesting moderate cognitive impairment. Only two patients had previous diagnoses of cognitive impairment. There were no significant differences ($p>0.05$) in pre-CI to 12-month post-CI speech recognition improvements for patients who screened positive for cognitive impairment compared to those who did not (CNC phoneme [53.6±23.5 versus 43.3±26.2], CNC word [51.8±21 versus 37.3±23.7], and AzBio in quiet [52±34.7 versus 43.8±34.8]. In addition, MoCA scores demonstrated absent to weak correlations with improvement in speech recognition scores (*r* range=-0.17- -0.05).

Conclusions: While there is a high prevalence of patients screening positive for cognitive impairment during the CI evaluation process, the degree of post-CI speech recognition improvement does not appear to be different between those who do and do not screen positive for cognitive impairment.

***Professional Practice Gap & Educational Need:** Given the association of cognitive impairment and hearing loss, cognitive screening tests are being incorporated into evaluations of patients with hearing loss. Little is known of the relationship between screening scores and speech outcomes after cochlear implantation. Understanding the relationship between speech outcomes and cognitive impairment screening scores is important for preoperative patient counseling and setting realistic post-CI expectations.

***Learning Objective:** To state the prevalence of cognitive impairment as assessed by the MoCA in adults undergoing CI evaluation; determine the correlation between preoperative MoCA scores and speech outcomes; compare the change from pre- to 12-month postoperative speech scores between patients with and without cognitive impairment;

***Desired Result:** Attendees will: (1) understand the prevalence of cognitive impairment in adults with moderate to profound hearing loss who are seeking cochlear implant care; 2) appreciate the lack of correlation between preoperative cognitive impairment screening scores and 12-month postoperative change in aided speech outcomes after cochlear implantation; 3) utilize cognitive screening of adults undergoing CI evaluation as a tool to direct further comprehensive cognitive evaluation but not to limit cochlear implant candidacy

***Level of Evidence -** Level V

***Indicate IRB or IACUC :** Medical University of South Carolina IRB #Pro00073019, approved 12/20/2017

Further Evidence for Individual Ear Consideration in Cochlear Implant Candidacy Evaluation

Ankita Patro, MD, MS; Nathan R. Lindquist, MD; Jourdan T. Holder, AuD, PhD
Kareem O. Tawfik, MD; David S. Haynes, MD, MMHC
René Gifford, PhD; Elizabeth Perkins, MD

Objective: To report speech and quality-of-life outcomes after cochlear implantation (CI) for asymmetric hearing loss (AHL) and assess the influence of contralateral hearing.

Study Design: Retrospective review.

Setting: Tertiary referral center.

Patients: 168 adults undergoing CI for AHL from 2015-2020. Candidacy included pure-tone average (PTA) $\geq$ 70 dB HL and AzBio in quiet $\leq$ 60% in the implanted ear and AzBio in quiet > 40% in the contralateral ear.

Main Outcome Measures: PTA; CNC, AzBio scores; speech, spatial and qualities of hearing scale (SSQ-12).

Results: Mean preoperative PTA and AzBio in the implanted and contralateral ears were 85 and 67 dB HL and 22% and 69%, respectively. Average CNC in the implanted ear increased from 17% preoperatively to 45% ($p<0.0001$) at 6 months and 49% ($p<0.0001$) at 12 months. Mean AzBio in the implanted ear improved from 22% preoperatively to 60% ($p<0.0001$) at 6 months and 64% ($p<0.0001$) at 12 months. AHL patients demonstrated significant improvement in all SSQ-12 domains at 6 and 12 months. When comparing patients with preoperative contralateral AzBio above 60% versus 41-60%, no significant differences existed in postoperative CNC scores (6-month: 47% vs. 41%, $p=0.08$; 12-month: 50% vs. 46%, $p=0.25$). There were no significant differences in 6-month ($p=0.36$) or 12-month ($p=0.87$) CNC scores between AHL patients and 212 unilateral CI patients with preoperative contralateral AzBio $\leq$ 40%.

Conclusions: CI recipients for AHL derive significant speech and quality of life improvements, supporting individual ear consideration for CI candidacy and patient benefit outside of current Medicare criteria.

Define Professional Practice Gap & Educational Need: AHL is a more recent indication for cochlear implantation. Outcomes data for AHL patients, especially in comparison to traditional candidates, are sparse. These data are important for increasing access to CI care and improving patient counseling with regards to treatment options for AHL.

Learning Objective: To understand average speech and quality-of-life outcomes after cochlear implantation for asymmetric hearing loss as well as to determine the potential impact of contralateral hearing on CI outcomes.

Desired Result: Providers will have additional knowledge about postoperative speech perception and quality-of-life outcomes in the AHL population. These results can be utilized to support reassessment of Medicare preoperative CI candidacy criteria to allow more adults to benefit from this technology.

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

Indicate IRB or IACUC: IRB Exempt (211355, Vanderbilt University).

ANS TRAINEE AWARD

Promontory Electrocochleography Recordings to Predict Speech-Perception Performance in Cochlear Implant Recipients

Amit Walia, MD; Matthew A. Shew, MD; Shannon M. Lefler, AuD
Cameron C. Wick, MD; Nedim Durakovic, MD
Jacques A. Herzog, MD; Craig A. Buchman, MD

Objective: To determine the relationship of electrocochleography (ECochG) responses measured on the promontory with responses measured at the round window (RW) and various intracochlear sites. Also, verify that promontory ECochG responses correlate with postoperative speech-perception performance using the cochlear implant (CI).

Study Design: Prospective cohort study

Setting: Tertiary referral center

Patients and Interventions: Ninety-six adult CI recipients with no cochlear malformations or prior otologic surgery

Main Outcome Measures: Acoustically-evoked ECochG responses were measured intraoperatively at both extracochlear and intracochlear locations. ECochG total response (ECochG-TR), a measure of residual cochlear function, was calculated by summing the fast Fourier transformation amplitudes in response to a range of frequency stimuli (250Hz–2kHz). Speech-perception performance (CNC) was measured at 6-months.

Results: There were strong linear correlations for promontory ECochG-TR with the ECochG-TRs measured at the RW (r = 0.95; p<0.0001), just inside scala tympani (r = 0.91; p<0.0001), and after full insertion (r = 0.83; p<0.0001). For an individual subject, the waveforms of the ECochG response were similar in character across all positions; however, the response amplitude increased from promontory to RW (~1.4-fold) to just inside scala tympani (~2-fold), with the largest response at full insertion (~2.5-fold). RW ECochG-TR independently explained 61.0% of the variability (r^2) in CNC at 6 months.

Conclusions: Promontory ECochG recordings are feasible in most CI recipients and explain a substantial portion of the variability in CI performance. These findings are a critical step in supporting translation of trans-tympanic ECochG into the clinic preoperatively to help predict postoperative CI performance.

***Professional Practice Gap & Educational Need:** Recognizing factors that affect CI performance at a preoperative candidacy level may have drastic implications on post-CI aural rehabilitation, device design and fitting, and surgical technique. Age at implantation, duration of hearing loss, and electrode positioning within the cochlea together explain less than 25% of the variability in speech-perception scores in quiet, making these poor indicators. ECochG responses, prior to implantation at the RW, account for ~50% of the variability in the same speech-perception measures. Prior studies have not investigated whether ECochG responses can be measured on the promontory, a more clinically accessible site.

***Learning Objective:** To determine whether acoustically-evoked ECochG responses measured on the promontory correlated with responses measured at other extracochlear and intracochlear sites. To assess whether ECochG responses can be used to explain the variability in postoperative CI performance.

***Desired Result:** Practitioners and researchers will further realize the feasibility and value of performing promontory ECochG recordings in CI patients, including those with no-response audiograms and understand the potential of using these responses to predict CI performance.

***Level of Evidence -** IV

***Indicate IRB or IACUC:** Washington University in St. Louis IRB #202007087.

Prospective, Observational Assessment of Factors Influencing Improvement of Quality of Life after Cochlear Implantation

Amit Walia, MD; James Bao, BS; Noel Dwyer, AuD
Susan Rathgeb, AuD; Jacques A. Herzog, MD
Craig A. Buchman, MD; Cameron C. Wick, MD

Objective: To prospectively measure the impact of cochlear implantation on quality of life using the novel Cochlear Implant Quality of Life (CIQOL-35) questionnaire. To determine audiologic and demographic factors influencing the CIQOL-35.

Study Design: Prospective observational study.

Setting: Tertiary referral center.

Patients: Thirty patients aged 31 to 96 years with sensorineural hearing loss

Interventions: Unilateral cochlear implantation

Main Outcome Measures: CIQOL-35 global score pre- and 6-months post-implantation. Physical function measured by the short form survey (SF-36), audiologic, and demographic variables.

Results: Speech-perception performance improved significantly across all patients with a mean CNC improvement of 45.1% (95% CI, 34.1 to 56.1). Likewise, the CIQOL-35 showed significant improvement from pre-implantation to 6-months post-activation with a mean difference of 14.9 points (95% CI, 11.3 to 18.5; $p < 0.0001$). Improvement in CIQOL-35 correlated linearly with age ($r = -0.63$; $p = 0.0004$) and improvement in CNC score ($r = 0.64$; $p = 0.0003$). Physical functional status, device usage, and performance in noise did not significantly correlate with CIQOL-35 global score outcomes ($p > 0.05$). Multivariate modeling using age and change in CNC score explained 64% of the variability measured by the CIQOL-35 global score.

Conclusions: This study is novel for pre- and post-implantation usage of the CIQOL-35. Cochlear implantation can be strongly recommended, not only for hearing rehabilitation, but also to improve quality of life. However, younger patients and those with a greater improvement in speech-perception performance are more likely to achieve a greater quality of life benefit.

***Professional Practice Gap & Educational Need:** Quality of life with cochlear implantation is perhaps the most important clinical outcome measure. Prior to the psychometrically validated CIQOL-35, there was poor correlation between patient reported outcomes and commonly obtained demographic variables or speech-perception outcomes. This study prospectively utilizes the CIQOL-35 to measure the quality-of-life effect size after implantation as well as determine which factors may influence CIQOL-35 outcomes.

***Learning Objective:** To understand quality of life improvement in patients after receiving cochlear implants. To assess the audiologic and demographic variables that contribute to the improvement in quality of life after cochlear implantation (CI).

***Desired Result:** Despite at times limited improvement in speech perception performance, practitioners and researchers will realize that the majority of patients receive significant improvement in quality-of-life metrics as measured by the CIQOL-35 global score after CI. Younger patients and those with a greater improvement in speech-performance metrics are more likely to experience a greater cochlear implant-specific quality of life improvement after CI.

***Level of Evidence -** IV

***Indicate IRB or IACUC:** Washington University in St. Louis IRB #201911035; 11/11/19

In Silico Localization of Perilymph Proteins Enriched in Meniere's Disease Using Mammalian Cochlear Single Cell Transcriptomics

Alexandra M. Arambula, MD; Shoujun Gu, PhD; Athanasia Warnecke, MD
Hinrich Staecker, MD, PhD; Michael Hoa, MD

Hypothesis: Proteins enriched in the perilymph proteome of Meniere's disease (MD) patients may implicate cochlear structures and cell types. Utilizing single cell transcriptome datasets from the mammalian cochlea, we hypothesize that these enriched perilymph proteins will localize to specific cochlear cell types.

Background: The limited understanding of human inner ear pathologies and their associated biomolecular variations hinder efforts to develop disease-specific diagnostics and therapeutics. Perilymph sampling and analysis is now furthering characterization of the cochlear microenvironment. Recently, enriched inner ear protein expression has been shown in patients with MD compared to patients with other inner ear diseases. Localizing expression of these proteins to cochlear cell types can further our knowledge of potential disease pathways and subsequent development of targeted therapeutics.

Methods: We compiled previously published data regarding differential perilymph proteome profiles amongst patients with MD, otosclerosis, EVA, SSNHL, and hearing loss of undefined etiology (controls). Enriched proteins in MD were cross-referenced against published single-cell/single-nucleus RNA-seq datasets to localize protein expression to specific cochlear cell types. Datasets included postnatal day 7 and 15 mouse organ of Corti and adult mouse spiral ganglion neurons, Schwann cells, and the stria vascularis.

Results: In silico analysis of single cell transcriptomic datasets localizes enriched perilymph proteins to specific inner ear cell types. We have also identified potential genetic targets within these cochlear regions, which may guide development of future treatment for MD.

Conclusions: Perilymph proteins enriched in MD are expressed by specific cochlear cell types based on in silico localization, potentially facilitating development of disease-specific diagnostic markers and therapeutics.

Define Professional Practice Gap & Educational Need: We lack knowledge of molecular processes and their pathologic variations within the inner ear, specifically as this relates to Meniere's disease (MD). We similarly lack reliable disease-specific diagnostic markers and therapies. Perilymph analysis has demonstrated multiple potential disease-specific biomarkers, though the cochlear cell type(s) producing these biomolecules remains to be elucidated.

Learning Objective: To appreciate: 1) that differentially enriched perilymph proteins in patients with MD localize to specific cochlear cell types based on in silico data analysis with previously published transcriptome datasets from the inner ear; 2) how this data can guide identification of potential genetic/protein targets for diagnosis and treatment of MD.

Desired Result: The audience will better understand perilymph protein expression unique to MD and these various proteins' localization to specific cells within the cochlea. We also aim for the audience to appreciate how this information can guide discovery of potential disease-specific diagnostics and therapeutics.

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

Indicate IRB or IACUC: Exempt

Hearing Aid Prevalence and Reported Hearing Difficulty in Americans with Subclinical Hearing Loss

Jacqueline M. Dragon, BA; Alexandria L. Irace, BA
Maeher R. Grewal, BS; Justin S. Golub, MD, MS

Objective: Subclinical hearing loss (SCHL, defined as a 4-frequency pure tone average [PTA] of 1-25 dB) has recently been associated with depressive symptoms and cognitive decline. This suggests that the common 25 dB adult cutpoint for normal hearing may not be sensitive enough. We aim to characterize real-world hearing difficulties, as measured by hearing aid use and self-reported hearing difficulty, among individuals with SCHL and borderline hearing loss (PTA4 of 21-25 dB).

Study Design: Analysis of biennial cross-sectional epidemiological survey (NHANES 1999-2012, 2015-2016)

Setting: Community

Subjects: Non-institutionalized U.S. citizens ≥12 years old, n=19,259

Main Outcome Measures: PTA4 (500, 1000, 2000, 4000 Hz), PTAhf (6000, 8000 Hz), subjective difficulty hearing, and hearing aid use

Results: Nearly 1 million Americans with SCHL wore hearing aids (~795,000, or 0.35%, 95% CI=0.23%-0.54%). 15.0% (13.9-16.3%; or 34.1 million) of those with SCHL reported at least "a little trouble" hearing, which increased to 41.8% for those with borderline hearing loss. Among those with SCHL who wore hearing aids, 80.8% had an abnormal PTAhf (i.e. PTAhf>25 dB). Among those with SCHL who reported at least "a little trouble" hearing, 50.4% had an abnormal PTAhf.

Conclusions: Despite hearing loss traditionally being defined by PTA4≤25, nearly 1 million adults and adolescents with SCHL (PTA4 of 1-25 dB) wore hearing aids, and nearly half with borderline HL (PTA4 of 21-25 dB) had subjective difficulty hearing. To better reflect real-world difficulties, stricter definitions of hearing loss should be explored, including a lower cutpoint for the PTA4 or by using the more sensitive PTAhf.

***Professional Practice Gap & Educational Need:** SCHL has recently been associated with cognitive decline and depressive symptoms. This raises the question of whether the traditional definition of hearing loss may be too insensitive. It is unclear whether those with so-called SCHL are truly asymptomatic.

***Learning Objective:** To understand the prevalence of hearing aid use and reported difficulty hearing among those with SCHL and borderline hearing loss.

***Desired Result:** Practitioners will understand that a substantial fraction of those with SCHL have reported difficulty hearing and a meaningful absolute number wear a hearing aid. Practitioners should recognize that the 25 dB PTA4 cutoff commonly used to define hearing loss may be too insensitive.

***Level of Evidence -** III

***Indicate IRB or IACUC:** Exempt

Otologic Manifestations after COVID-19 Vaccination: Long-term Symptomatic and Audiometric Follow-up

Helena Wichova, MD; Mia E. Miller, MD
John W. House, MD; M. Jennifer Derebery, MD

Objective: After reports of increased incidence of otologic manifestations after COVID-19 vaccinations, we present follow-up for newly symptomatic patients with longer follow-up.

Study Design: Retrospective chart review

Setting: Specialized otology ambulatory practice

Patients: All patients with available diagnostic codes, COVID-19 questionnaires and clinical follow-up of at least 30 days after initial visit

Interventions: Review of clinical treatment

Results: Out of 57 patients with reported post-vaccination symptoms, 31 (14 female and 17 male) had follow-up of at least 30 days post-treatment. The mean age was 56.6±14.5 years old. 16 received Moderna and 15 received Pfizer vaccine. At initial presentation, 17 patients had underlying otologic diagnosis, with 5 having active Meniere's disease or Autoimmune Inner Ear Disease. Initially, 24 patients (77.4%) noted hearing loss, 16 (61.3%) tinnitus, 9 (29%) dizziness, and 5(16%) vertigo. At last follow-up, symptoms resolved in 2 patients, improved in 17, worsened in 1, and no changes were noted by 11. Hearing loss (n=12) was the most commonly reported residual symptom followed by tinnitus (n=10). When available the initial and follow-up affected ear pure tone averages and word recognition scores were 49 dB/67% and 43 dB/72%, respectively. There were no abnormal retrocochlear findings on MRIs.

Conclusions: There are no definite correlations between COVID-19 vaccination and new or worsened otologic symptoms. Vaccinated patients with new or exacerbated otologic symptoms frequently improved over time. Cases of post-vaccination otologic symptoms should be reported to the CDC Vaccine Adverse Event Reporting System (VAERS) and patients should undergo prompt otolaryngology referral.

Professional Practice Gap & Educational Need: There is no long-term follow-up regarding initial reports of hearing loss and other otologic manifestations after covid vaccination. We present our data of patients who were monitored for more than 30 days (mean 101 day follow-up).

Learning Objective: To investigate the clinical and audiologic outcomes after vaccination.

Desired Result: To educate the community on no obvious correlation between COVID-19 vaccination and otologic manifestations.

Level of Evidence: Level VI

IRB: Approved, WCG IRB (#20203338).

White Matter Hyperintensities in Patients with Sudden Sensorineural Hearing Loss

Mehdi Abouzari, MD, PhD; Arash Abiri, BS; Ariel Lee, BS; Kotaro Tsutsumi, BA
Meleeka Akbarpour, MS; Beenish Patel, MS; Hamid R. Djalilian, MD

Objective: To compare white matter hyperintensities (WMHs) on T2-weighted magnetic resonance imaging (MRI) of patients with sudden sensorineural hearing loss (SSNHL) with an age-matched control group.

Methods: T2-weighted MRI scans of 150 patients with SSNHL were assessed for WMHs and compared with the data of 150 healthy age-matched adults. Assessments of WMHs included independent grading of deep white matter hyperintensities (DWMHs) and periventricular hyperintensities (PVHs). WMH severity was visually rated using Fazekas and Mirsen scales by two observers independently.

Results: Fazekas grades for PVHs ($p < 0.001$) and DWMHs ($p < 0.001$) of SSNHL patients were found to be significantly greater than those of healthy participants. The average Mirsen grades for DWMHs of healthy and SSNHL patients were evaluated to be 0.373 ± 0.550 and 2.140 ± 0.859, respectively. Mirsen grades for DWMHs of SSNHL patients were found to be significantly greater ($p < 0.001$) than those of healthy participants. The Mirsen scale was found to have higher sensitivity ($p < 0.001$) than the Fazekas scale in grading PVHs and DWMHs. No significant difference ($p = 0.24$) was found in specificities between the two scales.

Conclusions: Patients with sudden hearing loss have a much higher likelihood of having periventricular and deep white matter hyperintensities compared to age-matched controls. These findings indicate that sudden hearing loss patients are more likely to have microvascular changes in the brain, which may indicate a vascular origin to sudden sensorineural hearing loss.

REQUIRED:
Define Professional Practice Gap & Educational Need: The pathophysiology and management of SSNHL has remained subject of debate. Further investigation into discovering new and improved management solutions for better treating SSNHL has been called. For this reason, a need to educate otolaryngologists on new hypotheses for SSNHL etiology leading to new treatment strategies is warranted.

Learning Objective: To propose a new vascular etiology in SSNHL patients to ANS members which can relate this entity with other complex neurovascular disorders such as migraine. This can imply that SSNHL may have an underlying vascular or neurogenic inflammation pathophysiology similar to migraine offering new treatment strategies for SSNHL.

Desired Result: Informing neurotologists of a possible new pathophysiology for SSNHL that can be a stepstone for future treatment options in patients with SSNHL.

Level of Evidence - III

Indicate IRB or IACUC: The study has IRB approval from the UC Irvine

Cochlear Implantation and Programing Considerations in Children with Abnormal Cochleovestibular Nerves: The Project Talk Experience

Briana K. Ortega, MD; Omid Moshtaghi, MD, MS
Eric Y. Du, BS; Joan Hewitt, AuD; Elina Kari, MD

Objective: Describe the nuances regarding cochlear implant(CI) fitting and programming in children with cochleovestibular nerve(CVN) abnormalities.

Study Design: Retrospective case series examining patients with abnormal CVN with marginal benefit from CI, followed by reprogramming by an audiologist.

Setting: Outpatient.

Patients: Pediatric CI patients with abnormal CVNs and with unsatisfactory hearing outcomes.

Interventions: Following CI, patients underwent reprogramming and adjustment with an audiologist.

Main Outcome Measures: Clinical features, hearing data, imaging, and CI settings.

Results: Nine CI patients(16 ears) were included. Imaging data was available for four patients(7 ears). Mean imaging age was 8 months(range 4-12). Five had an abnormal modiolus and all had a normal cochlea. Six (85%) ears had an absent CVN within the internal auditory canal. Mean implantation age was 40 months (range 12-138). Nine ears had preprogramming by an outside audiologist prior to reprogramming by audiologist (J.H.). In all patients, all electrodes were activated across all frequencies. Following reprogramming, all CIs had stimulation reduced. Five (56%) had a pulse-width reduction. Additionally, 5(28%) had all electrodes activated, 6(33%) had low frequencies deactivated, 4(22%) had high frequencies deactivated, and 1(6%) had a mixture of frequencies deactivated. Following reprogramming, hearing perception was available for 8 CIs. The average speech recognition threshold was 35 (range 25-50). An open-set word list was used for 6(75%) ears. Word percentile perception was over 50% in 3(38%) CIs.

Conclusions: All patients benefited from CI, despite many having an absent CVN. Aside from the surgical pitfalls associated with implantation, this subset of patients may require nontraditional CI programming with specific electrode frequency activation to maximize hearing benefit.

Define Professional Practice Gap & Educational Need: The canonical thought is that CIs are ineffective or have unpredictable response in patients with abnormal CVN and hearing loss; thus, these patients often do not undergo implantation. We present a case series demonstrating that bilateral implantation and CI programing strategies improved hearing outcomes in this population.

Learning Objective: Illustrate that pediatric patients with abnormal CVNs can benefit from CIs, and clarify the nuances in their CI settings.

Desired Result: Encourage physicians and audiologists encountering patients with abnormal CVNs to consider bilateral cochlear implantation, and a corresponding reprograming methodology. We hope to bring awareness to the CI programming modifications specific to this population.

Level of Evidence - Level V

Indicate IRB or IACUC: University of California, San Diego IRB #190938: Congenital hearing loss

HiRes Ultra Series Recall: Failure Rates and Revision Speech Recognition Outcomes

Nathan R. Lindquist, MD; Nathan D. Cass MD; Ankita Patro MD
René H. Gifford, PhD; David S. Haynes MD, MMHC
Elizabeth L. Perkins MD; Jourdan T. Holder, AuD, PhD

Objective: To report Advanced Bionics Ultra and Ultra 3D (V1) cochlear implant (CI) electrode failures and revision speech recognition outcomes for patients at a large CI program.

Study Design: Retrospective case series.

Setting: Tertiary referral center.

Patients: Patients who underwent cochlear implantation with HiRes™ Ultra (v1) or Ultra 3D (v1).

Interventions: CI, documented device failure, speech recognition testing.

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

Results: As of September 21, 2021, 65 (21.1%) of the 308 implanted devices were known failures, with 61 (19.8%) definitively associated with the recent voluntary field corrective action (FCA). The overall failure rate for adults (18.6%) was lower than the pediatric (26.9%) failure rate ($p = 0.127$). Average time to device failure was 2.2 ± 1.1 years. 47 patients (77%) completed revision surgery. For adults, there was no significant difference ($p = 0.96$) between best pre-revision speech recognition scores (median CNC = 62%, SD = 23%) and most recent post-revision performance (median CNC = 54%, SD = 27%). 79% of patients recovered to within 15 percentage points of their pre-revision scores at last follow-up (median = 7.1 months).

Conclusions: A significant number of patients were identified with hard failures of the Ultra (v1) and Ultra 3D (v1) devices. This may be due to our institution's diligent use of electrical field imaging (EFI) to confirm device failure, which is not ubiquitously available. Despite the high failure rate, the majority of patients achieve speech recognition scores similar to pre-failure performance after revision CI surgery.

***Professional Practice Gap & Educational Need:** Manufacturer initiated CI device recalls are relatively uncommon, with the majority of reliability and failure data only available through post-explant data through manufacturer device analysis and reliability reporting. Consequently, clinical data regarding active recalls and device failures may improve patient counseling with regards to failure rate and post-revision speech recognition outcomes.

***Learning Objective:**
For the recent HiRes Ultra and Ultra 3D series recall:

1. Quantify and characterize such CI failures at a large CI center, and
2. Understand the post-revision speech recognition outcome scores for improved clinical decision making and patient counseling.

***Desired Result:** Surgeons and audiologists will use these clinical data from the recent HiRes Ultra and Ultra 3D series to quantify and characterize this type of CI failure and implement their knowledge regarding post-revision speech recognition outcome scores for improved clinical decision making and patient counseling.

***Level of Evidence -** Level V

***Indicate IRB or IACUC :** Vanderbilt University Medical Center IRB# 211355

Image Quality and MRI Artifact Reduction of a Multi-Magnet Cochlear Implant

Arianna R. Winchester MD; Emily Kay-Rivest, MD, MSc; Mary Bruno
Mari Hagiwara, MD; Daniel Jethanamest, MD, MSc

Objective: To determine if metal reduction MRI sequences and changes in implant placement minimize artifact from cochlear implants (CI) and improve visualization of intracranial structures.

Study Design: Cadaveric study.

Setting: Tertiary referral center.

Patients: Five cadaveric heads.

Interventions: Specimens were implanted with Advanced Bionics HiRes Ultra3D devices at nasion-external ear canal (EAC) angles of 90, 120, 160 degrees; and distances from the EAC of 9 or 12cm. Standard brain/internal auditory canal (IAC) sequences with metal artifact reducing technique were acquired in a 1.5-T scanner.

Main Outcome Measures: The primary outcome was visibility of 14 intracranial structures graded on a 4-point scale (1: structures <50% visible, 2: >50% visible with some areas nonvisible from artifact, 3: artifact present but adequate for diagnosis, and 4 high-quality). Scores were determined by an experienced head and neck radiologist and compared with one-way ANOVA.

Results: Imaging sequences included axial 5mm whole-brain turbo spin echo (TSE) T2 and fluid-attenuation inversion recovery high bandwidth, axial 5mm whole-brain slice-encoding metal artifact correction (SEMAC), axial IAC constructive interference in steady state (CISS), and axial 3mm T1 IAC with and without fat saturation. In all cases, SEMAC (mean:3.7,SD:0.7) was superior to TSE (mean:3.5,SD:0.8) for ipsilateral cortex and brainstem/cerebellum, and equivalent for the inner ear and cerebellopontine angle. CISS and T1 with fat saturation were poor for ipsilateral structures ($p=0.03$, $p<0.01$). The 120°/9cm position afforded visualization of ipsilateral structures except the brainstem/cerebellum, where 120°/12cm was best ($p<0.01$).

Conclusions: SEMAC sequence provides artifact suppression while retaining excellent image quality. Different placement angles didn't confer improvement in visualization, although placement distances provided slight advantages for some structures.

***Professional Practice Gap & Educational Need:** Many patients with CIs require advanced imaging after implantation, whether related to their hearing loss or another indication. With the prevalence of MRI-compatible devices, improving the quality of neuro imaging obtained with the device in place in these patients is important.

***Learning Objective:** Review recent technological advances in MRI metal artifact suppression for CIs. Determine an improved proposed MRI protocol for artifact reduction and discuss the role of implant positioning for a contemporary MRI compatible CI.

***Desired Result**: Discuss how to adapt implantation techniques to suit potential future imaging needs and develop a CI-specific MRI protocol.

***Level of Evidence -** Level III

IRB: Exempt

Twelve-Month Outcomes of Simultaneous Translabyrinthine Resection and Cochlear Implantation

Karl W. Doerfer, MD; Christian G. Fritz; Sandra L. Porps, AuD; Christopher A. Schutt, MD
Robert S. Hong, MD, PhD; Jeffrey T. Jacob, MD; Seilesh C. Babu, MD

Objective: Describe outcomes in patients undergoing simultaneous translabyrinthine resection of cerebellopontine angle (CPA) tumors and cochlear implantation (CI) 12 months following surgery.

Study Design: Prospective, nonrandomized study

Setting: Tertiary care neurotology center

Patients: Patients undergoing simultaneous translabyrinthine resection of CPA tumors and CI between 1/2019 and 1/2020.

Interventions: CI

Main Outcome Measures: AZ Bio Sentence Test; Consonant Nucleus Consonant (CNC) testing; Speech, Spatial and Qualities of Hearing Scale (SSQ) scores; Tinnitus Handicap Inventory (THI) scores.

Results: Thirteen patients underwent simultaneous CI with translabyrinthine tumor resection (vestibular schwannoma: 12; meningioma: 1). AZ Bio, CNC, SSQ, and THI scores were obtained at 1, 3, 6 and 12 months postoperatively. All modality measurements for AZ Bio testing showed statistically significant improvement at 3 months (In Quiet, $p = 0.039$; +10 SNR, $p = 0.021$; +5 SNR, $p = 0.003$), with the largest gains seen in +5 SNR scores (mean: +15%, range: +3-52%). There was no significant change in AZ Bio scores between 3 and 12 months, suggesting durable improvement. CNC test results showed statistically significant improvement at 3 months (mean: +27%, $p = 0.016$). Overall, comparing preoperative CNC results to those at 12 months revealed a statistically significant improvement (mean: +35%, $p = 0.004$). SSQ Speech subscore showed a statistically significant improvement at the 3 months ($p = 0.023$). This initial improvement was not maintained at 12 months ($p = 0.171$). THI scores showed statistically significant improvement at 3 months (mean: -23, $p = 0.002$). This initial improvement was maintained at the 12-month timepoint, as there was no significant change between 3 and 12 months ($p = 0.958$). Overall, comparing pre-operative THI scores to those at 12 months revealed a statistically significant improvement (mean: -22, $p = 0.014$).

Conclusions: Simultaneous CI with translabyrinthine tumor resection provides durable improvement in speech perception and tinnitus reduction one year following surgery.

***Professional Practice Gap & Educational Need:** Simultaneous CI and translabyrinthine tumor resection is an evolving strategy for managing expected hearing loss. Long-term outcomes are not well described in the literature.

***Learning Objective:** Participants will understand the potential durable hearing benefits provided by simultaneous cochlear implantation and translabyrinthine tumor resection.

***Desired Result:** For participants to incorporate consideration of simultaneous CI and translabyrinthine resection when managing patients with vestibular schwannoma or other CPA lesions.

***Level of Evidence:** III

***Indicate IRB:** #1349609, Ascension, Southeast Michigan

Fluorescein-guided Microsurgical Resection of Vestibular Schwannoma: A Prospective Feasibility Study

Stephen A. Chan, MD; Robert J. Macielak, MD; Brian A. Neff, MD; Colin L.W. Driscoll, MD
Jamie J. Van Gompel, MD; Michael J. Link, MD; Matthew L. Carlson, MD

Objective: To evaluate the optimal dose and timing of administration of fluorescein sodium (FS) for selective fluorescence of vestibular schwannoma (VS) during microsurgery with the YELLOW 560 nm microscope filter (YE560) and characterize the benefit, as determined from surgeon assessments.

Study Design: Prospective cohort study

Setting: Tertiary referral center

Patients: Adult patients undergoing VS microsurgery

Interventions: Intraoperative intravenous administration of FS and visualization with the YE560.

Main Outcome Measures: Time to peak fluorescence, duration of fluorescence, correlation of fluorescence of VS with electrostimulation and white light microscopy visual assessment, and likelihood of surgeons to use FS with the YE560 in future cases.

Results: Novel use of FS and YE560 during microsurgery achieved selective fluorescence of VS with capabilities to differentiate nerve fascicles and tumor. Nuances of FS administration and timing are discussed. Correlation of differential uptake of FS by VS with electrostimulation and white light microscopy was judged to be high by surgeons. Representative images and videos utilizing YE560 and FS are presented.

Conclusions: FS and YE560 may be used in VS microsurgery to visually differentiate VS from surrounding nerves and evaluate for residual tumor capsule.

Professional Practice Gap & Educational Need: FS has been used in the neurosurgical resection of intracranial neoplasms but has only been reported in 2 VS cases. There is educational need in understanding how FS can be routinely implemented in VS microsurgery.

Learning Objective: Attendees will become familiar with a protocol for safe and effective use of IV FS in VS microsurgery and will understand the tissue differentiation achieved.

Desired Result: Attendees will consider the use of fluorescence in VS microsurgery.

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

Indicate IRB or IACUC: Approved (2/21/20), IRB #19-005178, Mayo Clinic

Spontaneous Volumetric Tumor Regression During Wait-and-Scan Management of 952 Sporadic Vestibular Schwannomas

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Jacob B. Hunter, MD; Christine M. Lohse, MS
Douglas Kondziolka, MD, MSc; Matthew L. Carlson, MD

Objective: Spontaneous tumor shrinkage during wait-and-scan management of sporadic vestibular schwannoma is generally considered an uncommon phenomenon. However, most data informing this understanding stem from single-slice linear tumor measurements taken in the axial imaging plane. The objective of current work was to characterize the regression capacity of sporadic vestibular schwannomas using volumetric tumor measurements.

Study Design: Retrospective cohort study using slice-by-slice, three-dimensional volumetric tumor measurements on serial MRI studies.

Setting: Three tertiary referral centers.

Patients: Patients with sporadic vestibular schwannoma.

Interventions: Wait-and-scan.

Main Outcome Measures: Regression-free survival rates where regression is defined by a decrease of ≥20% of the tumor volume.

Results: Among 952 patients undergoing observation, 123 experienced volumetric tumor regression following diagnosis at a median of 1.2 years (IQR 0.6-2.9). Volumetric regression-free survival rates (95% CI; number still at-risk) at 1, 3, and 5 years following diagnosis were 94% (92-95; 662), 86% (83-89; 275), and 78% (73-82; 132), respectively. Neither age at diagnosis (HR 1.05; p=0.54) nor volume at diagnosis (HR 0.94; p=0.31) was significantly associated with tumor regression. Among 405 patients who demonstrated an initial period of tumor growth but continued wait-and-scan management, 48 experienced subsequent volumetric regression at a median of 1.2 years (IQR 0.8-2.6) following initial growth. Subsequent volumetric regression-free survival rates at 1, 3, and 5 years following initial growth were 94% (92-97; 260), 84% (79-89; 99), and 75% (67-83; 43), respectively.

Conclusions: Spontaneous regression in volumetric tumor size during wait-and-scan management occurs more frequently than suggested by prior studies using linear tumor measurements and can even occur following previous episodes of documented tumor growth.

Professional Practice Gap & Educational Need: Current understanding of the natural history of sporadic vestibular schwannoma growth during observation is predominantly informed by studies employing single-slice linear tumor measurements in the axial imaging plane. The current study examines the natural history of sporadic vestibular schwannoma in a large cohort of patients at three tertiary referral centers across the United States using sensitive slice-by-slice volumetric measurements, showing that more tumors exhibit periods of shrinkage than previously reported.

Learning Objective: Describe the capacity for sporadic vestibular schwannomas to undergo periods of tumor shrinkage following diagnosis, as well as following periods of previously documented growth in patients who elected continued observation.

Desired Result: When considering definitive treatment of sporadic vestibular schwannoma during wait-and-scan management, practitioners would account for the potential that not all tumors that exhibit growth continue to grow, and tumors can regress in size during continued observation following previous episodes of documented growth.

Level of Evidence: III

Indicate IRB or IACUC: IRB approval was obtaining from each participating center prior to data collection (IRB numbers,15-008224, 112016-040, and S13-00063, respectively).

Systematic Review and Meta-Analysis for Surgery Versus Stereotactic Radiosurgery for Jugular Paragangliomas

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Tracy Truong, MS; Hwanhee Hong, PhD
Maragatha Kuchibhatla, PhD; David M. Kaylie, MD

Objective: Comprehensively analyze tumor control and treatment complications for jugular paraganglioma patients undergoing surgery versus stereotactic radiosurgery (SRS)

Data Sources and Study Selection: EMBASE, Medline, and Scopus were searched for English and Spanish manuscripts from 1/1/1995-1/1/2019 for studies reporting tumor control and treatment side effects regarding patients with jugular paraganglioma treated with surgery or SRS.

Main Outcome Measures: Short-term and long-term tumor recurrence, and post-intervention complications

Data Synthesis, and Results: We identified 10,952 original abstracts, 705 eligible studies, and 107 studies for final data extraction. There were 3,498 patients—2,215 surgical patients and 1,283 SRS patients. Bayesian meta-analysis was applied to the extracted data, with tau measurements for study heterogeneity. SRS tumors were larger (3.9 cm3 vs 8.1 cm3). Meta-analysis results demonstrated low rates of long-term recurrence for both modalities (surgery: 15% recurrence, SRS: 7%), with SRS demonstrating lower rates of post-intervention CSF leak, dysphagia, and Vll, lX, X, Xl, or Xll palsies.

Conclusions: This is the largest analysis of jugular paraganglioma treatment with surgery or SRS. It demonstrates excellent tumor control by both modalities, and lower intervention morbidities with SRS for many complications.

Professional Practice Gap & Educational Need: Provide an updated systematic review and meta-analysis for surgical versus SRS treatment of jugular paraganglioma.

Learning Objective: Provide high level evidence regarding outcomes and complications for surgical and SRS treatment of jugular paragangliomas.

Desired Result: Analysis of tumor control and outcomes for treatment of jugular paragangliomas substantiated by a large systematic review and meta-analysis.

Level of Evidence - Level III

Indicate IRB or IACUC : Deemed exempt by Duke IRB

Electrically Evoked Vestibulo-ocular Reflex in a Patient with a 23-year History of Bilateral Vestibular Hypofunction

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Kelly E. Lane; Celia Fernandez Brillet, BS; John P. Carey, MD
Charles C. Della Santina, MD, PhD

Objective: To characterize the early eye movement responses to vestibular stimulation in a patient implanted with an investigational vestibular implant 23 years after onset of ototoxic bilateral vestibular hypofunction (BVH).

Study Design: Case Report

Setting: Tertiary care center as part of a first-in-human clinical trial.

Patients: 1

Interventions: Unilateral vestibular implantation with an investigational multichannel vestibular implant in a 55-year-old male with a well documented 23-year history of aminoglycoside induced bilateral vestibular hypofunction.

Main Outcome Measures: Electrically evoked vestibulo-ocular reflexes (eeVOR).

Results: Three-dimensional video-oculography during canal specific stimulation shows eeVOR elicited eye movements that approximately aligned with each semicircular canal stimulated. The magnitude of the eeVOR response increased with increasing stimulus pulse frequency and current amplitude. Response alignment and magnitude were similar to those observed for patients who underwent vestibular implantation less than ten years after BVH onset.

Conclusions: Vestibular implantation and electrical stimulation of the semicircular canal afferent nerves can drive canal-specific eye movement responses in a patient with >20 years of vestibular loss.

***Professional Practice Gap & Educational Need:** Limited understanding of the use of vestibular implants in patients with long-term bilateral vestibular hypofunction.

***Learning Objective:** Improved understanding of which patients may benefit from a vestibular implant.

***Desired Result:** Demonstrate that vestibular implantation and stimulation can drive canal-specific eye movements in patients with a prolonged duration of vestibular loss.

***Level of Evidence -** V

***Indicate IRB or IACUC :** Johns Hopkins School of Medicine IRB: NA_00051349

ANS TRAINEE AWARD

Examination of Saccade Patterns in Compensated and Uncompensated Unilateral Vestibular Hypofunction

Hunter L. Elms, MD; Kristal M. Riska, PhD, AuD

Objective: To determine if corrective saccade patterns during video head impulse testing (vHIT) may provide a biomarker for physiologic compensation relative to rotary chair findings in patients with unilateral vestibular hypofunction (UVH).

Study Design: Retrospective cohort study

Setting: Tertiary referral center, academic hospital

Patients: 229 Adults >18 years old with evidence for UVH (defined by >25% caloric asymmetry) who also underwent rotary chair and vHIT testing.

Interventions: Vestibular laboratory results were extracted. Patients were characterized as demonstrating evidence for physiologic compensation of eye movements if there was no asymmetry during rotary chair testing, in addition to, an absence of spontaneous and positional nystagmus.

Main Outcome Measures: Corrective saccade parameters (latency, amplitudes, clustering scores)

Results: 36 patients were identified as having an uncompensated UVH, while 193 showed evidence for compensation on rotary chair. Compensated UVH patients had lower dizziness handicap scores relative to uncompensated UVH ($F=4.83$, $p=0.029$). Among patients with corrective saccades during vHIT, there was a difference in overt saccade latency ($F=7.74$, $p=0.006$), and in percent of impulses generating overt corrective saccades ($F=1.50$, $p=0.001$) between uncompensated and compensated patients. Trends toward differences in amplitudes of corrective saccades (covert & overt) and average VOR gain did not reach significance. No differences were seen between group for any covert corrective saccade parameters.

Conclusions: Patients characterized as having a compensated UVH showed statistically significant differences in overt compensatory saccade patterns compared to those with an uncompensated UVH. This may provide evidence for vHIT saccades as a biomarker for compensation status.

***Professional Practice Gap & Educational Need:** The role of corrective saccades as a marker of compensation has not been systematically compared to other measures of compensation in the vestibular laboratory test battery in a large cohort of patients with unilateral vestibular hypofunction.

***Learning Objective:** Describe vHIT corrective saccade patterns based on classification of compensation status using standard clinical laboratory measures.

***Desired Result:** Identification of an objective biomarker of physiologic compensation in UVH on vestibular laboratory testing that is more accessible than rotary chair.

***Level of Evidence -** IV

***Indicate IRB or IACUC :** Exempt

NICHOLAS TOROK VESTIBULAR AWARD

Vestibular Migraine Confounds Management of Superior Canal Dehiscence Syndrome

Miriam R. Smetak, MD, MS; Nathan D. Cass, MD; Nauman F. Manzoor, MD
Kelsey Hatton, AuD, CCC-A; Matthew R. O'Malley, MD
Marc L. Bennett, MD, MMHC; David S. Haynes, MD, MMHC

Objective: To investigate the prevalence of vestibular migraine (VM) in a cohort of patients with radiologic confirmation of superior canal dehiscence (SCD) and to compare management of superior canal dehiscence syndrome (SCDS) in patients with and without comorbid VM.

Study Design: Retrospective review of a SCD database

Setting: University-based tertiary medical center

Patients: 91 patients identified with SCDS from 2008 to 2017

Interventions: None

Main Outcome Measures: Coincidence of VM and SCD, resolution of symptoms

Results: Ninety-one patients with SCD met inclusion and exclusion criteria. VM was diagnosed in 36 (39.6%) patients. Of those receiving medical therapy for VM alone, 5 (45.5%) reported symptom resolution, 5 (45.5%) reported partial improvement, 1 (9.1%) had no change, and none worsened. Fifteen patients (41.7%) were treated with both surgery (for SCD) and medical therapy (for VM). Seven (46.7%) reported symptom resolution, 7 (46.7%) reported partial improvement, and 1 (6.7%) worsened. There was no statistically significant difference in symptom resolution between SCD+VM patients who were treated medically compared with those treated with medical therapy and surgery ($p = 0.95$). There was no significant difference in symptom resolution after surgery between SCD+VM and SCD-only cohorts ($p = 0.29$).

Conclusions: This is the first study describing the incidence of VM in a cohort of patients with SCDS. The symptoms of VM confound those of SCDS and unrecognized or undertreated VM may contribute to surgical failure in SCDS. Therefore, we recommend a high index of suspicion for VM in patients with SCDS and a trial of medical therapy in the setting of suspected VM.

***Professional Practice Gap & Educational Need:** A significant number of patients with SCDS in this cohort have a comorbid diagnosis of VM. Many have persistence of symptoms after surgical correction of SCD. Part of this treatment failure may be related to co-existence of VM in this patient population.

***Learning Objective:** To better understand the patient-specific factors that may lead to failure of surgical treatment for SCD, specifically the high prevalence of comorbid VM.

***Desired Result:** A high level of suspicion should be maintained for the coexistence of VM in patients with radiographic finding of SCD.

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

***Indicate IRB or IACUC:** Vanderbilt University Medical Center, IRB #201632 (approved 08/15/2020).

Different Phenotypes of Vestibular Migraine Based on Visually Enhanced Vestibulo-Ocular Reflex (VVOR) Results

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Natalie Sienko, BS; Adam Gardi, BS; Jeffrey D. Sharon, MD

Objective: Compare the characteristics of patients with vestibular migraine (VM) who had elevated visually enhanced vestibulo-ocular reflex (VVOR) to those of patients with VM who had normal/low VVOR.

Study Design: Retrospective chart review of 217 consecutive English-speaking adult patients between October 2016 and April 2019.

Setting: Tertiary referral center.

Patients: Retrospective cohort of 129 patients who had VVOR testing and a neurotology evaluation

Interventions: We reviewed patients' symptom questionnaires, notes, and vestibular testing results.

Main Outcome Measures: We stratified VM patients by their VVOR results and compared demographics, triggers, associated symptoms, and vestibular test results.

Results: In a cohort of 217, 129 had VVOR testing. Of the 217, 101 patients (47%) had VM. Among 56 VM patients with VVOR testing, 22 patients (39%) had elevated VVOR. Elevated-VVOR VM patients were younger than those with normal/low VVOR (43 vs. 53, p=0.037). A higher proportion of elevated-VVOR VM patients had symptoms triggered by scrolling through a screen (23% vs. 3%, p=0.019). Elevated-VVOR VM patients experienced associated headache (62% vs. 32%, p=0.029) and showed caloric weakness (14% vs.42%, p=0.027) less frequently than normal/low-VVOR VM patients. There was no difference in dizziness handicap index (DHI) between the two groups (45 elevated-VVOR vs. 48 normal/low-VVOR, p>0.05).

Conclusions: Elevated-VVOR VM patients have an earlier onset of symptoms that are triggered more easily by scrolling on a screen than normal/low-VVOR VM patients. The differential rates of associated headaches and caloric weakness suggest that separate processes may mediate the two types of VM.

***Professional Practice Gap & Educational Need:** Although VVOR elevation has been linked with VM, VVOR is not universally elevated in all VM patients. The field has a limited understanding of how elevated-VVOR VM patients may present differently from those with normal/low VVOR.

***Learning Objective:** Describe the different presentations of VM depending on VVOR results.

***Desired Result:** Clinicians will recognize that VVOR can provide an insight into how a particular patient's VM may present.

***Level of Evidence:** III

***Indicate IRB or IACUC:** Approved 2/12/19, UCSF IRB 18-25365

Fixation Stability during Moving Visual Stimulation in Persistent Postural-Perceptual Dizziness

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Shinsuke Ohshima, MD, PhD; Shuji Izumi, MD, PhD
Kuniyuki Takahashi, MD, PhD; Arata Horii, MD, PhD

Objective: To examine the fixation stability in patients with Persistent Postural-Perceptual Dizziness (PPPD) when presented with moving visual stimuli that may exacerbate their vestibular symptoms.

Study Design: Cross-sectional study.

Setting: Tertiary referral center.

Patients: 25 patients with PPPD and 7 with unilateral vestibular hypofunction (UVH) showing chronic vestibular symptoms (> 3 months).

Main Outcome Measures: Three different moving visual stimuli ((1) checkerboard stimulus reversed in contrast at 12 Hz, (2) optokinetic stimulus by black-and-white vertical stripes, (3) radial optic flow stimulus with white dots expanding, and stationary white screen as the control) were presented on a PC screen for 30 seconds each. The subjects were instructed to fixate on the center of the screen, and their fixation stability was measured using a computed eye tracking system. Mann-Whitney U tests were conducted on the number of fixations, mean duration of fixation, saccades count, and bivariate contour ellipse area (BCEA) between the two groups. The BCEA represents the area of the ellipse where the fixation point is detected with a certain probability, thus lower BCEA-values indicate higher/better fixation stability.

Results: The BCEAs during checkerboard and optokinetic stimulation were significantly higher in the PPPD group than those in the UVH group. There were no significant differences in fixation stability during optic flow stimulation and stationary white screen between the two groups.

Conclusions: Patients with PPPD cannot fixate on the center of the screen during checkerboard and optokinetic stimulation, which would result in an exacerbation of vestibular symptoms by moving visual stimuli in PPPD.

Professional Practice Gap & Educational Need: The core vestibular symptoms of PPPD are exacerbated by upright posture/walking, active or passive movement, and exposure to moving or complex visual stimuli, with exacerbation by visual stimulation being the most characteristic. However, the mechanism of exacerbation by visual stimuli is not known. In the first place, there are no reports that have examined the fixation stability in patients with PPPD.

Learning Objective: To learn about the fixation stability unique to PPPD when compared to UVH, which is considered difficult to differentiate from PPPD.

Desired Result: 1. To gain a better understanding of the pathogenesis of PPPD. 2. To improve the ability to differentiate and accurately diagnose PPPD from other chronic vestibular disorders.

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

Indicate IRB or IACUC: This study was approved by the IRB of Niigata University Medical and Dental Hospital on September 14, 2020. (#2020-0242)

Comparison of vHIT with Caloric and Rotary Chair Measurements in Adult Patients with Balance Complaints

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Objective: The role of recently introduced vestibular testing is unclear, and may yield differing results than traditional diagnostics. To reconcile these results, we sought to characterize the relationship between rotary chair (RC), caloric, and video head-impulse (vHIT) measurements in our multidisciplinary vestibular clinic.

Study Design: Retrospective chart review

Setting: Tertiary academic center

Patients: 277 symptomatic adult patients seen in a multidisciplinary vestibular clinic between 1/1/2019 and 12/31/2019.

Interventions/Outcome Measures: Correlations between vHIT, RC, and caloric testing measurements

Results: vHIT gains were more correlated with vestibulo-ocular reflex (VOR) gain on RC at low-to-mid frequencies (0.01-0.04Hz, r=0.12-0.26;p<0.0001-0.0425) than at medium-to-high frequencies (0.26-0.32Hz, r=0.06-0.10;p=0.0899-0.3166). vHIT gain was also better correlated with VOR phase at low-to-mid (r=-0.21;p=0.0004) than mid-to-high frequencies (r=-0.10-0.02;p=0.0964-0.7469). When compared to calorics, vHIT gains demonstrated weak correlations for warm (r=0.11-0.19) and cold (r=0.16-0.18). Similar to vHIT, cold calorics were better correlated with VOR gains at low frequencies (r=0.27-0.47;p=<0.0001) than high frequencies (r=0.06-0.19;p=0.0014-0.3335). Lastly, the presence of catchup saccades was best correlated with vHIT gain and slope (r=0.25-0.43) compared to all other vestibular testing modalities (low-frequency VOR, r=0.08-0.27; calorics, r=0.20-0.22).

Conclusions: While laboratory data suggests that vHIT reflects high-frequency vestibular physiology, these results show that vHIT values best correlate with low-to-mid frequency RC gain and phase in our symptomatic population. vHIT also displays a weak-to-moderate correlation with caloric measurements. These data may be useful to guide interpretation of mixed results from vestibular testing. Further study is needed to further contextualize vHIT data compared to RC and caloric results in specific vestibular conditions.

***Professional Practice Gap & Educational Need:** vHIT is a relatively new addition to the neurotologist's armamentarium that utilizes high-acceleration vestibular stimulation, and is marketed as equivalent to existing vestibular testing modalities like RC and caloric testing. The correlation of vHIT values with more traditional caloric and RC measurements is not yet understood.

***Learning Objective:** To understand where vHIT interpretation fits into existing and widely accepted vestibular function testing modalities—can vHIT serve as a substitute test, particularly at institutions without the infrastructure for RC, or should it only be used as adjunctive data?

***Desired Result:** To describe the role and integration of vHIT information in vestibular testing.

***Level of Evidence:** Level IV

***Indicate IRB or IACUC:** Approved by the University of Pennsylvania Institutional Review Board. Approval #831279. Approval Date 9/28/2021.

Visuospatial Cognitive Deficits in Patients with Vestibular Disorders

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Objective: Patients with peripheral vestibular loss have been shown to have deficits in certain cognitive domains. Herein, we aim to better characterize the type of cognitive impairment in patients with vestibular disorders and determine whether a correlation exists between Patient-Reported Outcome Measures (PROMs) and performance on neuropsychological tests.

Study Design: Cross-sectional cohort.

Setting: Academic medical center.

Patients: Fifty-two age-matched subjects were recruited: 15 patients with bilateral vestibular loss (BVL), 7 patients with unilateral vestibular loss (UVL), 15 patients with vestibular migraine (VM), and 15 healthy control subjects.

Interventions: Subjects completed neuropsychological tasks to assess auditory working memory (Digit Span Test [DST]) and visuospatial working memory (Corsi Block Tapping Test [CBTT]). Subjects also completed PROMs to assess severity of vestibular dysfunction (Dizziness Handicap Inventory [DHI]) and cognitive impairment (Cognitive Failures Questionnaire [CFQ] and Cognitive Function - Quality of Life in Neurological Disorders [CF-Neuro-QOL]).

Main Outcome Measures: Scores on PROMs and performance on neuropsychological tests.

Results: BVL and UVL patients performed significantly worse on the CBTT compared to control subjects and VM patients ($p<0.01$ and $p<0.05$, respectively). All subject cohorts performed similarly on the DST. BVL, UVL, and VM patients scored significantly higher on the DHI compared to normal controls. VM patients scored significantly higher on NeuroQOL surveys compared to normal controls ($p<0.05$). PROMs were not significantly correlated with CBTT or DST performance.

Conclusions: Patients with peripheral vestibular loss demonstrate impairments on tasks of visuospatial working memory, but not auditory working memory. Novel surveys are needed to screen for patients with vestibular disorders for cognitive impairment, particularly visuospatial ability.

Professional Practice Gap & Educational Need: 1) Lack of in-depth knowledge of cognitive impairment and, in particular, visuospatial working memory deficits, in patients with vestibular disorders. 2) Need for improved screening tools to identify patients with vestibular disorders who are at risk for cognitive impairment.

Learning Objective: 1) Attendees will understand that peripheral vestibular loss, including both bilateral vestibular and unilateral vestibular loss, is associated with deficits in visuospatial ability. 2) Attendees will appreciate that improved screening methods are needed to characterize visuospatial deficits in vestibular disorders

Desired Result: A greater understanding of the degree, severity and type of cognitive impairment in patients with vestibular disorders.

Level of Evidence - III

IRB: 2019P000438, Massachusetts Eye and Ear

SELECTED ABSTRACTS

POSTER PRESENTATIONS

in numerical order

57th Annual Spring Meeting

AMERICAN NEUROTOLOGY SOCIETY

April 29 - 30, 2022
Hyatt Regency Dallas
Dallas, TX

Posters will be viewed on Friday & Saturday, April 29-30. Oral presentations are Saturday & Sunday, April 30-May 1.

Vestibular Vertigo and Healthcare Utilization: Data from the 2016 National Health Interview Survey

Jacob C. Matthews, BS; Yuri Agrawal, MD MPH; Eric X. Wei, MD

Objective: We sought to characterize whether individuals with vestibular vertigo were more likely to utilize various healthcare resources.

Study Design: Cross-sectional study

Setting: Noninstitutionalized households in the United States

Patients: 32,047 adults completed the 2016 NHIS Balance Supplement.

Interventions: None

Main Outcome Measures: We examined several measures of healthcare utilization including number of nights in the hospital in the last 12 months, healthcare use 10 or more times in the past 12 months, number of visits to a healthcare professional in the last 2 weeks, and use of specific healthcare resources in the last 12 months.

Results: After controlling for demographics, socioeconomic factors, and medical comorbidities (including cardiovascular risk factors, hearing and vision issues, and cancer)**,** participants with vestibular vertigo had significantly increased odds of receiving healthcare 10 or more times in the last 12 months (OR 2.22, 95% CI 1.99, 2.48), a rate comparable to individuals with cancer (OR 2.29; 95% CI 2.03, 2.59). Individuals with vestibular vertigo spent on average 0.67 more days in the hospital per year (95% CI 0.37, 0.97) and were significantly more likely to visit several provider groups including general doctors, specialist doctors, mental health professionals, eye doctors, physical and occupational therapists, family doctors, and the ER/ED.

Conclusions: These findings demonstrate that individuals with vestibular vertigo have significantly higher rates of healthcare utilization in multiple domains including inpatient, outpatient, rehabilitative, and ER/ED settings. Further work is needed to characterize when and why individuals with vertigo tap into specific healthcare resources to better counsel these patients and help them navigate the healthcare system.

***Professional Practice Gap & Educational Need:** Lack of contemporary knowledge of how individuals with vestibular vertigo utilize healthcare resources in the U.S.

***Learning Objective:** Attendees will learn how individuals with vestibular vertigo are more likely to utilize healthcare resources in different domains including inpatient, outpatient, rehabilitative, and emergency room settings.

***Desired Result:** Attendees will gain a better understanding of how individuals with vestibular vertigo interact with the healthcare system and integrate this knowledge in counseling patients.

***Level of Evidence -** Level IV – Historical cohort and case-control studies

***Indicate IRB or IACUC:** Exempt

Evidence for Conscious Cortical Control of Balance in Individuals with Unilateral Sensorineural Hearing Loss

Jennifer Kelly, DPT; Maura Cosetti, MD; Daphna Harel; Brittani Morris, DPT
Sarah Mischianti SPT; Bryan Hujsak DPT; Anat Lubetsky, PhD

Objective: To identify the mechanism governing postural responses in individuals with Unilateral Sensorineural Hearing Loss (USNHL) and those with Unilateral Vestibular Hypofunction (UVH). Analyzing the frequency distribution of postural sway via Power Spectral Density (PSD) may shed light on the contribution of each sensory system to standing balance.

Study Design: Cross-sectional

Setting: Laboratory

Patients: USNHL (n=9, mean age 48, range [22, 82]), UVH (n=12, 62 [23, 78]), and 21 healthy controls (52, [28, 80]).

Interventions: Postural sway measurements during manipulation of auditory, visual and somatosensory cues within a virtual 3-wall display of stars projected from a virtual reality headset with headphones.

Main Outcome Measures: PSD (cm^2) from anterior-posterior postural sway data in 4 segments of frequencies: (Hz): Low [0, 0.25], Mid [0.25, 0.5], Mid-high [0.5, 1], high [1, 3].

Results: The vestibular group was significantly higher than controls on the static scene on all segments. UVH patients also showed greater increase when standing on foam for PSD 1, 3 and 4 and greater increase with moving visuals for PSD 2. The USNHL group was not different than controls on PSD 2, 3, 4 but they had significantly higher PSD 1 on the static scene, yet did not increase with the visuals like controls did.

Conclusions: While balance problems related to vestibular hypofunction are known to stem from difficulty in sensory integration, increased slow feedback loops response at baseline with minimal changes in response to perturbations suggests that people with USNHL employ a compensatory strategy of conscious cortical control of balance.

***Professional Practice Gap & Educational Need:**
Recent literature has demonstrated a correlation between hearing loss and increased risk of falls, balance instability and other fall-risk assessments**.** However, the mechanisms underlying the relationship between and hearing loss and balance dysfunction remain unknown. Greater insight into the postural strategies of those with unilateral hearing loss could expand our understanding of this relationship and influence our treatment paradigms.

***Learning Objective:** To identify whether the mechanism governing postural responses is similar between those with USNHL and those with unilateral vestibular hypofunction and shed light on the contribution of each sensory system to standing balance.

***Desired Result:** Improved understanding of the impact of USNHL and vestibular hypofunction on balance and postural stability

***Level of Evidence -** III

***Indicate IRB or IACUC :** Mount Sinai IRB # 18-00431

Defining the Need for MRI Screening in Vestibular Schwannoma: A Deep Learning-Based Analysis of Clinical and Audiometric Data in Vestibular Schwannoma Patients

Sarah Kortebein, MD; Shoujun Gu, PhD; Elizabeth Zhao, BA; Kathy Dai, BS
Kristal Riska, PhD AuD; Michael Hoa, MD; David Kaylie, MD

Objective: To find a more objective method of assessing which patients should be screened for a vestibular schwannoma (VS) with magnetic resonance imaging (MRI) using a deep-learning algorithm to assess clinical and audiometric data.

Study Design: Retrospective review

Setting: Tertiary referral center, academic hospital.

Patients: 1,192 adults (166 with a VS) who received an audiogram between January 2015 and January 2020 at Duke University Health Center.

Interventions: Clinical and audiometric data was collected for patients with and without VS confirmed by MRI. These data were analyzed data using a deep learning-based analysis to determine if the need for MRI screening could be determined more objectively with adequate sensitivity and specificity.

Main Outcome Measures: Ability to predict patients which have a VS based on audiometric and clinical variables

Results: Patients with VS showed slightly elevated but not statistically significant mean thresholds compared to those without. Tinnitus, gradual hearing loss, and ear fullness were more common in patients with VS. Of these only tinnitus was statistically significant. Several machine learning algorithms were used to incorporate and model all of the collected clinical and audiometric data, but none were able to distinguish ears with and without confirmed VS. When tumor size was taken into account the analysis was still unable to distinguish a difference.

Conclusions: Using audiometric and clinical data, deep learning-based analyses failed to produce an adequately sensitive and specific model for the detection of patients with VS. This suggests that a specific pattern of audiometric asymmetry and clinical symptoms may not necessarily be predictive of the presence/absence of VS.

***Professional Practice Gap & Educational Need:** This study would either take the onus off of physicians to decide on when to screen a patient for a VS or prove that there is not an adequate way to use audiometric and clinical data to more specifically decide which patients to screen with MRI in order to save money and resources.

***Learning Objective:** To understand whether a deep learning-based algorithm is capable of predicting which patients have a vestibular schwannoma

***Desired Result:** An objective method to more sensitively and specifically determine which patients have a vestibular schwannoma using clinical and audiometric data

***Level of Evidence –** Level III

***Indicate IRB or IACUC:** Approved, Pro00104949, Duke University Hospital

Hearing Loss is Associated with Smaller Social Networks in U.S. Hispanic Adults

Maeher R. Grewal, BS; Justin S. Golub MD, MS

Objective: Hearing loss (HL) is a risk factor for social isolation, which may predispose to dementia and depression. The association between HL and socialization has been primarily characterized in Caucasians. We aimed to explore this relationship in U.S. Hispanics.

Study Design: Cross-sectional epidemiological study

Setting: Hispanic Community Health Study (HCHS)

Participants: Hispanics age 18-76 years

Interventions and Main Outcome Measures: Multivariable linear regressions controlling for age, gender, and education were conducted to analyze the association between HL (measured by 4-frequency pure tone average) and socialization. Socialization was measured by a modified social network index (SNI), which assessed the number of close relatives with whom a participant had regular communication (at least once every 2 weeks). The ratio (SNI-R) between the SNI and total number of living close relatives was also calculated.

Results: 13,551 participants had audiometric and SNI data; average age was 46 years (SD=13.9 years). Of participants who reported at least one living relative, average SNI was 7.05 (range=0-18, SD=3.23). For every 10 decibel (dB) worsening in HL, SNI decreased by 0.25 (95% CI = -0.31, -0.18; $p<0.0001$) controlling for age, gender, and education. Thus, someone with moderate HL (40 dB) would communicate regularly with 1 fewer close relative than someone with no HL (0 dB). For every 10 dB worsening in HL, SNI-R decreased by 0.005 (95% CI= -0.009, -0.003; $p<0.0005$), controlling for age, gender, and education.

Conclusions: HL is associated with significantly smaller social networks in the U.S. Hispanic adult population

***Professional Practice Gap & Educational Need:** HL is associated with social isolation, which may, in turn, predispose patients to comorbidities such as dementia and depression. These relationships have primarily been studied in Caucasian populations, which prohibits generalization to other race/ethnic groups.

***Learning Objective**: HL is associated with smaller social networks in US Hispanic adults.

***Desired Result:** The relationship between HL and lower socialization appears to span multiple race/ethnic groups, including Hispanics. Providers should consider these findings in discussions regarding HL treatment.

***Level of Evidence -** IV

***Indicate IRB or IACUC:** Exempt

Assessing Barriers to Cochlear Implantation

Andrew R. Mangan, BS; Kyle P. Davis, MD; Robert Saadi, MD
Deanne King, MD; C. Lane Anzalone, MD; John L. Dornhoffer, MD

Objective: Evaluate barriers patients face that deter them from following through with cochlear implantation.

Study Design: Phone Survey.

Setting: Tertiary referral center.

Patients: Fourteen patients who qualified for a cochlear implant (CI) but did not follow up for implantation.

Main Outcome Measures: Assessment of factors that had the greatest impact, rated on a scale of 1 to 10 (10 being the most impactful), on their decision to defer a CI.

Results: 139 patients were evaluated for CI eligibility between January 2019 and July 2020. Thirty-four (24.5%) of these patients qualified for a CI but did not follow up for implantation. Two patients died prior to the start of this study, leaving 32 eligible patients. Response rate of the survey was 43.8% (14/32). Average age of respondents was 68.3 years (range 33 to 89) and a majority were male (9/14). General medical health (mean rating 5.5) and fear of losing residual hearing (5.4) rated the highest among the patients, followed by: time requirement and travel distance (3.8), cost and financial concerns (3.5), feels like current hearing is “good enough” (3.1), lack of family or social support (2.1), trust (or lack of trust) in the implant team (2.0), COVID pandemic (1.7), and attitude of others towards implants (1.3). Males rated cost and financial concerns higher than females (4.9 vs. 1.0; p=0.07).

Conclusions: Fear of losing residual hearing is a major concern for patients. Spending greater time educating patients about the success and failure rates of cochlear implantation may reduce patient hesitancy with implantation.

***Professional Practice Gap & Educational Need:** Patient perceived barriers to cochlear implantation.

***Learning Objective:** Factors that have the greatest impact on patients deferring a cochlear implant.

***Desired Result:** Understand areas in which we can invest time and resources to lessen the barriers people feel keep them from receiving a cochlear implant.

***Level of Evidence -** Level V.

***Indicate IRB or IACUC :** Approval for this study was obtained from the University of Arkansas for Medical Sciences IRB (#261590).

The Impact of Frailty on Older Adults Undergoing Cochlear Implantation: A Prospective Single-Center Study

Emily Kay-Rivest, MD, MSc; David R Friedmann, MD, MSc, Sean O. McMenomey, MD
Daniel Jethanamest, MD, MSc, J. Thomas Roland Jr., MD, Susan Waltzman, PhD

Objective: To determine the impact of frailty on cochlear implant outcomes in post-lingually deafened older adults.

Study Design: Prospective cohort study.

Setting: Tertiary referral center.

Patients: Adults over the age of 65.

Interventions: Frailty was assessed using Fried's Frailty Phenotype, a validated metric that includes grip strength, gait speed, self-reported exhaustion, unintentional weight loss and levels of physical activity. Demographic information, a comorbidity index and preoperative auditory testing were recorded.

Main Outcome Measures: The primary outcome was the relationship of frailty to adverse peri- and postoperative events. Secondary outcomes included improvement in speech perception scores at three months and at one-year.

Results: Fifty post-lingually deafened older adults were enrolled, with a mean age of 76.9 (SD: 7.1, range 65 to 94). Four patients (8%) were classified as frail, nine (18%) as pre-frail and the remainder as non-frail (74%). There were no major complications in any groups. Two (4%) patients required overnight admission, neither of whom were frail. Neither frail nor pre-frail patients had extended hospital stays or need for postoperative vestibular therapy. Among frail patients, median preoperative CNC word score in the implanted ear was 2% (range 0-8%), which increased to 16% on 3-month follow-up. Pre-frail and non-frail patients had a median preoperative word score of 8% (range 0-52%), which increased to 51% (range 23-84%) postoperatively. Median device use time in frail, pre-frail and non-frail individuals were 9.2, 12.1 and 11.8 hours daily respectively.

Conclusions: Frailty did not predict postoperative adverse events after CI surgery. The frailty phenotype may impact early speech perception scores, but longer term follow up will address whether frailty results in poorer long-term hearing outcomes.

***Professional Practice Gap & Educational Need:** Frailty is thought to affect between 10-15% of community-dwelling older adults. It is well-documented that frailty can significantly impact surgical outcomes of older adults and is distinct from age and multi-morbidities. Frail patients have an increased risk of falls, delirium and death after surgery. In the United States, over half of patients with severe to profound hearing loss are over the age of 65. Given that a growing number of older adults may benefit from cochlear implants, understanding the factors that can impact outcomes, including frailty, is important.

***Learning Objective:** The learning objective is to determine the prevalence of the frailty phenotype among our older adult cochlear implant candidates and understand its association with outcomes.

***Desired Result:** Elderly patients are a growing portion of our population. Understanding factors that can improve outcomes may help us tailor our approach to their treatment, whether it is choosing the appropriate type of anesthesia, preemptive vestibular training, or more intensive postoperative auditory rehabilitation.

***Level of Evidence -** Level III

***Indicate IRB or IACUC:** NYU School of Medicine Institutional Review Board i20-02050.

Na/K-ATPase in the Human Saccule

Michael P Avillion, MD; Ivan A Lopez, PhD
Hirooki Matsui, MD; Gail Ishiyama MD; Akira Ishiyama, MD

Hypothesis: There is a difference in expression of Na^+, K^+-ATPase (Na/K-ATPase) in the saccule of human patients with otologic disease compared to those without otologic disease.

Background: We have recently characterized changes in the expression of Na/K-ATPase in the normal and pathological cochlea, however, no studies have determined the distribution Na/K-ATPase in the human saccule. The present study utilizes archival temporal bones to study the expression Na/K-ATPase in the human saccule.

Methods: Archival celloidin formalin fixed 20-micron thick sections of the vestibule from patients diagnosed with sensorineural hearing loss (SNHL) (n=12), Meniere's disease (MD) (n=4), otosclerosis (n=6), and normal hearing and balance (n=4) were analyzed. Sections containing the saccular macula were immunoreacted with mouse monoclonal antibodies against Na/K-ATPase alpha-1 subunit. Digital images were acquired using a high-resolution light and laser confocal microscope.

Results: In the normative human saccule, robust Na/K-ATPase immunoreactivity (IR) was present in nerve fibers and calyces that surround type I vestibular hair cells and nerve terminals. The basolateral membrane of extramacular saccular epithelium was also Na/K-ATPase-IR. Comparison between normal and pathological specimens showed that specimens from patients with SNHL, had a significant reduction in Na/K-ATPase-IR and specimens from patients diagnosed with Meniere's disease and otosclerosis exhibited a reduced Na/K-ATPase-IR.

Conclusions: . The decrease of Na/K-ATPase-IR in the saccule from patients with otopathologies suggests its critical role in inner ear homeostasis and pathologic alterations in SNHL.

Professional Practice Gap & Educational Need: The identification of proteins involved in ionic, osmotic and potential gradients like Na/K-ATPase in the inner ear would be helpful to explain inner ear pathologies.

Learning Objective: To describe the changes in Na/K-ATPase expression in the human saccule when the cochlea is affected by different types of hearing loss.

Desired Result: Identifying changes in presence and distribution of Na/K-ATPase can help elucidate the connection between hearing loss and saccule function.

Level of Evidence: Level IV

Indicate IRB or IACUC: #10-001449, UCLA, January 2021

A Five-Year Update on the Profile of Adults Undergoing Cochlear Implant Evaluation and Surgery – Are We Doing Better?

Ankita Patro, MD, MS; Nathan R. Lindquist, MD; Jourdan T. Holder, AuD, PhD
René Gifford, PhD; Elizabeth Perkins, MD

Objective: Characterize the influence of expanding indications on the profile of adults undergoing cochlear implantation (CI) at a high volume CI center.

Study Design: Retrospective review.

Setting: Tertiary referral center.

Patients: 774 adults undergoing CI evaluation from 2015-2020.

Main Outcome Measures: Demographics, preoperative audiometry and speech recognition (CNC and AzBio) scores.

Results: Of 741 (95.7%) patients qualifying for implantation, 642 (86.6%) pursued surgery. Mean age at evaluation was 65.4 years; 53.2% were male; 88.2% were white. Average distance to our center was 107 miles. The majority (61.4%) had public insurance (e.g. Medicare, Medicaid), followed by private (38.2%) and military (0.4%). Mean CNC, AzBio, and pure-tone averages for the ear to be implanted were 13%, 17%, and 77 dB HL, respectively. 479 patients (64.6%) met Hybrid/EAS criteria, and 438 (56.6%) had aidable hearing in the better hearing ear for a bimodal hearing configuration. Age (OR 0.96; 95% CI 0.93–0.92) and white race (OR 7.01; 95% CI 3.25–15.12) predicted CI candidacy. Likelihood of surgery increased for white (OR 8.94; 95% CI 5.57–14.34) and married (OR 2.12; 95% CI 1.45–3.09) patients and decreased for those with public insurance (OR 0.34; 95% CI 0.22–0.51).

Conclusions: Despite expansions in criteria, speech understanding at CI evaluation remains extremely low. Compared to 2013-2015, a larger percentage met Hybrid/EAS criteria (25.4% vs. 64.6%), and a smaller percentage had bimodal hearing (72.1% vs. 56.6%). Younger age and white race predicted candidacy while white, married patients with private insurance were more likely to pursue surgery.

Define Professional Practice Gap & Educational Need: There has not been a large, comprehensive assessment of both demographic and auditory profiles of patients undergoing CI evaluation and surgery. Greater awareness of disadvantaged groups can help increase access to CI care.

Learning Objective: To characterize the demographic and auditory profiles as well as to identify predictive factors of adult patients who underwent CI workup and surgery.

Desired Result: This information can help improve referral patterns for CI evaluation as well as patient counseling for surgery so that every patient who qualifies has the opportunity to benefit from this technology.

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

Indicate IRB or IACUC: IRB Exempt (211355, Vanderbilt University).

Machine Learning for Automated Calculation of Acoustic Neuroma Volumes

Nathan D. Cass MD; Nathan R. Lindquist MD; Qibang Zhu; Hao Li
Ipek Oguz PhD; Kareem O. Tawfik MD

Hypothesis: Machine learning-derived algorithms are capable of automated calculation of acoustic neuroma tumor volumes without operator input.

Background: Volumetric measurements are more sensitive than diametric measurements for detection of tumor growth in acoustic neuroma, and vital for patient counseling and management decisions. Yet, manually measuring volume is logistically challenging and time-consuming to perform, as well as subjective and difficult to reproduce. We created a machine learning algorithm to calculate acoustic neuroma volumes without operator input.

Methods: We developed a deep learning framework fusing transformers and convolutional neural networks to segment acoustic neuromas. The algorithm was trained and validated on an external, publicly available dataset consisting of medium and large tumors ([178 – 9598mm^3]). Testing of the algorithm was performed with additional subjects from the dataset.

Results: The algorithm yielded 87% overlap (Dice score) with manually segmented tumors on the test subjects.

Conclusions: Sophisticated machine learning algorithms can delineate tumors with an accuracy of 87% overlap with manual segmentations, without operator input, on images matching the acquisition protocols of the training dataset. Previously published intra- and inter-rater reliability studies for manual volumetric measurements demonstrate errors of up to 20% with repeated measurements; thus, our algorithm exceeds established norms for accuracy in volumetric assessment. This technology has promise for wide clinical applicability and time savings. Generalizing our algorithms to a diverse set of tumor sizes, MRI sequences, and acquisition protocols via data augmentation and image harmonization techniques remains as future work.

Define Professional Practice Gap & Educational Need: Tumor volumetrics are vital for patient counseling and management decisions, but logistically difficult and time-consuming to perform. This study introduces a sophisticated machine learning algorithm to address this need.

Learning Objective: Understand current advancements in machine learning for automated segmentation and thus tumor volumes in patients with acoustic neuroma.

Desired Result: As we provide attendees with a better understanding of current applications of machine learning algorithms to neurotology, we hope to inspire them to explore the possibilities of this intersection within their own institutions.

Level of Evidence: IV

Indicate IRB or IACUC: IRB Approved (#210996, Vanderbilt University Medical Center)

Quantification of Internal Auditory Canal Visualization Using Endoscopes

Nathan D. Cass MD; Hannah G. Mason BS; Mohammad M.R. Khan, MS
Jack H. Noble PhD; Kareem O. Tawfik MD

Hypothesis: Angled endoscopes have been postulated to increase visualization of the internal auditory canal (IAC); however, few studies have quantified extent of IAC visualization using endoscopes of varying angles.

Background: Preservation of the bony labyrinth in middle fossa (MF) hearing preservation acoustic neuroma surgery may limit visualization of the lateral IAC. We sought to determine the extent to which IAC visualization is increased with endoscopes in these situations.

Methods: CT scans were acquired before and after two cadaveric MF bony drillouts. An atlas-based method was used to localize the IAC in the pre-procedure CT, then registered with the post-procedure CT using standard image registration methods. Virtual microscope and endoscope positions and angle of approach were determined in a 3D rendering environment. Using ray-casting techniques, the percentage of IAC surface area visible (unobscured by bony structures) with microscope and 0˚, 30˚, and 45˚ endoscopes was calculated.

Results: For cadaver 1, microscope led to visible IAC surface areas of 72%, while 0˚, 30˚, and 45˚ endoscopes visualized 58, 79, and 84%, respectively. For cadaver 2, microscope led to visible surface areas of 67%, while the same endoscopes visualized 66, 84, and 84%, respectively.

Conclusions: Using a microscope yields similar proportions of visible IAC surface area to a 0˚ endoscope in MF bony drillouts. Increased visualization of the IAC is possible with more angled endoscopes. Using angled endoscopes may facilitate improved tumor dissection in the lateral IAC with neural and vascular preservation in acoustic neuroma surgery aimed at hearing preservation.

Define Professional Practice Gap & Educational Need: Neurotologists recognize that visualization of the lateral IAC is challenging in hearing preservation acoustic neuroma surgery, and may benefit from learning about techniques that might render this task safer.

Learning Objective: Attendees should understand the possible advantages of endoscopes for lateral IAC visualization in hearing preservation acoustic neuroma surgery.

Desired Result: As we all learn more about advances in techniques to assist in hearing preservation for patients with acoustic neuroma, we hope that the neurotology community would join us in evaluating outcomes to see whether these techniques actually improve care for our patients with this disorder.

Level of Evidence: V

Indicate IRB or IACUC: IRB Exempt (Vanderbilt University Medical Center)

Development of In Vitro Model for Ototoxic Demyelinating Injury and Rehabilitation

Michelle K. Hong, BS; Kristen A. Echanique, MD
Larry F. Hoffman, PhD; Ashley E. Kita, MD

Background: Recent evidence indicates that compromise to Schwann cells ensheathing inner ear afferent neurons results in inner ear dysfunction mimicking drug-induced ototoxicity. Cisplatin and aminoglycosides are widely prescribed but known to cause ototoxicity. While both drugs have been shown to induce peripheral nerve demyelination, demyelination of spiral or Scarpa's ganglion neurons has not been extensively studied. There is a need for a model for ototoxic demyelination to screen medications for injurious or protective potential in Schwann cells.

Hypothesis: An in vitro model of Schwann cells can be used to evaluate the potential of cisplatin and gentamicin to compromise their viability, thereby identifying risk factors for demyelination.

Methods: Rat Schwann RT4-D6P2T cells were seeded on 96-well plates 18-24 hours prior to treatment with cisplatin or gentamicin. Cell viability was evaluated 24 hours after treatment with the MTT cell proliferation assay.

Results: Dose-response curves were created using 4-parameter log logistic regression models. LC50 doses for cisplatin and gentamicin were 29.6μM (p=1.606E-11) and 2.0mM (p=1.035E-10) respectively, reflecting an approximate 64 fold difference.

Conclusions: Our RT4-D6P2T toxicity assay provides a high-throughput in vitro model for exploring Schwann cell sensitivity to ototoxins suggestive of demyelinating pathology. We demonstrated dose-dependent reductions in cell viability from cisplatin and gentamicin with significantly greater sensitivity to cisplatin. This suggests that cisplatin exhibits a greater potential than gentamicin for compromising Schwann cells and that cisplatin may cause demyelination-induced afferent neuron hypofunction in the inner ear. This assay is also well-positioned to screen for protective agents to preserve afferent neuron function during chemotherapy.

***Professional Practice Gap & Educational Need:** There is a need for a high-throughput method of testing pharmacologic agents to rehabilitate or prevent ototoxic injury from widely prescribed drugs such as gentamicin and cisplatin.

***Learning Objective:** To highlight demyelination as a potential mechanism for cisplatin ototoxicity and an important pathway to consider for rehabilitation. To develop a high-throughput method of screening multiple pharmacologic agents for rehabilitation benefit.

***Desired Result:** To identify a rehabilitation agent for ototoxic demyelination in vitro and further study this agent as a drug of choice for mitigating ototoxicity in a clinical setting

***Level of Evidence –** N/A

***Indicate IRB or IACUC :** Exempt

Combined Arterial and Venous Phase Computed Tomographic Findings in Patients with Pulsatile Tinnitus

Eric J. Formeister, MD, MS; Grace Xiao, BS
Ferdinand Hui, MD; Yuri Agrawal, MD; James Clark, MD
John P. Carey; Daniel Q. Sun, MD

Objective: To describe the demographic, clinical and radiologic findings in a consecutive series of patients presenting to otolaryngologists with a chief complaint of pulsatile tinnitus (PT).

Study Design: Retrospective review of 157 patients undergoing a novel combined arterial/venous phase computed tomographic (CT) imaging study.

Setting: Tertiary Referral Center

Patients: Adult patients referred to neurotology faculty for evaluation of PT between 2016 and 2020.

Interventions: CT arteriography/venography study.

Main Outcome Measures: Prevalence of venous or arterial pathology, clinicodemographic characteristics.

Results: One-hundred and fifty-seven adults (avg. age, 52 years; 79.6% female) were evaluated. A history of migraine headaches was common (19.7%). The average BMI was 30.0 (S.D., 6.8), and 17.2% of subjects had a diagnosis of obstructive sleep apnea. Idiopathic intracranial hypertension was diagnosed by elevated opening pressure on lumbar puncture in 14.0%. Comorbid depression and anxiety were common (25.5% and 26.1%, respectively).

Overall, abnormalities were found in 78.9% of scans, with bilateral transverse sinus stenosis (TSS) seen in 38.9% and unilateral TSS found in 20.4%. Fifteen subjects (9.6%) had evidence of osseous etiologies, including superior canal dehiscence or thinning in 8.9% and sigmoid sinus dehiscence in one subject. There were 3 dural arteriovenous fistulae identified. Unilateral PT was ipsilateral to the side of TSS in 84.4% of subjects with unilateral TSS.

Conclusions: In a large consecutive series of patients with PT referred for CT venography/arteriography, transverse sinus stenosis was the most common finding at 59%. Venous etiologies for PT should be suspected when patients are referred to neurotologists for evaluation.

***Professional Practice Gap & Educational Need:** Pulsatile tinnitus (PT) is a common referral to otologists and neurotologists and can indicate serious underlying pathology. However, there is wide practice variation in the diagnostic imaging modalities suggested for adequate workup. A single screening study for PT that can simultaneously assess arterial, venous, and skull base anomaly etiologies of PT may offer higher diagnostic accuracy and lower healthcare costs.

***Learning Objective:** To describe venous etiologies for PT demonstrated on a novel arterial/venous phase computed tomography protocol.

***Desired Result:** To demonstrate the importance of assessing for venous etiologies of PT in patients presenting to otology/neurotology practices.

***Level of Evidence –** Level III

***Indicate IRB or IACUC :** The following study was approved by the Johns Hopkins University Institutional Review Board (IRB Number 00231197).

Gender-Based Differences in Operating Room Ergonomics and Musculoskeletal Pain among Otolaryngology Trainees

Eric J. Formeister, MD, MS; Lekha Yesantharao, BS
John Pentikis, PhD; John P. Carey, MD; Deepa J. Galaiya, MD

Objectives: (1) To assess perception of operating room (OR) ergonomics and musculoskeletal (MSK) pain related to operating; and (2) To describe gender bias in size/adjustability of standard operating room tables and chairs.

Study Design: Survey study of otolaryngology trainees at a university medical center.

Main Outcome Measures: (1) Responses to a comprehensive ergonomics survey; and (2) Percentage of males and females accommodated by standard operating room equipment.

Results: Twenty-three trainees (43% female, avg. age, 30.9 years) completed the survey. The most common sites of MSK pain experienced included the neck (91%), lower back (87%), shoulders (74%), and upper back (65%). Sixty-one percent experienced neck pain at least 8 days per month, and 53% attributed MSK pain directly to operating. All female respondents reported neck pain, compared to 83% of male respondents. Forty-percent of female respondents experienced upper back pain more than 8 days per month, compared to 17% of male respondents. Overall, 0% reported pain or discomfort to supervisors, and 0% requested time off or breaks from operating. The majority (81%) of respondents were completely unfamiliar with ergonomics principles.

Based on population normative data, a substantially smaller proportion of females are ergonomically accommodated when seated compared to males when using standard otolaryngology stools on 3 measures (lowest seat pan height, 3% of females accommodated versus 54% males; seat pan depth, 85% versus 95%; and elbow rest height, 31% versus 38%).

Conclusions: MSK pain is almost universal among otolaryngology trainees, with more than half attributing pain directly to surgical training. Standard operating room equipment is less accommodating to the average female stature and thus may differentially disadvantage female trainees in otolaryngology.

***Professional Practice Gap & Educational Need:** Work-related musculoskeletal disorders are common in surgical specialties. This study characterizes this issue among otolaryngology trainees and provides insight into differences in ergonomic risk with respect to gender.

***Learning Objective:** (1)The audience will understand the prevalence of MSK pain in otolaryngology trainees and ergonomic differences with respect to gender; and (2) The audience will recognize that standard otolaryngology equipment is poorly optimized for surgeons with smaller stature.

***Desired Result:** Increasing awareness of ergonomic issues in otolaryngologic surgery.

***Level of Evidence -** IV

***Indicate IRB or IACUC :**
This study was approved by the Johns Hopkins Institutional Review Board (IRB number 00289314).

Evaluation of Navigation Deficits in Patients with Bilateral Vestibular Loss using a Novel Virtual Reality Spatial Navigation Task

Maimuna Ahmad, BS; Susan King, BS; Sacha Panic, PhD
Richard F. Lewis, MD; Divya A. Chari, MD

Objective: To determine whether performance in a virtual reality spatial navigation (VRSN) task is poorer in patients with bilateral vestibular loss (BVL) compared to healthy controls and assess the correlation between patient-reported outcomes measures (PROMs) and visuospatial navigation.

Study Design: Cross-sectional study.

Setting: Academic medical center.

Patients: Nineteen age-matched subjects: fourteen BVL and five control subjects.

Interventions: Subjects completed questionnaires to assess the severity of vestibular and cognitive impairment, including the Dizziness Handicap Inventory (DHI) and Cognitive Function - Quality of Life in Neurological Disorders (CF-Neuro-QOL). Subjects performed a VRSN ("complete-the-triangle") task while wearing a VR headset. Two versions were performed: 1) ambulatory, in which subjects navigated on a platform, providing the brain with visual, vestibular, and proprioceptive cues; 2) stationary, in which subjects navigated virtually using a gamepad controller without head or body movement, providing the brain with only visual information.

Main Outcome Measures: Survey scores and VRSN task performance (mean and standard deviation (SD) of angular and linear error, with mean characterizing accuracy and SD characterizing precision).

Results: Male BVL subjects demonstrated improved accuracy with reduced mean linear error ($V=39;p<0.05$) and precision with reduced SD of angular and distance error ($V=35;p<0.1$ and $V=38;p<0.05$, respectively) on the stationary task compared to the ambulatory task. Female BVL and control subjects performed similarly on both tasks. DHI and Neuro-QOL scores negatively correlated with VSRN task performance in BVL subjects ($r=-0.74;p=-0.02$ and $r=-0.79;p=0.02$, respectively).

Conclusions: Unlike healthy controls, BVL subjects perform better on stationary tasks than ambulatory tasks, suggesting that spatial orientation is degraded when aberrant vestibular inputs are provided to the brain.

Professional Practice Gap & Educational Need: 1) Lack of in-depth characterization of previously reported visuospatial navigation deficits in patients with bilateral vestibular loss, specifically in the comparison of tasks that utilize the peripheral vestibular system (e.g. head turning and ambulation) and tasks that do not require activation of the peripheral vestibular system. 2) Paucity of information relating subjective cognitive complaints using patient reported outcome measures (PROMs) to performance on visuospatial navigation tasks.

Learning Objective: 1) Attendees will obtain an improved understanding of the effect of bilateral vestibular loss on path integration and spatial navigation. 2) Attendees will gain a greater appreciation for the role of patient reported outcome measures (PROMs) in quantifying subjective complaints of cognitive impairment.

Desired Result: A greater understanding of visuospatial navigation deficits in patients with bilateral vestibular loss and an improved appreciation of the method in which patient reported outcome measures (PROMs) can aid physicians in assessing and quantifying cognitive deficits.

Level of Evidence - III

IRB: IRB 2019P000438, Massachusetts Eye and Ear

Auditory Brainstem Implant (ABI) Outcomes in Tumor and Non-Tumor Patients: A Systematic Review and Meta-Analysis

Alejandro Garcia, MD; Sonja Poe; Afash Haleem; M. Christian Brown, PhD
Barbara S. Herrmann, PhD; Daniel J. Lee, MD

Objective: To compare auditory and non-auditory outcomes between auditory brainstem implant (ABI) users with tumor and non-tumor etiologies.

Data Sources: A systematic search was performed in Pubmed, Embase, and Web of Science Core Collection from 1990-2021. The search methodology was limited to studies published in English.

Study selection: Included studies had five or more patients reporting ABI outcomes due to tumor (neurofibromatosis type-2 (NF-2), sporadic vestibular Schwannomas) or non-tumor etiologies (cochlear malformations/ossification, trauma).

Data extraction: Forty-one studies were included and underwent full-text review. Data were extracted for 1083 ABI recipients (75% tumor recipients, 25% non-tumor recipients). Most recipients were post-lingually deafened (60% adult subjects). Seven studies directly compared auditory performance in tumor and non-tumor recipients. Study quality was assessed using the Newcastle-Ottawa scale.

Data synthesis: A random effects model was used to compare speech recognition scores due to high study heterogeneity (92-67%). Non-tumor patients performed significantly ($p<0.05$) better than tumor patients, with a standardized mean difference (SMD) for open-set sentence recognition of 1.65 (95% CI, 2.04-1.26) and a SMD for word recognition score of 0.75 (95% CI, 1.47-0.03) resulting in a medium-large effect size. No differences were seen in the categories of auditory performance (CAP) scale. The most common side effects were head tingling and vertigo for tumor versus non-tumor subjects, respectively. The mean weighted average of active electrodes was significantly different ($p<0.05$) across ABI device manufacturers.

Conclusions: Overall, non-tumor ABI subjects demonstrated superior auditory perception compared to tumor subjects. This performance difference could be considered for expanding ABI candidacy criteria to non-tumor etiologies in the United States.

***Professional Practice Gap & Educational Need:** There is no consensus about the difference in performance between tumor and non-tumor ABI users. The lack of enough evidence demonstrating auditory outcomes in this diverse patient population leads to a reduction in number of recipients. Physicians should be able to inform potential ABI candidates about their possible auditory performance.

***Learning Objective:** Determine the clinical indications and difference in auditory performance between tumor and non-tumor ABI patients.

***Desired Result:** Attendees should be able to differentiate the auditory outcomes in ABI patients with tumors and without tumors.

***Level of Evidence** – Level II

***Indicate IRB or IACUC:** Exempt

Long-term Audiometric Outcomes following attempted Hearing Preservation in Vestibular Schwannoma

Kristen L. Yancey, MD, Samuel L. Barnett, MD, J. Walter Kutz Jr., MD
Brandon Isaacson, MD; Bruce Mickey, MD; Zabi Wardak, MD
Samuel L. Barnett, MD; Jacob B. Hunter, MD

Objective: Assess success and durability of audiological outcomes among different treatment modalities intended for hearing preservation in the management of vestibular schwannoma.

Study Design: Retrospective review.

Setting: Tertiary skull base center

Patients: Sporadic adult vestibular schwannoma patients with class C hearing or better at the time of intervention.

Interventions: Gamma knife radiation, middle cranial fossa or retrosigmoid approaches

Main Outcome Measures: Pure tone audiometry, speech discrimination scores.

Results: Of the 107 patients treated with Gamma-knife, 32 (29.9%) had serviceable hearing at last follow-up, compared to 42 (40.8%) that underwent retrosigmoid (N=10) and middle cranial fossa (N=32) approaches (p=0.11). One surgical and 34 (31.8%) radiated patients subsequently experienced loss of residual hearing despite initial preservation (p<.001), at a mean 5.15 ± 9.4 years following radiation. Among those with initially preserved hearing, twenty radiated and fifteen surgical patients had follow-up ≥5 years.
There was no difference in mean tumor size (p=0.75) or distribution of pre-treatment hearing classes (p=0.66) between surgical and radiated groups. Mean age was higher among radiated patients (60.48 ± 11.21 years vs. 44.87 ± 13.25 years, p<0.01).

Conclusions: Neither surgery nor radiation conferred a higher likelihood for hearing preservation. When successful however, surgical approaches offered more durable hearing outcomes.

***Professional Practice Gap & Educational Need:** Long-term audiometric data outcomes following hearing preservation treatment approaches is needed to inform clinical decision making and guide patient expectations.

***Learning Objective:** Evaluate the long-term hearing results among patients undergoing following hearing preservation treatment modalities.

***Desired Result:** To share the audiologic outcomes among a large cohort of surgical and radiated patients with sporadic vestibular schwannoma treated at a single academic skullbase center.

***Level of Evidence -** IV

***Indicate IRB or IACUC :** STU 112016-040, UT Southwestern Medical Center

Trends in Spontaneous CSF Leak Repair in the United States 2009-2015

Douglas J. Totten, MD, MBA; Mohamad Z. Saltagi, MD; Elizabeth Schueth, MD, MPH
Cyrus Rabbani, MD; Alyssa H. Harris, MPH; Samuel F. Hohmann, PhD
Rick F. Nelson, MD, PhD

Objective: To determine national rates of spontaneous cerebrospinal fluid (sCSF) leaks, how these rates have changed over time, and to determine the association with risk factors

Study Design: Retrospective review from 2009-2015

Setting: Vizient Clinical Database of 141 academic institutions in the United States that reported all CSF leak repairs from all years of the study.

Patients: Patients who underwent craniotomy for sCSF leak repair in hospitals included in the Vizient Clinical Database.

Main Outcome Measures: National rates of craniotomy for sCSF leak repair each quarter and single and multivariable linear regression comparing these quarterly rates over time along with covariables, which were included as percentage of total patients per quarter.

Results: The rate of sCSF leak repairs per quarter increased by over 50% from 2009 to 2015 (β=2.4, $p<0.001$). Obstructive sleep apnea (OSA) and diabetes were associated with higher rates of sCSF leak repairs in multivariable regression (β=2.5, p=0.008; β=2.4, p=.02, respectively). Obesity was associated with higher repair rates in single-predictor regression [(β=3.8, $p<0.001$) and was not included in multivariable analysis due to collinearity with time (i.e. progressive quarters)]. Black patients were overrepresented in the CSF leak repair cohort compared to expected population rates (22% vs. 13%).

Conclusions: In this nation-wide study of adults in the United States**,** the rate of sCSF leak repairs continues to nearly double every decade since 2002. Co-morbid conditions like obesity, diabetes, and OSA are associated with increased risk of sCSF leak repairs. The temporally shifted rise in sCSF leaks mirrors the rise in US obesity, which began in the 1980s.

***Professional Practice Gap & Educational Need:** Understanding of change in sCSF leak repair rates over time, which may affect practice patterns, trainee exposure to cases, and patient counseling regarding treatment and prevention.

***Learning Objective:** The incidence of sCSF leak repairs continues to increase. Black patients may be disproportionately affected by need for sCSF leak repairs. While obesity itself is not predictive of need for sCSF leak repair, increased BMI may still be associated with this need.

***Desired Result: s**CSF leak rates continue to increase. Otolaryngologists should have a high index of suspicion for spontaneous sCSF leaks and be well-equipped to repair sCSF leaks when they occur.

***Level of Evidence -** IV

***Indicate IRB or IACUC:** Exempt

Improved Facial Nerve Preservation with Inferior Long Axis Dissection of Large VS Tumors

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Cyrus C. Rabbani, MD; Jesse J. Savage, MD; Mitesh V. Shah, MD
Rick F. Nelson, MD, PhD

Objective: To determine the facial nerve (FN) outcomes and degree of resection in large vestibular schwannomas (VS) using the inferior long axis dissection of the tumor/FN interface in the cisternal segment.

Study Design: Retrospective case series of patients who underwent inferior long axis approach for VS dissection from 2017-2021.

Setting: Tertiary medical center

Patients: Patients who underwent resection of large VS (>2.0 cm measured along the petrous ridge).

Main Outcome Measures: Levels of intraoperative FN stimulation; rates of good post-operative FN outcomes (House-Brackmann 1-2); and rates of surgical resection defined at 1-month postoperative MRI [gross total resection (GTR), near-total resection (NTR), defined as residual tumor volume of <0.5 cm^3), and subtotal resection (STR)].

Results: 29 patients had an average [SD] VS tumor size of 3.3 [0.9] cm. FN stimulation at 0.05 mAmp with >100μV was achieved in 97% of cases. GTR or NTR was achieved in 83% of cases. Good FN outcomes were observed in 78% of cases immediately post-op and at 1-month follow-up, in 76% of cases at 1-year follow-up for patients who were followed for a full year, and in 81% of patients at last follow-up.

Conclusions: The inferior long-axis technique allows for optimal visualization and dissection of the thinnest portion of the FN leading to both high rates of facial nerve preservation and high degree of tumor resection. Further research is needed to systematically compare this technique to standard medial-to-lateral (or lateral-to-medial) techniques.

***Professional Practice Gap & Educational Need:** While GTR/NTR results in lower rates of tumor re-growth, STR is associated with better FN outcomes. The inferior long axis technique to FN dissection is designed to remove more tumor while placing less strain on the facial nerve through identification of a plain that allows for improved tumor dissection with reduced traction on the splayed fibers of the facial nerve.

***Learning Objective:** The inferior long axis technique may improve GTR/NTR rates while reducing FN deficits postoperatively

***Desired Result:** Inferior long axis technique should be further studied to compare outcomes to more standard techniques of FN dissection.

***Level of Evidence -** IV

***Indicate IRB or IACUC :** Indiana University School of Medicine IRB #1806000302

Endolymphatic Hydrops in the Setting of Vestibular Schwannoma: A Temporal Bone Study

Mia E. Miller, MD; Ivan A. Lopez, PhD; Helena Wichova, MD
Akira Ishiyama, MD; Yu-Tung Wong, MD

Hypothesis: Vestibular schwannoma (VS) may be associated with endolymphatic hydrops (EH). EH may account for symptomatology in a subset of patients with VS.

Backround: Presenting symptoms of VS and EH overlap and MRI evaluation of the membranous labyrinth in some patients with VS demonstrates EH. The aim of the current study is to evaluate whether EH is present in temporal bones of patients with VS.

Methods: The NIDCD and House Temporal Bone Laboratory at UCLA Eccles database was queried for the diagnosis of "acoustic neuroma". Exclusion criteria included concomitant ear disease and surgery. Temporal bones were analyzed for EH of the basal, middle and apical turns and vestibule. Pre-mortem audiometric and clinical data were gathered.

Results: Of 43 human temporal bones with VS, 6 met inclusion criteria. All temporal bones demonstrated VS that was undisturbed by surgery. 3/6 demonstrated EH of at least one cochlear turn as well as vestibular hydrops. Three patients had severe to profound hearing loss. One patient carried a diagnosis of Meniere's Disease.

Conclusions: EH is demonstrated in the setting of VS in human temporal bones. EH may be one mechanism of hearing loss and dizziness in patients with VS.

Professional Practice Gap & Educational Need: The underlying mechanisms of symptoms of VS may be multifactorial. The association of EH in some patients with VS would modify our clinical approach to management.

Learning Objective: To discover if EH may be associated with VS.

Desired Result: To broaden understanding of pathophysiologic mechanisms in patients with VS.

Level of Evidence: Level IV

IRB Approved: UCLA IRB#10-001449

Post-Operative Evaluation of CT Imaging Following Cochlear Implantation

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Brandon Koch, PhD; Varun Varadarajan, MD; Kevin Zhan, MD; Oliver Adunka, MD

Objective: Use automatic segmentation to determine the position of cochlear implant (CI) electrodes that produces the best audiologic outcomes for the patient. We also compare automatic segmentation to manual measurements. We hypothesize that electrodes within the scala tympani (ST) without translocation into the scala vestibuli (SV) will result in better audiologic outcomes.

Study Design: Retrospective chart review.

Setting: Tertiary referral center.

Patients: Patients implanted from 2015-2019 with imaging and post-operative AzBio or Consonant-vowel Nucleus-consonant (CNC) testing. Patients were excluded if pre or perilingual at the time of implantation (<18 years of age), non-English speaking, had a cognitive disorder or a cochlear malformation.

Interventions: Retrospective analysis of CT scans.

Main Outcome Measures: Post-operative speech perception testing and detection of translocation via automated and manual methods.

Results: 47 patients met inclusion criteria, 15 had a dislocation. When controlling for cochlear implant usage and the pre-operative AzBio score, patients with a dislocation had a significantly lower CNC score and AzBio score 6-months post-operation compared to patients without a dislocation. The number of dislocated electrodes was significantly associated with CNC score post-operation among patients with a dislocation. 42 of 47 manual evaluations did not suggest there was a dislocation, 32 of these evaluations were correct, while all 5 of the evaluations suggesting a dislocation were correct, providing evidence that manual evaluations are predictive of dislocations ($p = 0.002$).

Conclusions: Placement of CIs within the ST without translocation to the SV leads to improved audiologic outcomes. Additionally, manual evaluation of temporal bone CT shows promise for identification of electrode position for prediction of audiologic outcomes.

***Professional Practice Gap & Educational Need:**
1. Lack of consensus on factors affecting CI hearing outcomes 2. Lack of an available method to evaluate position of CI electrodes in a non-research setting.

***Learning Objective:**
1. To recognize that our data provides additional support for the hypothesis that position of CI electrode impacts audiologic outcomes 2. To raise awareness that CI electrode position can be measured to a satisfactory degree by physicians using post-operative CT scans, while automated segmentation remains the standard for research purposes.

***Desired Result:**
For physicians to recognize the importance of CI electrode position and the availability of methods to identify when patients are at risk for worse audiologic outcomes.

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

***Indicate IRB or IACUC :** Approved 9/26/2018 - 2018H0394 - Assessment of Electrode Placement and Audiologic Outcomes in Cochlear Implantation.

Bone-Island Craniotomy Technique for the Placement of Bonebridge Active Transcutaneous Bone Conduction Implants

Scott B. Shapiro MD, Pablo A. Llerena B.S., P. Ashley Wackym, MD

Objective: Current techniques for placement of the Bonebridge active transcutaneous bone conduction implant require drilling of a precisely size bone bed for the device fixation points to make appropriate contact, which is often difficult even when lifts are used. In this study we describe the surgical technique and outcomes of a novel bone-island craniotomy technique which simplifies the procedure and precludes the necessity for lifts in securing the device.

Study Design: Prospective case series

Setting: Tertiary care academic medical center

Patients: Fourteen patients who underwent surgery for placement of 15 Bonebridge active transcutaneous bone conduction implants. Twelve for conductive or mixed hearing loss with maximum bone conduction threshold of 45 dB HL between 500 and 3000 Hz on the operative side, and three for single sided deafness with contralateral maximum air conduction threshold of 60 dB HL.

Interventions: Surgical placement of the Bonebridge active transcutaneous device with a novel bone island craniotomy technique.

Main Outcome Measures: Functional gain in air conduction thresholds, frequency of need for lifts, minor and major complications

Results: For patients with conductive or mixed hearing loss, the mean functional gain in air conduction pure tone average with the device compared to the unaided condition was 31.2 dB HL (SD 8.3). Lifts were not needed in any case to secure the device. There was 1 minor complication requiring a second procedure due to wound infection in a patient who had received radiation. There were no major complications. There was no device loss or failure.

Conclusions: A bone island craniotomy technique eliminates the need for lifts and is a simple, safe, and effective method for placement of the Bonebridge active transcutaneous bone conduction implant.

Define Professional Practice Gap & Educational Need:
Current techniques for placement of the Bonebridge bone conduction implant require drilling of a bone bed such that the device fixation points make appropriate contact at the edges, which is often difficult even when lifts are used to assist in achieving proper fit and fixation. A novel bone-island craniotomy technique simplifies the process and avoids the needs for lifts, but its safety and efficacy have not been studied.

Learning Objective: Evaluate the safety and efficacy of a novel bone-island craniotomy technique for placement of the Bonebridge bone conduction implant.

Desired Result: Attendees will be able to perform Bonebridge surgery with a bone-island craniotomy technique and understand the benefits, risks, and outcomes with this technique.

Level of Evidence – Level III

Indicate IRB or IACUC : Approval per Rutgers Robert Wood Johnson Medical School IRB, Protocol# 2021001732

Social Determinants of Health in the Management of Vestibular Schwannoma

Susan Ellsperman, MD; Rachel Fryatt, AuD; JiCi Wang, BA; Karen Hoi, BS
Shannon Fayson, MD; Renee Banakis, MD, AuD; Emily Stucken, MD

Objective: To evaluate the influence of racial disparities and social determinants of health in vestibular schwannoma (VS) management

Study Design: Retrospective review

Setting: Tertiary academic center

Patients: 556 adults (>18) with VS diagnosed between 1/1/2010 to 12/31/2019

Interventions: VS evaluation and management, clinical decision making

Main Outcome Measures: Initial treatment recommendation, actual treatment pursued, hearing class

Results: Of the 556 patients analyzed, 47% were female and 53% were male. 87% identified as white, 3.4 % as black, 3.4% as Asian, and 6% were of other or unknown races. Only 3.2% identified as Hispanic or Latinx. Surgical resection was recommended as a treatment option for 57.2% of patients. On multivariate logistic regression, race (p 0.04), age (p <0.001), marital status (p 0.001), insurance type (p 0.004), and tumor size (p <0.001) were correlated with a recommendation of surgery. Ethnicity (p 0.49), hearing class (p 0.74), and Charlson Comorbidity Index (CCI) score (p 0.14) were not associated with a recommendation of surgery. Ultimately 37.7% of patients in this cohort underwent surgery within one year of diagnosis. Tumor size (p <0.001), CCI (p 0.01), and hearing class (p 0.41) were correlated with surgical intervention. Race (p 0.44), ethnicity (p 0.29), marital status (p 0.50) and insurance type (p 0.89) were not associated with undergoing surgical intervention.

Conclusions: Social determinants of health and racial disparities may influence the evaluation and management of patients with VS. Multi-institutional analysis and evaluation of area deprivation index is ongoing.

Define Professional Practice Gap & Educational Need: Racial disparities and social determinants of health are known to impact diagnosis and disease management in many medical disciplines. There has been very little investigation into the impact this has on VS management. Prior studies have suggested that racial disparities may impact whether patients are treated with surgical excision. Further investigation is warranted to identify and acknowledge opportunities for the delivery of more equitable medical care.

Learning Objective: Social determinants of health including race may influence initial treatment recommendations for VS management and ultimate treatment pursued

Desired Result: Identify and acknowledge the influence of racial disparities and social determinants of health in the management of VS

Level of Evidence - Level V

Indicate IRB or IACUC : HUM00191920; 6/2/2021

Generation and Initial Validation of the Hearing Health Utilities Index

Peter R. Dixon, MD, MSc; George Tomlinson, PhD; Sharon Cushing, MD, MSc
David Feeny, PhD; Joseph M. Chen, MD; Murray Krahn, MD, MSc

Objective: Utility is a single-number summary of health-related quality of life used as an outcome measure in clinical trials and cost-effectiveness analyses. Existing utility measures do not detect important hearing changes and underestimate the benefit of hearing treatments including bilateral cochlear implantation. The Health Utilities Index, Mark 3 was re-designed to address this limitation. Here we debut the Hearing Health Utilities Index (HUI-Hearing) and describe its content validation.

Study Design: Cognitive interviews, focus groups, modified Delphi

Setting: Tertiary center

Subjects: Stratified sample of adults (age ≥18 years) with hearing loss, their communication partners, and clinical and measurement experts.

Interventions: Hour-long, transcribed semi-structured interviews with patients who completed HUI-Hearing. Focus groups including patients and their communication partners. Modified Delphi process involving clinical and measurement experts.

Main Outcome Measures: (1) Saturation, defined by no emergence of novel themes during interviews/focus groups. (2) Consensus in modified Delphi

Results: Focus groups included 40 subjects in 8 groups. Cognitive debriefing included 10 subjects with hearing ranging from normal to profound loss and broad demographics and treatment experiences. The modified Delphi included 4 audiologists, 4 otologist/neurotologists, and 2 health economists. Adjustments were made to the preliminary HUI-Hearing in response to identified issues with clarity, interpretation, response time, and range of functioning described.
The final HUI-Hearing classifies hearing status according to 7 domains: speech recognition, environmental sounds, localization, listening effort, tinnitus, music appreciation, and assistive hearing devices. It describes 25,920 unique hearing states.

Conclusions: HUI-Hearing is a comprehensive hearing status classification system with excellent granularity and face validity that will facilitate appropriate health resource allocation for hearing treatments.

***Professional Practice Gap & Educational Need:** Health utility is often calculated using generic instruments applicable to all health conditions that lack granularity for detection of clinically important differences in specific conditions like hearing loss. Until now, no hearing-specific utility instrument has been available.

***Learning Objective:** Understand the composition of health utility instruments, steps involved in their derivation, and appreciate the limitations of generic utility instruments in hearing loss

***Desired Result:** Knowledge of available alternatives to generic health utility instruments, including the HUI-Hearing, for estimating health utility in patients with hearing loss.

***Level of Evidence –** V

***Indicate IRB:** Sunnybrook REB, Project Identification Number 114-2018

Identifying Ideal Candidates with Vestibular Schwannoma for the Middle Cranial Fossa Approach

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Alexander D. Claussen, MD; Marin A. Mcdonald, MD
Marc Schwartz, MD; Rick A. Friedman, MD, PhD

Objective: Identify characteristics associated with ideal outcomes after middle cranial fossa (MCF) approach for vestibular schwannomas (VS).

Study Design: Case-control

Setting: Tertiary care hospital

Patients: Adults with VS and serviceable hearing

Interventions: MCF approach between 2017 and 2021

Main Outcome Measures: Ideal outcomes were defined as preserved AAO class A or B hearing, House-Brackmann (HB) Grade I facial function, and gross total resection; each without complications or length of stay >4 days. A perfect outcome was defined by the combination of all ideal outcomes.

Results: Of the 83 patients included, hearing was preserved in 58(70%), HB Grade I in 58(70%), with gross total resection in all cases. Perfect outcome was observed in 41 and was associated with better median pre-operative pure tone average (10dB vs. 17dB; $p<0.01$) and word recognition (100% vs. 64%, $p<0.01$). Transverse tumor dimension was smaller in the perfect outcome group (median 8.1 vs. 9.2 mm, $p=0.034$). The position of the tumor within the internal auditory canal (IAC) was measured relative to the mid-pole of the IAC as ratios of distances to the anterior vs. posterior, and superior vs. inferior tumor borders. Perfect outcome was associated with more posteriorly-based tumors (median anterior:posterior component ratio 1.00 vs. 1.04, $p<0.01$).

Conclusions:
Preoperative hearing, tumor size, and relative position of the tumor within the IAC could be important features to consider in the selection of candidates for MCF approach. Further analysis including machine-learning feature selection techniques will be applied to identify independent predictors from more than 100 other clinical and radiographic characteristics and will be presented with the final abstract.

***Professional Practice Gap & Educational Need:** Small sporadic vestibular schwannomas may often be reasonably managed with observation, stereotactic radiosurgery, or microsurgical resection. Identification of patients most likely to experience ideal surgical outcomes may facilitate decision making and counselling.

***Learning Objective:** To identify clinical and radiographic characteristics that are available at preoperative consultation after routine investigations that may be associated with ideal surgical outcomes.

***Desired Result:** Facilitate counselling for small sporadic vestibular schwannomas and improve selection of candidates for middle fossa approach to vestibular schwannomas.

***Level of Evidence -** Level III

***Indicate IRB:** #180978, University of California San Diego

Instrumented Insoles for Assessment of Gait in Vestibular Schwannoma Patients

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Tony J. C. Wang, MD; Damiano Zanotto, PhD; Anil K. Lalwani, MD

Objective: Imbalance and gait disturbances are common in vestibular schwannoma (VS) patients and can result in significant morbidity. Here, we use custom-engineered instrumented insoles to evaluate the gait and balance of patients diagnosed with VS; we then compare our results to published metrics from the general population. We aim to validate instrumented insoles as a means of personalized gait assessment in VS patients.

Study Design: Prospective clinical study.

Setting: Otology, neurosurgery, and radiation oncology clinics at a tertiary referral center.

Patients: Inclusion criterion: diagnosis of VS without prior treatment. Exclusion criteria: > 80 years of age, significant neurological disorder with gait dysfunction.

Interventions: Functional gait assessment (FGA), 2-minute walk test, and uneven surface walk test with diagnostic instrumented insoles.

Main Outcome Measures: Scores on standardized gait assessments; spatiotemporal gait parameters from instrumented insoles.

Results: FGA scores and insole data were obtained for 12 patients with untreated VS. The average FGA score was 25.9±4.3 vs. 26.1±4.0 in the general population. FGA scores were significantly correlated with metrics obtained from the two-minute walk test (2MW), including normalized stride length (NSL) ($r=0.86$, $p=0.01$), normalized stride velocity (NSV) ($r=0.83$, $p=0.02$), and swing period (SP) ($r=0.76$, $p=0.05$). Compared to the 2MW, on the uneven surface walk test (USW), patients had significantly decreased NSV (0.30 vs. 0.33, $p=0.03$) and SP (37.8% vs. 39.9%, $p=0.04$).

Conclusions: VS patients have significant gait disturbance on uneven surfaces that cannot be detected by standard assessment (FGA). Instrumented insoles have greater sensitivity for identifying gait dysfunction in VS patients and may be valuable in gait assessment before and after treatment.

***Professional Practice Gap & Educational Need:**
Diagnostic instrumented insoles allow for personalized assessment of gait and balance dysfunction. Precision medicine in the realm of gait and balance has not been widely explored in otology and neurotology clinics.

***Learning Objective:**
To understand the value of diagnostic instrumented insoles in personalized medicine.

***Desired Result:**
Greater interest and investment in personalized assessment methods for gait and balance dysfunction.

***Level of Evidence:** Level II

***Indicate IRB or IACUC:**Columbia University Irving Medical Center, IRB #AAAT5366 (approved 3/11/2021)

Predicting Incomplete Microsurgical Resection of Sporadic Vestibular Schwannoma

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Skye K. Lawlor, MD; Brian A. Neff, MD; Colin L. W. Driscoll, MD; Matthew L. Carlson, MD

Objective: Develop a predictive model for incomplete microsurgical resection of sporadic vestibular schwannoma (VS)

Study Design: Retrospective cohort

Setting: Tertiary referral center

Patients: Patients with sporadic VS

Interventions: Microsurgery with preoperative intent of gross total resection (GTR)

Main Outcome Measures: Incomplete resection

Results: Among 603 patients, 101 (17%) had intracanalicular tumors and 502 (83%) had tumors with cerebellopontine angle (CPA) extension. For patients with CPA tumors, 331 (66%) underwent reported GTR and 171 (34%) underwent reported near total/subtotal resection (NTR/STR). Multivariable modeling identified older age at surgery, larger linear tumor size, and absence of a fundal fluid cap as predictive of NTR/STR ($p<0.001$). From this model one can estimate that a 20-year-old with a tumor that has <10 mm of CPA extension and a fundal fluid cap has a predicted probability of NTR/STR of 1%, while a 70-year-old with a tumor that has ≥30 mm of CPA extension and no fundal fluid cap has a predicted probability of NTR/STR of 91%. Among the 171 patients who underwent a NTR/STR, 24 (14%) required secondary treatment at the time of last follow-up.

Conclusions: Predictive factors for incomplete microsurgical resection of VS include older age at surgery, larger linear tumor size, and the absence of a fundal fluid cap. These factors can be used to estimate the likelihood of NTR/STR, aiding in preoperative discussions regarding future surveillance and risk of secondary treatment as well as clinical decision-making.

***Professional Practice Gap & Educational Need:** Optimal management of small- to medium-sized vestibular schwannoma remains debated. A predictive model for likelihood of gross total resection and subsequent cure can aid in this clinical decision-making.

***Learning Objective:** Identify risk factors for incomplete microsurgical resection and apply these in a predictive model to aid in patient counseling.

***Desired Result:** To provide clinicians with an additional tool in clinical decision-making and patient counseling when all management options of vestibular schwannoma are available.

***Level of Evidence -** IV

***Indicate IRB or IACUC:** Mayo Clinic IRB Protocol #16-007363

The Natural History of Primary Inner Ear Schwannomas: Outcomes of Long-Term Follow-Up

Zain Khera, BA, Emily Kay-Rivest, MD, J. Thomas Roland Jr, MD
David R. Friedmann, MD, MSc, Sean McMenomey, MD
Daniel Jethanamest, MD, MSc

Objective: To describe the natural history of primary inner ear schwannomas over a long follow up period.

Study Design: Retrospective case series.

Setting: Tertiary referral center.

Patients: Patients with primary inner ear schwannomas (PIES), with serial audiometric and radiologic follow up were included.

Interventions: None.

Main Outcome Measures: Patterns of hearing loss, rate of hearing decline, presence of vestibular symptoms, and rate of tumor growth.

Results: A total of 12 patients with 13 tumors were identified. The mean duration of follow up was 7.0 years (median 7.5 years, range 1.75 to 11.3 years). Tumor locations were described as per the Kennedy classification and 46% were intracochlear, 15% intravestibular, 23% transmodiolar and 15% intravestibular-cochlear. There were no cases of tumors breaking through the otic capsule. Among patients with serviceable hearing (AAO Class A or B) at the time of presentation, the median time to decline to a non-serviceable hearing level was 55 months (range 21 to 117 months). The hearing loss was sudden in 33% of patients, progressive in 58% and fluctuating in 8%. No patients had intractable vertigo; however, two required vestibular physiotherapy. On the first MRI, the mean largest tumor dimension was 3.1 mm (SD: 1.3 mm) and the mean largest dimension on most recent MRI was 4.4 mm (SD: 1.1 mm). Two tumors exhibited no growth over a follow up of 11.3 and 2.8 years respectively. For the remaining tumors, the mean rate of growth was 0.29 mm per year followed. Two patients underwent a CI with simultaneous tumor resection and had favorable outcomes.

Conclusions: Long-term follow up suggests that a conservative approach, with possible hearing rehabilitation at the time of deterioration, is a safe management strategy for PIES.

***Professional Practice Gap & Educational Need:** 1. There are no formal guidelines on how aggressively PIES should be managed. A better understanding of the natural history of PIES will help inform treatment decisions and the safety of observation. 2. The current literature on the natural history of PIES has relatively short follow-up times.

***Learning Objective:** To better understand the progression, growth rates, and time-to-hearing loss related to PIES.

***Desired Result:** To guide the attendee in their treatment approaches and further their knowledge of the natural history of PIES so they can better inform patients of their prognosis.

***Level of Evidence –** Level V: Case series, studies with no controls

***Indicate IRB or IACUC :** NYU School of Medicine Institutional Review Board, s21-00257 (03/10/21)

Does Compliance or Cost Regulate Effectiveness of Phone Applications for Tinnitus Relief?

Richard Adamovich-Zeitlin, BS; Maja Svrakic, MD

Objective: To evaluate compliance with and effectiveness of notched sound therapy (NST) administered through a mobile application in improving symptoms of patients suffering from chronic tinnitus.

Study Design: Prospective randomized control trial

Setting: Tertiary referral center

Patients: Adult patients with tinnitus

Interventions: A free subscription to notched sound therapy (NST) mobile app (AudioNotch), or standard of care (SOC)

Main Outcome Measures: Frequency and duration of therapy use, change from baseline in the Tinnitus Handicap Inventory (THI)

Results: There was a clinically relevant mean decrease in THI from baseline in the NST group compared with SOC. Only 35% of patients with the free mobile app, and 25% of the patients without the free mobile app used NST for 3 months post enrollment. Of the patients using NST, 30% used it for the prescribed 2 hours per day.

Conclusions: Mobile application administration of notched sound therapy (NST) is effective in improving subjective symptoms of tinnitus after at least 3 months of therapy. Cost was not a determinant on use of therapy and very few patients were able to comply with 2 hours of listening time. Despite these limitations, any use of therapy decreases symptoms and should therefore be used as a standard in treating patient with tinnitus.

***Professional Practice Gap & Educational Need:** Despite high prevalence of tinnitus and a perceived impact on quality of life, few studies address the effectiveness of easily accessible apps for treatment of tinnitus and even less is known about the effect of cost of and compliance to tinnitus sound therapy.

***Learning Objective:** To identify the early clinical results of at-home, mobile app delivered notched sound therapy in the treatment of chronic tinnitus.

***Desired Result:** To increase the clinician's knowledge of the effectiveness and feasibility of mobile application administration of notched sound therapy for the treatment of tinnitus.

***Level of Evidence –** Level II

***Indicate IRB or IACUC :** North Shore LIJ IRB, protocol number 17-0537

Image Guided Cochlear Implant Programming: A Systematic Review and Meta-analysis

Alex W. Yang, BA; Katie F. Lee, BS; Michael Noller, MD; Nora Watson, PhD
Elicia M. Pillion, AuD; Charles A. Riley, MD; Anthony M. Tolisano, MD

Objective: To review studies that have implemented clinical image guided cochlear implant programing (IGCIP) and to evaluate its effect on cochlear implant (CI) performance.

Data Sources: PubMed, Embase, and Google Scholar were searched for publications through August 1st, 2021 without date or language restrictions.

Study Selection: Included studies prospectively compared intra-individual CI performance between an image-guided experimental map and a patient's preferred traditional map. Non-English, cadaveric, and studies where imaging did not directly inform programming were excluded.

Data Extraction: Eight studies were identified for review, and four reported comparable audiological testing and follow-up times appropriate for meta-analysis. Demographic, speech, spectral modulation, pitch accuracy, and quality of life (QOL) survey data were collected. Aggregate data was used when individual data was unavailable.

Data Synthesis: Audiological test outcomes were evaluated as standardized mean difference (SMD) [95% confidence interval] using random-effects meta-analysis with raw score standardization. Improvements in speech and QOL measures using the IGCIP map demonstrated nominal effect sizes: CNC words: 0.15 [-0.12, 0.41]; AzBio quiet: 0.09 [-0.05, 0.22]; AzBio +10 dB SNR: 0.14 [-0.01, 0.30]; BKB-SIN: -0.08 [-0.36, 0.21]; Abbreviated Profile of Hearing Aid Benefit (APHAB): -0.14 [-0.28, 0.00]; Speech Spatial and Qualities of Hearing Scale (SSQ): 0.14 [-0.02, 0.30]. Nevertheless, 79% of patients allowed to keep their IGCIP map opted for continued use after the investigational period.

Conclusions: IGCIP has potential to precisely guide CI programming. Nominal effect sizes for currently employed objective outcome measures may fail to fully identify benefits given discordance with the percentage of patients who prefer to maintain their IGCIP map.

***Professional Practice Gap & Educational Need:** Image guided cochlear implant programming remains a novel but heterogenous concept that has not been easily described.

***Learning Objective:** To describe the several approaches to image guided cochlear implant programming and to measure its clinical potential objectively.

***Desired Result:** Physicians will have an improved understanding of image guided cochlear implant programming and how it is relevant to modern day precision medicine.

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

***Indicate IRB or IACUC:** Exempt.

Matched Cohort Study of Radiographic Superior Semicircular Canal Dehiscence and Tegmen Dehiscence and Obstructive Sleep Apnea

Adam C. Kaufman, MD, PhD; Noor Ali, BS; Shayna Cooperman, BA; Jennifer C. Alyono, MD

Objective: Report the frequency of radiographic superior semicircular canal dehiscence (SSCD) and tegmen dehiscence in patients with and without obstructive sleep apnea(OSA).

Study Design: Retrospective matched cohort study

Setting: Tertiary care center

Patients: Adults with OSA and fine cut CT scans including the temporal bone were matched to patients without OSA by age, gender, and type of CT(protocol, scanner type, slice thickness). Ears with otologic surgery or temporal bone tumors were excluded.

Main Outcome Measures: Prevalence of SSCD and tegmen dehiscence assessed by two independent reviewers.

Results: The average BMI of the OSA patients was 29.3 kg/m^2 with an average AHI of 36.5. The control group had an average BMI of 26.3 kg/m^2. 34/352(9.7%) temporal bones in the OSA cohort had SSCD vs 37/352(10.5%) of controls($p>0.05$). 7(25.6% of those with SSCD) OSA patients had bilateral SSCD vs 8(27.6% of those with SSCD) controls ($p>0.05$). The majority(87.3%) of dehiscences involved the temporal lobe with the remaining involving the superior petrosal sinus or both. 90/352(25.6%) of OSA ears had a tegmen dehiscence vs 95/352(27.0%) of controls ($p>0.05$). Neither group had a laterality preference for SSCD or tegmen dehiscence.

Conclusions: The prevalence of radiographic SSCD and tegmen dehiscences in OSA patients does not significantly differ from age and gender matched controls. This is in contrast to prior case-control studies finding patients with symptomatic SSCD to have higher rates of OSA. This may suggest the effect size of OSA on SSCD prevalence may be limited despite OSA being a risk factor for elevated intracranial pressure.

***Define Professional Practice Gap & Educational Need:**
Although previous studies have shown that patients with symptomatic SSCD have a higher rate of OSA, the reverse relationship does not hold true. Patients with OSA did not have an elevated rate SSCD compared to a control population. This study emphasizes the need for further research in understanding the risk factors for SSCD.

***Learning Objective:**
Radiographic SSCD is seen no more frequently in the OSA patient population than the general population.
SSCD or skullbase dehiscences do not preferentially occur on one side in either the OSA or general patient population.

***Desired Result:** The increased intracranial pressure seen in patients with OSA is not enough to induce SSCD at rates higher than the general population. These dehiscences are often asymptomatic and therefore do not need an intervention.

Level of Evidence - IV

Indicate IRB or IACUC : Assessed by IRB as non-human subjects research, Stanford University

Quality of Life Impact of Cochlear Implantation for Single Sided Deafness: Assessing the Interrelationship of Objective and Subjective Measures

Matthew Ryan, MD; Joshua G.W. Bernstein, PhD; Elicia M. Pillion, AuD
Coral E. Dirks, AuD, PhD; Nora Watson, PhD; Anthony M. Tolisano, MD

Objective: Cochlear implants (CIs) for single-sided deafness (SSD) and asymmetric hearing loss (AHL) provide objective spatial speech-understanding in noise (SIN) and sound-localization (SL) and subjective quality-of-life (QOL) benefits. How patients weigh objective benefits in subjective QOL responses is unknown. This study examined the pre- and post-operative time course for a patient-reported QOL outcome measure validated for CI patients (CI-QOL) and its relationship to changes in spatial-hearing and standard monaural-CI speech-in-quiet (SIQ) outcomes in a standardized clinical SSD-CI protocol.

Study Design: Retrospective cohort study

Setting: Tertiary-care military medical center

Patients: 22 SSD and 2 AHL adults

Interventions: Unilateral CI

Main Outcome Measures: CI-QOL score, CI-alone SIQ score (CNC), binaural SIN threshold, binaural SL error

Results: At post-activation Visit 1 (mean 1.9 months post-implantation), 17/24 (71%) had clinically beneficial (>3-point) CI-QOL improvement from pre-preoperative. Longitudinal results (n=10) showed mean post-operative CI-QOL improvement peaked at Visit 1 (10.0 points), decreasing through Visit 4 (7.3 points, mean 8.9 months). Speech-understanding improvement increased dramatically over the same period (SIQ: 28-52%; SIN: 7.4-12.2 dB) while SL improvement was steady (6.8-7.4 degrees). For those with data for all four outcomes (n=16), there was moderate positive correlation between QOL and SIQ improvements ($r=0.52$, $p=0.04$) and a strong positive correlation between SIN and SIQ improvements ($r=0.65$, $p<0.01$) at the latest timepoint tested.

Conclusions: QOL improvements reflect speech-understanding performance but likely also other untested objective or subjective factors. Different subjective- and objective-benefit time courses suggest clinical conclusions will be most valid after all measures asymptote. CI-alone SIQ is technically and logistically more feasible and can stand in for binaural SIN assessment.

***Professional Practice Gap & Educational Need:** To examine the QOL impact of CI for SSD patients with a validated instrument and to identify pre or post-operative metrics which may predict QOL benefit.

***Learning Objective:** CI for SSD patients leads to a clinically impactful improvement in QOL. QOL improvement is closely related to improvement in the patient's ability to understand speech.

***Desired Result:** Attendees will be able to better counsel patients regarding magnitude and timing of QOL improvement that can be expected from CI for SSD or AHL. Attendees will be able to focus on post-implant audiometric parameters which best impact their patient's QOL.

***Level of Evidence -** III

***Indicate IRB or IACUC :** Approval obtained through the Department of Research Programs at Walter Reed National Military Medical Center (IRB# WRNMMC-2020-0290). The contents of this publication are the sole responsibility of the author(s) and do not necessarily reflect the views, opinions or policies of Uniformed Services University of the Health Sciences (USUHS), the Department of Defense (DoD), the Departments of the Army, Navy, or Air Force. Mention of trade names, commercial products, or organizations does not imply endorsement by the U.S. Government.

The Effect of Delayed Intervention Prior to Microsurgical Resection of Vestibular Schwannoma

Omid Moshtaghi, MS, MD; Peter R. Dixon, MD; Alexander D. Claussen, MD
Pasha Mehranpour, BS; Kareem O. Tawfik, MD
Marc Schwartz, MD; Rick A. Friedman, MD, PhD

Objective: Identify outcomes associated with length of observation in patients who underwent microsurgical resection of vestibular schwannomas (VS).

Study Design: Retrospective single institution cohort study spanning November 2017 to July 2021.

Setting: Tertiary care hospital.

Patients: Sporadic VS surgically treated.

Interventions: Observation window greater (delayed intervention) or less (quick intervention) than 3 months defined by time from first available MRI to date of surgery.

Main Outcome Measures: Pre- and post-operative audiometric performance, objective mobility and balance metrics, tumor maximum linear dimension.

Results: Of the 492 patients who met inclusion criteria, 307 waited longer than 3 months ("delayed intervention group") with a median observation time of 354 days, while 185 underwent surgery within 3 months of the first available MRI (median 59 days). Median tumor size was larger in the delayed intervention group (20mm vs. 18mm, p=0.016). Pre-operative word recognition score (WRS) was worse in the delayed intervention group (92% vs. 84% , p=0.02). No statistically significant difference in AAO hearing classification or pure tone average was noted between the two groups. On post-operative mobility and balance metrics, the delayed intervention group scored poorly compared to quick intervention group both on the 10 Meter Walk Test (median 1.47 vs.1.58 minutes; p=0.003) and 2 Minute Walk Test (132 vs. 145 meters; p<0.01), respectively. No statistically significant difference was observed on other metrics including the dynamic gait index, functional gait assessment.

Conclusions: Patients who underwent delayed intervention of a tumor for greater than 3 months prior to surgery (median 354 days) demonstrated worse pre-operative WRS and post-operative functional mobility despite presenting at a younger age with a smaller tumor size.

***Professional Practice Gap & Educational Need:** This study better defines the potential risks associated with delay in tumor intervention beyond 3 months after initial diagnostic MRI.

***Learning Objective:** To evaluate differences in pre-operative clinical outcomes in those who elected to delay their tumor resection for at least 3 months after initial diagnostic MRI.

***Desired Result:** To better council patients who elect to undergo delayed intervention at time of diagnosis and later pursue surgical intervention.

***Level of Evidence -** Level IV

***Indicate IRB:** #180978, University of California San Diego

Audiometric Outcomes of a Novel Bone-Conduction Hearing Aid Implanted via a Minimally-Invasive Approach

Alexandra E. Quimby, MD, MPH; Jino Park, BS; Michael J. Ruckenstein, MD, MSc

Objective: To report the audiometric outcomes of a series of patients having undergone implantation of a novel transcutaneous osseointegrated hearing device via a minimally invasive surgical approach.

Study Design: Retrospective case series.

Setting: Single academic tertiary referral center.

Patients: Adults (≥ 18 years) who have undergone transcutaneous osseointegrated implant placement (Osia®) between December 1, 2019 and August 1, 2021 with audiometric data available prior to and following device activation and a minimum of 4 weeks follow-up.

Interventions: Transcutaneous osseointegrated bone-conduction device implantation.

Main Outcome Measures: Change in pure tone average (PTA) after implantation. Secondary outcomes include average operative time and complications.

Results: 22 patients underwent implantation of the transcutaneous osseointegrated device via the minimally invasive surgical approach and had complete follow-up, forming the largest series of patients in the published literature. The most common indication for implantation was unilateral conductive hearing loss with a mastoid cavity. The mean operative time was 60.4 minutes (range, 26-117). The mean pre-implantation air conduction (AC) PTA was 61dB, and mean post-implantation was 27.6dB. The mean change in PTA was 34.3dB, which achieved statistical significance ($t=8.406$, $p<0.0001$). Some complication was suffered by 50% of patients, the most common of which were pain (23%) and device-related complications (excluding failure; eg buzzing, magnet displacement) (23%).

Conclusions: A minimally invasive surgical approach is feasible for the implantation of this novel transcuatneous osseointegrated hearing device. It provides a safe and effective means of hearing rehabilitation in individuals with unilateral or bilateral conductive or mixed hearing losses. Further prospective study is warranted in order to fully elucidate long-term outcomes.

***Professional Practice Gap & Educational Need:** Few studies of small numbers of patients have examined audiometric and safety outcomes of this novel transcutaneous osseointegrated device since its approval. Further data on larger numbers of patients is necessary in order to better assess outcomes following implantation of the device.

***Learning Objective:** Gain knowledge of the audiometric outcomes and common complications experienced by patients who have undergone implantation of the device.

***Desired Result:** The knowledge gained adds to that from existing literature by means of demonstrating outcomes in a larger series of patients than those previously reported on.

***Level of Evidence –** V

***Indicate IRB or IACUC :** University of Pennsylvania, IRB exempt, protocol no 849747.

Association between Thyroid Stimulating Hormone Level and Bell's Palsy

Avishai Stahl, MD; T. Hornik, PhD; B. Nageris, MD

Objective: Association between dysregulated thyroid hormone function and Bell's palsy has not been investigated. Our hypothesis is that dysregulated thyroid hormone function is associated with Bell's palsy.

Study Design: Retrospective cohort comparison study.

Setting: Electronic medical record database of Clalit Health Services (CHS). CHS is an Israeli payer-provider integrated health care system, serving >4.5 million members, which includes 54% of the Israeli population.

Patients: Older than 18 years old patients with Bell's palsy during 2000-2019.

Interventions: A total of 2807 patients with Bell's palsy who had Thyroid stimulating hormone (TSH) blood level prior to the palsy were matched (1:2) for age and sex with 5614 controls who had TSH blood level with no history of bell's palsy.

Main Outcome Measures: TSH level.

Results: A total of 12,628 patients with bell's palsy were found after retrospective review of the CHS database, from 2000–2019. Of which, 2807 met the inclusion criteria. Mean age was 57.9 years, and 58.4% were female. There was a significantly higher percentage of low TSH < 0.55 milli-international units per liter (mIU/L) in the Bell's Palsy group compared to controls (5.9% vs 3.7%, p< 0.001). The rate of pregnant women was similar between the bell's palsy group and control group (3% vs. 2.2%, respectively; p=0.081), as was the rate of purchasing thyroid hormone drugs (5% vs. 4.2%, respectively; p= 0.212). The Bell's palsy group had higher BMI, and more patients with diabetes mellitus, hypertension and prior cerebrovascular accident. Therefore, when we performed a binary logistic regression model to determine the risk of developing Bell's Palsy, we included the confounder variables into the model, together with the independent variable TSH (divided into 5 groups: low- <0.55 mIU/L; 0.55-1.96 mIU/L; 1.96-3.37 mIU/L; 3.37-4.78 mIU/L; high - >4.78 mIU/L). In logistic regression, TSH was found to be an independent predictor for Bell's Palsy (p=0.014). Low TSH increased the odds for Bell's Palsy compared to the other four TSH groups, [< 0.55 mIU/L] vs. [0.55-1.96 mIU/L] OR 1.44, CI (1.10-1.89), p=0.007; [1.96-3.37 mIU/L] OR 1.58 CI (1.20-2.08), p=0.001; [3.37-4.78 mIU/L] OR 1.44 CI (1.44-1.95), p=0.019; [>4.78 mIU/L]= OR 1.64 CI (1.20-2.25), p=0.002.

Conclusions: TSH <0.55 mIU/L is associated with Bell's Palsy.

Define Professional Practice Gap & Educational Need: The etiology of Bell's palsy is unknown. We hope to expand the knowledge regarding the etiology of Bell's palsy by looking for an association between thyroid hormone level and Bell's palsy.

Learning Objective: Explore the epidemiologic association between dysregulated thyroid hormone function and Bell's palsy.

Desired Result: Clinicians will consider examining thyroid hormone function for Bell's Palsy patients; thus increasing the possibility of early diagnosis of hyperthyroidism. In addition, balance dysregulated thyroid hormone function may improve bell's palsy prognosis, but further study is required.

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

Indicate IRB or IACUC: RRM-003-20. Approved.

The Efficacy of CT Angiography in Assessing Vascular Injury in Patients with Temporal Bone Fracture

Erin Harvey, MD; Eileen Peterson, BS; Mana Espahbodi, MD; Ahmed Beydoun, MD
David R. Friedland, MD, PhD; Jazzmyne A. Adams, MPH; Jake Luo, PhD

Objective: To determine the utility of computed tomography angiography (CTA) to assess vascular injury following temporal bone fracture.

Study Design: Retrospective cohort study.

Setting: Tertiary academic hospital.

Patients: Trauma patients with radiographic temporal bone fracture undergoing subsequent CTA head.

Interventions: Patients with temporal bone fracture were characterized with respect to demographics, mechanism of injury, otologic/neurologic morbidities, fracture location, and neurosurgical intervention. CTAs were evaluated for carotid involvement, intracranial hemorrhage, and other skull base fractures.

Main Outcome Measures: Pearson's regression analysis and one-way ANOVA to identify variables correlating with positive CTA (CTA+). Secondary analyses were performed for predictors of facial paralysis, CSF leak and hearing loss.

Results: Among 228 temporal bone fractures, 11.8% had subsequent CTA+. CTA+ findings were noted in 20% of those with carotid canal involvement. Patients with CTA+ were significantly younger (33.8±12.6 vs 43.7±17.7, $p=0.005$) and more likely to have otic capsule involving ($p=0.0002$), bilateral ($p=0.0008$), mixed-type temporal bone fractures ($p=0.004$). Motor vehicle collisions ($n=28$) were more commonly associated with CTA+ findings, while no blunt assault patient ($n=12$) had CTA+ ($p=0.04$). Cranial hemorrhage, need for neurosurgical intervention, expiration from injury, facial nerve paralysis, and extra-temporal skull base fractures did not correlate with CTA+. Facial paresis correlated with otic capsule involving fractures ($p=0.001$), initial GCS ($p<0.0001$), and concomitant hearing loss ($p<0.0001$).

Conclusions: Vascular injury on CTA following temporal bone fracture correlates with younger age, more extensive fracture patterns and higher speed mechanisms of injury. These factors may inform more judicious use of high-cost radiographic assessments.

***Professional Practice Gap & Educational Need:** CTA is commonly ordered following temporal bone fracture with concern for carotid involvement. There is lack of evidence as to factors likely to predict positive findings resulting in high-cost and low-yield healthcare delivery.

***Learning Objective:** To recognize the multifactorial nature of temporal bone injury with carotid canal involvement and correlation with CTA+.

***Desired Result:** For physicians to be more cost-effective by considering clinical and demographic factors prior to ordering CTA for temporal bone fracture**.**

***Level of Evidence -** IV

***Indicate IRB or IACUC :** IRB# 1538127

Impact of Demographics and Clinical Features on Initial Treatment Decision Making in Vestibular Schwannoma

Erin Harvey, MD; Katarina Stark, BS; David R. Friedland, MD, PhD
Jazzmyne A. Adams; Michael S. Harris, MD; Ling Tong MS; Jake Luo PhD

Objective: To identify demographic and clinical features impacting decision making for vestibular schwannoma treatment.

Study Design: Retrospective chart review.

Setting: Tertiary care academic medical center.

Patients: Patients diagnosed with vestibular schwannoma between 2009 and 2019

Interventions: Initial treatment decisions of 197 patients with vestibular schwannoma were analyzed with respect to socioeconomic factors, tumor size, hearing status, treating surgeon, and final treatment course. Multivariate logistic regression was used to develop a model for predicting treatment pathway.

Main Outcome Measures: Initial treatment pathway for vestibular schwannoma.

Results: Among 197 patients, 93 (47%) were initially treated with observation, 60 (30%) with Gamma Knife and 44 (22%) with surgical resection. Age univariately had no statistically significant impact on initial pathway but those undergoing surgery trended toward a younger demographic (49.1y (sur) vs 57.2y (obs) vs 59.0y (GK)). Males were more likely to elect observation than females ($p=0.04$). Patients opting for observation were more likely to have a lower Koos classification ($p<0.001$) and have better tumor-ear hearing ($p=0.03$). Only 34.4% of patients living outside the local geographic region elected observation compared with 53.0% living locally ($p=0.055$). Interestingly, surgeon correlated with initial treatment ($p=0.03$) but did not maintain significance when adjusting for hearing level or tumor size. A multiple linear regression model found age, maximum tumor diameter, and Koos class to predict initial treatment ($p<0.0001$, $r^2=0.42$).

Conclusions: Treatment pathway decision making for vestibular schwannoma is impacted by demographic factors such as age, sex, and geographic proximity to the medical center. Clinical features including hearing level and tumor size also impacted treatment decision making.

***Professional Practice Gap & Educational Need:** Various options are available for vestibular schwannoma treatment. It is unclear what demographic and clinical factors contribute to patient decision making among these options.

***Learning Objective:** To recognize the influence of sex, age, and proximity to the medical center in treatment pathway decision making; to recognize the impact of hearing level and tumor size on treatment pathway decisions.

***Desired Result:** For physicians to recognize and consider demographic factors, along with clinical features, in shared decision making with vestibular schwannoma patients.

***Level of Evidence -** IV

***Indicate IRB or IACUC :** IRB# 1538127

Presbycusis and Hearing Preservation in Observed Acoustic Neuromas

Julia R. Brennan, MD; Shreyas G. Krishnapurna, BS; Nathan R. Lindquist, MD
Nicole Kloosterman, BS; Nathan D. Cass, MD
David S. Haynes, MD; Kareem O. Tawfik, MD

Objective: We reviewed a cohort of patients with untreated sporadic AN and examined the relationship between high-frequency hearing loss (HFHL) in the non-AN ear and long-term hearing outcomes in the AN-affected ear. We hypothesized that progression of HFHL is associated with accelerated hearing decline in sporadic AN.

Study Design: Retrospective cohort study.

Setting: Tertiary center.

Patients: 109 patients with sporadic AN diagnosed from 1999-2015 with ≥5 years of observation (average 7.3yr). 64 had AAO-HNS Class A/B hearing at presentation and were included in analysis.

Interventions: Audiometry, observation of AN.

Main Outcome Measures: Four-frequency pure tone average (PTA) and word recognition scores (WRS) in the AN-affected ear. Decline in high-frequency PTA (HFPTA [average of thresholds at 4000, 6000, and 8000 Hz]) was defined as ≥10 dB over the study period. Decline in WRS was defined as ≥10%.

Results: Compared to those without, patients with progressive HFHL in the non-AN ear demonstrated a higher rate (84% vs 50%, p=0.0039) of decline in speech understanding in the AN ear. However, the same group showed no difference (64% vs 46%, p=0.1679) in decline in PTA of the AN ear.

Conclusions: Patients with observed AN who experience progressive HFHL in the non-AN ear are more likely to experience significant declines in speech understanding (but not PTA) in the AN-affected ear over time. This observation suggests that a personal or family history of presbycusis could increase the risk of loss of serviceable hearing in ears affected by sporadic AN.

***Professional Practice Gap & Educational Need:** The trajectory of neurosensory decline in acoustic neuromas remains unpredictable. This study provides increased data for clinical guidance and decision making in patients presenting with acoustic neuromas.

***Learning Objective:** For patients diagnosed with acoustic neuromas

1. Provide insight into the relationship between sensorineural hearing loss and hearing outcomes in the tumor ear for patients undergoing observation, and
2. Understand implications for counselling and clinical guidance on expected audiometric decline.

***Desired Result:** This study provides increased data surrounding underlying cochlear health as it relates to long-term outcomes in patients with observed acoustic neuromas.

***Level of Evidence -** Level IV

***Indicate IRB or IACUC :** IRB #110839

Frailty Predicts Increased Length of Hospital Stay after Middle Cranial Fossa Approach for Encephalocele or Cerebrospinal Fluid Leak

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Andrew P. Gard, MD; Geoffrey Casazza, MD

Objective: The modified 5-item frailty index (mFI-5) is a concise, comorbidity-based risk stratification tool that has been shown to predict adverse outcomes after surgery. The goal of this study was to understand the frailty of patients undergoing surgery for temporal encephalocele or cerebrospinal fluid (CSF) leak and the utility of mFI-5 for predicting increased post-operative outcomes.

Study Design: Retrospective cohort.

Setting: Single tertiary care academic medical center.

Patients: Adults with temporal encephalocele or CSF leak who underwent middle cranial fossa (MCF) approach craniotomies with or without mastoidectomy from January 2018 through August 2021 were included. Patients who underwent additional surgeries or extended surgical approaches were excluded.

Interventions: The mFI-5 was calculated for all patients. Demographic and clinical data were obtained from the medical record.

Main Outcome Measures: Length of hospital and ICU stay (LOS).

Results: 35 patients underwent 39 MCF approach craniotomies for temporal encephalocele or CSF leak, including 3 revision cases and 1 patient with sequential bilateral operations. Mean age was 53.8 ± 11.4 years, and 65.7% were female. There were 13 patients with a mFI-5 of 0 (34.3%), 9 with mFI-5 of 1 (25.7%), 11 with mFI-5 of 2 (31.4%), and 3 with mFI-5 of 3 (8.6%). In the regression analysis, mFI-5 was significantly associated with increased hospital LOS (p=0.002) but not increased ICU LOS (p=0.06). Multiple regression analysis of factors in the mFI-5 index showed that hypertension requiring medication (p=0.04) and history of pneumonia or COPD (p=0.02) were independently associated with increased hospital LOS. No comorbidity was associated with increased ICU LOS.

Conclusions: Increasing frailty is associated with increased length of hospital stay among patients undergoing MCF approach for treatment of temporal encephalocele or CSF leak.

Professional Practice Gap & Educational Need: Surgical treatment with craniotomy has a risk of complications that can be debilitating to patients and costly to the health care system. Understanding who is at greater risk for post-operative complications can provide an impetus for medical optimization and improve patient counseling.

Learning Objective: To understand the utility of mFI-5 in risk stratification of patients for increased length of stay and post-operative complications after MCF approach craniotomy for temporal encephalocele or CSF leak.

Desired Result: Better understanding of the role of frailty in patients undergoing surgery for temporal encephalocele or CSF leak.

Level of Evidence: Level IV

IRB: Approved, UNMC IRB #412-19-EX.

An Elusive Diagnosis: Delays in Treatment and Opportunities for Improvement in Temporal Encephalocele and CSF leak

Steven D. Curry, MD, MPH; Colin McCorkle, MD
Jonathan L. Hatch, MD; Geoffrey Casazza, MD

Objective: Symptoms of temporal encephalocele or cerebrospinal fluid (CSF) leak causing middle ear effusion or otorrhea can be non-specific and mistaken for other common diagnoses, leading to delays in diagnosis, failed treatments, and a risk of meningitis. This study sought to investigate the association between symptomatology and time to definitive surgical management.

Study Design: Retrospective cohort.

Setting: Single tertiary care academic medical center.

Patients: Adults treated for temporal encephalocele or CSF leak via a middle cranial fossa (MCF) approach. Revision cases were excluded.

Interventions: Chart review was performed to identify pertinent symptoms at presentation. Four patients who had symptoms for "several/many years" were coded as having symptoms for 3 years for quantitative analysis. Multivariable analysis was performed to identify the association between symptoms and time to surgical management.

Main Outcome Measures: Otologic and related symptoms present prior to MCF. Length of time between symptom onset and surgical treatment.

Results: 35 patients had symptoms present 23.6 ± 25.7 months (range: 1 month to 12 years) prior to surgery. The most common symptoms were subjective hearing loss in the affected ear (77%) and aural fullness (74.3%). Otorrhea was present in 57.1%, and 42.9% had a history of myringotomy with or without tube insertion. Meningitis occurred in 5 patients (14.3%). Only otalgia was statistically significantly associated with decreased time between symptoms onset and surgery ($p=0.03$).

Conclusions: Encephalocele and CSF leak were most commonly associated with aural fullness and hearing loss. Medical treatment for presumed Eustachian tube dysfunction or myringotomy and subsequent CSF otorrhea were commonly observed. Patients had symptoms for an average of about 2 years prior to surgical management.

Professional Practice Gap & Educational Need: Temporal encephalocele or middle ear effusion due to CSF leak can present with non-specific otologic symptoms including aural fullness and conductive hearing loss. This can result in a lengthy period of time before the correct diagnosis is made, and having CSF otorrhea puts the patient at risk of ascending infection and meningitis.

Learning Objective: To understand the presentation of temporal encephalocele of CSF leak and the need for consideration in the differential diagnosis of common otologic symptoms.

Desired Result: Increased recognition of encephalocele and CSF leak in the differential diagnosis of common symptoms including aural fullness, conductive hearing loss, and middle ear effusion, as well as appreciation of the need for improvement in diagnosis of these entities to avoid unnecessary treatment delays and added risks to patients.

Level of Evidence: Level IV

Indicate IRB or IACUC: Approved, UNMC IRB #412-19-EX.

Vitamin D Supplementation for Benign Paroxysmal Positional Vertigo: A Systematic Review

Xinyuan Hong, MD; David Moher, PhD; Darren Tse, MD; Daniel A. Lelli, MD
David Schramm, MD, SM; Lisa Caulley, MD, MPH
Georgios Kontorinis, MD, MSc

Objective: Benign Paroxysmal Positional Vertigo (BPPV) is commonly attributed to displaced otoconia. These have been shown to have biomineralization close to that of bone, and Vitamin D deficiency has been associated with BPPV. We aim to systematically review the available literature on Vitamin D supplementation and BPPV intensity and recurrence in adults.

Data sources: PubMed, MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials (CENTRAL), Current Controlled Trials, and ClinicalTrials.gov

Study selection: We systematically reviewed the available literature from 1947 to April 2020. The study protocol was registered in the PROSPERO database (Trial Registration: CRD42020183195).

Data extraction: A total of 179 abstracts were identified and screened by two independent reviewers. Based on inclusion and exclusion criteria, six studies were selected and subjected to a quality assessment.

Data synthesis: In one randomized clinical trial (RCT), Vitamin D supplementation was found to reduce annual recurrence rate of vertigo in patient with BPPV and subnormal serum Vitamin D levels compared to placebo (odds ratio [OR] 0.69, 95% Confidence Interval [CI]: 0.54, 0.90). Non-randomized clinical trials demonstrated the possibility of a null effect in the random effects model (OR 0.08, CI [0.00, 1.56]). The RCT considered as low risk of bias. All of the non-randomized studies were assessed as serious risk of bias.

Conclusions: The intervention studies identified consistently demonstrated a decrease in BPPV recurrence with supplementation of Vitamin D in patients with subnormal Vitamin D levels. Although there is a paucity of high-quality studies, the present literature does highlight a role for optimization of Vitamin D levels in patients with BPPV.

***Professional Practice Gap & Educational Need:** It has been shown that serum Vitamin D levels are significantly lower in individuals with BPPV, and that Vitamin D deficiency is an independent risk factor for BPPV. Indeed, some small studies have shown that Vitamin D supplementation are associated with a reduction in the recurrence of BPPV. However, many fail achieve statistical significance to demonstrate causation, and very few clinicians routinely measure and supplement Vitamin D despite its potential benefits.

***Learning Objective:** 1) To appreciate the relationship between Vitamin D deficiency and BPPV; 2) To understand Vitamin D supplementation in reducing the recurrence of BPPV.

***Desired Result:** In reviewing the evidence demonstrating significant effect of Vitamin D therapy to reduce frequency of BPPV episodes and improve quality of life, clinicians may consider investigating for and treating Vitamin D deficiency in patients with BPPV.

***Level of Evidence –** Level II

***Indicate IRB or IACUC:** Exempt

Incidence and Management of Traumatic Facial Paralysis, an Administrative Database Study

Nneoma S. Wamkpah, MD MSCI; Dorina Kallogjeri, MD MPH
Alison Snyder-Warwick, MD; Nedim Durakovic, MD

Objective: Report the incidence and treatment of facial nerve palsy after skull base fracture.

Study Design: Single-group cohort study

Setting: IBM MarketScan Commercial and Medicare Supplemental Databases (2006-2019)

Patients: Human subjects with skull base fracture, per International Classification of Diseases, 9th and 10th Revisions diagnosis codes.

Main Outcome Measures: Incidence and median time to facial nerve palsy diagnosis and treatment (corticosteroids, antivirals, botulinum toxin, facial nerve decompression, facial reanimation) within 30 days of skull base fracture; demographics; medical comorbidities; associated injuries (loss of consciousness, hearing loss, vertigo, tympanic membrane rupture, cerebrospinal fluid leak).

Results: The incidence of facial nerve palsy within 30 days of skull base trauma was 1.0% (738/72,273 patients). Facial nerve palsy was associated with significantly higher rates (proportion difference, 95% confidence interval) of hearing loss (26%, 22-29%), tympanic membrane rupture (5.4%, 0.8-3.6%), cerebrospinal fluid leak (6.4%, 4.5-8.3%), loss of consciousness (24.3%, 20.7-27.9%), and medical comorbidity (14%, 10.4-17.6%). The median time to diagnosis of facial nerve palsy was 6 days; only 22.9% (169 patients) were diagnosed within 1 day of skull base fracture. Patients with loss of consciousness or medical comorbidity had longer median time to facial nerve palsy diagnosis. Corticosteroids were the most common treatment, but only occurred in less than 1/3 of patients. Only 8 patients underwent facial nerve decompression within the first 21 days after injury.

Conclusions: Facial nerve palsy after skull base fracture is associated with higher comorbidity and the diagnosis is often delayed. Few patients were treated for traumatic facial nerve palsy and there are inconsistencies in the types and timing of treatments.

***Professional Practice Gap & Educational Need:** The two clinical factors governing management of facial nerve palsy in the setting of skull base trauma are: 1) timing and 2) severity of facial nerve palsy. Often the presence and severity of facial nerve palsy cannot be assessed due to other clinical factors, such as critically illness or altered consciousness. Evidence-based guidelines for management of facial nerve palsy after trauma are lacking.

***Learning Objective:**
1. To measure the 30-day incidence and median time to diagnosis of facial nerve palsy among patients with a diagnosis of skull base fracture.
2. To describe medical and surgical management of patients with traumatic facial nerve palsy.

***Desired Result:** Attendees will have a better understanding of the inconsistences in current practices regarding traumatic facial nerve palsy. This work will support efforts to create guidelines based on the best available evidence for management of traumatic facial nerve palsy.

***Level of Evidence –.** Level V, Case series, studies with no controls

***Indicate IRB or IACUC :** Exempt

Impact of Obesity on Postoperative Complications After Lateral Skull Base Tumor Resection: A Systematic Review

Kelly Bridgham, BS; Meryam Shikara, MD
Emilie Ludeman MSLIS, David J. Eisenman, MD

Objective: To determine the relationship between obesity and postoperative outcomes following lateral skull base tumor resection

Data Sources: PubMed, Embase, CINAHL, and Cochrane CENTRAL databases were searched using a comprehensive keyword strategy in accordance with PRISMA guidelines.

Study Selection: Included studies assessed the relationship between obesity and outcomes following lateral skull base tumor removal, including postoperative complications such as CSF leak, readmission and reoperation rates, and/or length of stay. Studies with ≤5 patients, duplicate patient populations, or insufficient data were excluded.

Data Extraction: Two independent investigators reviewed each study for inclusion. A third reviewer served as a tie-breaker for any conflicts. Extracted data includes patient demographics, tumor pathology, surgical approach, and postoperative outcomes including incidence of CSF leak and other postoperative complications, length of stay, and readmission and reoperation rates.

Data Synthesis: Studies were categorized based on outcome measurement (CSF leak, readmission rates, reoperation rates, and/or length of stay). Descriptive statistics were used for data analysis.

Conclusions: 15 studies met final inclusion criteria. Nine studies evaluated the relationship between obesity and CSF leaks. Four studies found a significant increase in post-operative CSF leak in obese patients compared to non-obese controls. The remaining studies trended towards an increased incidence of CSF leak in the obese population however did not reach statistical significance. One out of seven studies found that obesity increased post-operative length of stay, and one out of five studies found that obesity increased reoperation rates following tumor resection. Based on the results, obesity does not appear to increase length of stay, readmission, or reoperation rates after lateral skull base tumor resection. The relationship between obesity and post-operative CSF leak however warrants further analysis.

Define Professional Practice Gap & Educational Need: 1. Inconsistencies in the literature regarding the relationship between obesity and postoperative CSF leak after lateral skull base tumor removal. 2. Lack of knowledge with regards to how obesity affects postoperative outcomes, including length of stay, readmission, and reoperation.

Learning Objective: 1. To evaluate and synthesize the existing literature on the obese population and lateral skull base tumors 2. Describe the difference in outcomes after lateral skull base tumor resection based on obesity status

Desired Result: 1. Attendees will be able to discuss the role of obesity status in postoperative outcomes after lateral skull base tumor removal.

Level of Evidence: Level III

Indicate IRB or IACUC: Exempt

Proposal of a Scoring System for Discriminating Skull Base Osteomyelitis from Malignancies

Kuniyuki Takahashi, MD, PhD; Yuka Morita, MD, PhD; Chihiro Yagi, MD
Tatsuya Yamagishi, MD, PhD; Shinsuke Ohshima, MD, PhD
Shuji Izumi, MD, PhD; Arata Horii, MD, PhD

Objective: Skull base osteomyelitis (SBO) sometimes causes bone destructions and cranial nerve palsies, which is often misdiagnosed as malignancies such as nasopharyngeal cancer (NPC) and external auditory canal cancer (EACC) by CT/MRI. Since treatments for SBO and malignancies are different, histological evaluations are necessary for diagnosing both conditions. However, pre-treatment assessments on the differential diagnosis for SBO would be important for earlier starting the appropriate antibiotic therapies. Moreover, inappropriate specimen or false-negative biopsy in EACC-suspected patients that sometimes occurs in clinical settings would make confusion when diagnosing SBO. In this study, we proposed and validated a scoring system for discriminating SBO from NPC/EACC.

Study Design: Retrospective

Setting: University Hospital

Patients: Fourteen patients with SBO, twenty-five with NPC, and nineteen with EACC.

Main Outcome Measures: A scoring system (full score, 8 points) consisted of various characteristics which may be useful for diagnosing SBO was proposed. Eight scoring items included age (≥65), immunocompromised status, severe pain, otorrhea, cranial nerve palsy, C-reactive protein levels (≥1 mg/dL), petrous bone destruction, and no deformity of nasopharyngeal mucosal surface on CT.

Results: The average score for SBO (6.57) was significantly higher than that for NPC/EACC (2.55) ($p<0.01$). The area under the receiver operating characteristic curve was 0.99, showing very high accuracy. The cut-off value set at 5 points had the best combination of sensitivity (100%) and specificity (90.9%) to discriminate SBO from NPC/EACC.

Conclusions: The scoring system for discriminating SBO from NPC/EACC would be useful for an early starting the treatment for SBO.

***Professional Practice Gap & Educational Need:** Since it is difficult to distinguish SBO from malignancies, a scoring system that can be easily diagnosed is required.

***Learning Objective:** The readers can easily diagnose SBO from the scoring system.

***Desired Result:** The scoring system for screening SBO had high sensitivity and specificity.

***Level of Evidence -** Level V

***Indicate IRB or IACUC :** This study has been submitted to the Institutional Review Board of Niigata University Medical and Dental Hospital.

Use of a Novel Clinical Decision-Making Tool in Vestibular Schwannoma Treatment

Olivia A La Monte, BS; Omid Moshtaghi, MD; Edison Tang, BS; Peter Dixon, MD
Shamim Nemati, PhD; Hamid R. Djalilian, MD; Rick A. Friedman, MD, PhD

Objective: To determine the utility of a personalized tool in the decision-making process for vestibular schwannoma (VS) patients.

Study Design: Proof-of-concept prospective study.

Setting: Academic skull base surgery program.

Patients: Patients with VS.

Interventions: A comprehensive clinical decision support (CDS) tool was constructed from retrospective patient-reported data obtained from patients within the Acoustic Neuroma Association from January to March 2017. Demographic, tumor characteristic, and treatment modality data, including associated side effects, were previously collected for 775 patients. These data were integrated in an interactive and personalized mobile tool.

Main Outcome Measures: A comparison of pre- and post-tool questionnaires assessing the process of deciding on treatment modality for VS using a Decisional Conflict Scale (DCS) and Satisfaction with Decision (SWD) scale was implemented.

Results: A pilot study of 3 patients with mean age 59.00 (±19.08) years and mean tumor size 7.00 mm have been analyzed. After using the tool, average confidence in decision improved from 81.33% (±8.08) to 84.67% (±5.03) confidence. Similarly, DCS score decreased from an average of 19.79 to 16.67 points (indicating decreased conflict). Post-tool decision satisfaction, indicated by SWD scale, demonstrated an average increase from 30 to 31. Notably, 100% of patients reported the tool added important information to previous consults and could facilitate better communication with their medical team. Additional data will be available for presentation at the meeting.

Conclusions: In this pilot study of 3 patients, all demonstrated an increase in confidence and decrease in conflict with decision-making following implementation of this personalized tool. Further data collection is ongoing and will be available at time of presentation.

Professional Practice Gap & Educational Need: Patient education and quality of life consideration is variable across VS patients and practitioners alike. Several studies have highlighted the role for improved communication through shared decision-making in this population. This study tests the utility of an informative, personalized, patient-facing tool as an adjunct in patient education regarding disadvantages and advantages of each treatment modality.

Learning Objective: To assess how sharing additional information regarding VS treatment through an interactive tool may improve patient autonomy and ability to participate in shared decision-making.

Desired Result: To provide evidence that individualized, interactive tools can improve patient education and communication. To determine what interventions strengthen the patient's role in shared decision-making. Further data is being actively collected to better understand the role of this interactive information when deciding on VS treatment.

Level of Evidence – Level II

IRB: UCSD IRB Project #180978XL; Approved on 9/14/2021

Cochlear Implantation in Patients with Known Cognitive Impairment: What are the Benefits?

Eric E. Babajanian, MD; Erin C. Carmichael, MS
Neil S. Patel, MD; Richard K. Gurgel, MD, MSCI

Objective: To evaluate the benefit of cochlear implantation (CI) in adults with preoperatively diagnosed cognitive impairment.

Study Design: Retrospective cohort study.

Setting: Tertiary-care academic center.

Patients: Adults undergoing CI with preexisting cognitive impairment.

Interventions: Cochlear implantation.

Main Outcome Measures: 1) Hearing improvement following CI; 2) Morbidity and mortality associated with surgery.

Results: Eight patients met inclusion criteria with mean age 77.8 years (SD 9.6 years) at time of implantation. Average preoperative MoCA cognitive score of 22.1 (SD 4.1, ≤25 demonstrates cognitive impairment). Average follow up was 26.8 months (SD 31.5 months). Two patients passed away at an average 58.0 months (SD 31.1 months) after surgery. Median preoperative pure tone average (PTA) was 88.9 dB HL (IQR 32.2 dB HL) compared to 33.8 dB HL (IQR 4.1 dB HL) postoperatively (p=0.012). Median preoperative speech testing score (AzBio/HINT) was 21% (IQR 24%) compared to 44% (IQR 21%) postoperatively (p=0.018). There were no observed surgical complications during the follow up period.

Conclusions: This study demonstrates that patients with cognitive impairment prior to CI can experience improved hearing, no increased risk of complications, and good longevity following CI. Further prospective studies are needed to further define the utility of CI in patients with impaired cognition.

***Professional Practice Gap & Educational Need:** We still do not know whether treating hearing loss will mitigate the risk of dementia, nor whether CI is beneficial to candidates with impaired cognition.

***Learning Objective:** To describe the benefits of CI in patients with preexisting cognitive impairment.

***Desired Result:** To provide guidance on the utility and benefits of CI in patients with known cognitive impairment.

***Level of Evidence -** V

***Indicate IRB or IACUC:** University of Utah IRB#00105049

Incidence of Surgical Complications and Postoperative CSF Leaks in Morbidly Obese Patients Undergoing Middle Cranial Fossa Approach for Spontaneous CSF Leak Repair

Raffaello M. Cutri; Seiji B. Shibata, MD, PhD; Huan Zhang, MD
Bruce J. Gantz, MD; Marlan R. Hansen, MD

Objective: Over the past few decades, spontaneous CSF (sCSF) leaks have increased in incidence, coinciding with a rise in obesity in the general population. We sought to determine the rate of surgical complications and postoperative CSF leaks in morbidly obese patients (BMI 40+) versus those with a BMI of 18.5-39.9 following MCF craniotomy for CSF leak repair.

Study Design: Retrospective chart review study.

Setting: Tertiary academic center.

Patients: All adults, n = 57 (21 patients with BMI 40+ vs. 36 patients with BMI 18.5-39.9), undergoing sCSF leak repair via a middle cranial fossa approach were evaluated.

Main Outcome Measures: Clinical records were reviewed for age, gender, BMI, comorbidities, complications at <30 days and between 30-60 days, and material used for CSF leak repair.

Results: 64 operative MCF repairs were performed for sCSF leaks on 57 patients (7 had bilateral CSF leaks). The average age was 60 years, and 45% were female. There were no postoperative complications in 78% (50 of 64) of cases. Twenty-two percent of adults with (BMI 18.5-39.9) and 21.7% of adults with (BMI 40+) had surgical complications. The percentage of postoperative CSF leaks in adults with (BMI 18.5-39.9) was 9.7% and 15% in adults with (BMI 40+). Differences in the rate of surgical complications and postoperative CSF leaks between both groups were not statistically significant (Chi-Square p-values = 0.6, 0.69, respectively).

Conclusions: Surgical complication rates and postoperative CSF leaks between undergoing MCF approach for sCSF leak repair were comparable.

Define Professional Practice Gap & Educational Need: There exists a strong correlation between obesity and spontaneous CSF leaks, as well as an increased incidence of CSF leaks in obese patients undergoing intracranial surgery. However, data evaluating the complication rate of MCF sCSF leak repair in the morbidly obese population (BMI 40+) is limited.

Learning Objective: To better understand the role of obesity in spontaneous CSF leaks, as well as its influence on rates of postoperative CSF leaks and surgical complications when undergoing intracranial surgery.

Desired Result: Given that obesity is suspected to play a role in an increased incidence of CSF leaks, we hope to clarify any CSF-related complications and adverse events associated with MCF procedures on morbidly obese patients.

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

Indicate IRB or IACUC : Exempt.

Management of the High Riding Jugular Bulb in Vestibular Schwannoma Surgery using 3-Dimensional Endoscopy and 3-Dimensional Computational Modeling

Ryan A. Bartholomew, MD; Alejandro Garcia, MD; Nir Ben-Shlomo, MD; Haoyin Zhou, PhD
Jeffrey P Guenette MD; Jagadeesan Jayender, PhD; C. Eduardo Corrales, MD

Objective: We present a series of patients with a high riding jugular bulb (HRJB) who underwent vestibular schwannoma (VS) resection via retrosigmoid approach (RSA) assisted by 3-Dimensional (3D) computational modeling and 3D endoscopy and compare them to matched controls without a HRJB.

Study Design: Retrospective case-control series.

Setting: Academic center.

Patients: Five patients with VS and HRJB resected via RSA and matched controls without HRJB matched for tumor geometry and laterality.

Interventions: Tumor resection via RSA assisted by 3D endoscopy and 3D computational modeling using 3D Slicer.

Main Outcome Measures: Radiographic percentage of tumor resected, jugular bulb injury, cranial nerve deficits, craniotomy size.

Results: 3D modeling accurately rendered the HRJB in relation to the internal auditory canal (IAC) and coupled with 3D endoscopy provided depth perception for safe and complete resection at the fundus. Mean tumor resection was 99.1 ± 2.1%. Post-operative outcomes included facial paresis (2/5), vocal cord paresis (1/5), and no cases of iatrogenic breach or mobilization of the jugular bulb (0/5). Controls had similar completeness of tumor resection and craniotomy size.

Conclusions: The HRJB impedes visualization of the IAC fundus during RSA. Strategies include a large craniotomy for microscopic visual reach, a wide IAC drill out, or deliberate breach of the jugular bulb with downward transposition of the HRJB. However, these may be limited by inadequate surgical exposure, brisk bleeding, or increased risk of thrombus formation. We demonstrate thorough and safe resection of intracanalicular VS in the presence of a HRJB via RSA facilitated by 3D modeling and 3D endoscopy.

***Professional Practice Gap & Educational Need:** Vestibular schwannoma resection at the IAC via RSA is impeded by a high riding jugular bulb and current strategies in the literature are limited.

***Learning Objective:** Thorough and safe resection of intracanalicular vestibular schwannoma in the presence of a high riding jugular bulb via a retrosigmoid-suboccipital approach is facilitated by 3D endoscopy and 3D anatomic surgical modeling.

***Desired Result:** Thorough and safe vestibular schwannoma outcomes for all patients regardless of jugular bulb status.

***Level of Evidence -** IV

***Indicate IRB or IACUC:** Mass General Brigham IRB exempt: #2021P002699

ENoG Characteristics Demonstrate Subtle Neuronal Asynchrony in Patients with Vestibular Schwannoma

Mariel O. Watkins, MD; Renee M. Banakis, MD, AuD; Susan E. Ellsperman, MD
Steven A. Telian, MD; Paul R. Kileny, PhD

Objective: To evaluate preoperative facial electroneuronography (ENoG) for changes suggestive of neural asynchrony in patients with vestibular schwannoma (VS)

Study Design: Retrospective review

Setting: Academic tertiary referral center

Patients: 45 adults with a diagnosis of presumed VS underwent ENoG testing between January 2017 and 2020. Patients with Neurofibromatosis type 2 or non-VS causes of facial weakness were excluded.

Interventions: ENoG testing

Main Outcome Measures: ENoG response metrics (latency, duration, amplitude, half-peak width, area), post-operative facial function

Results: ENoG responses from the tumor versus non-tumor side demonstrated a significant increase in duration (2.42 vs. 2.22 ms; p 0.014), latency (5.72 vs. 5.58 ms; p 0.037), and half-peak width (1.09 vs. 0.98 ms; p 0.033). There was no significant difference in amplitude (1.34 vs 1.40 mV; p 0.165) or area (1.67 vs 1.41; p 0.0581). There was no significant relationship between tumor dimension and ENoG metrics. Correlation with intraoperative tumor findings and postoperative facial function will be reviewed.

Conclusions: There is subtle but significant evidence of neuronal asynchrony in preoperative ENoG for patients with VS. Correlation with intraoperative findings and postoperative facial function will be discussed.

***Professional Practice Gap & Educational Need:** The literature has yet to examine how changes in preoperative ENoG metrics may reveal subtle neuronal asynchrony even without significant differences between amplitude of the affected and non-affected sides.

***Learning Objectives:**
1. Identify ENoG characteristics that demonstrate subtle neuronal asynchrony.
2. Determine clinical utility of ENoG testing in characterizing neuronal asynchrony in patients with VS.

***Desired Result:** Attendees will recognize characteristic ENoG changes that indicate preoperative neuronal asynchrony of the facial nerve in patients with VS.

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

***Indicate IRB or IACUC:** Exempt 4/20/202, University of Michigan Protocol #HUM00195967

Surgical Outcomes for Resection of Medium to Large Vestibular Schwannomas: Retrosigmoid versus Translabyrinthine Approaches

Alexander D. Claussen, MD; Peter Dixon, MD, MSc; Omid Moshtaghi, MS, MD
Pasha Mehranpour, BS; Jimmy Yu, BS; Marc Schwartz, MD
Rick A. Friedman, MD, PhD

Objective: To compare surgical outcomes between retrosigmoid (RS) or translabyrinthine (TL) approaches to resection of vestibular schwannomas (VS) greater than 2cm in those with serviceable hearing.

Study Design: Retrospective cohort study

Setting: Tertiary academic hospital

Patients: Patients with serviceable hearing (AAO Class A or B) undergoing RS (n=41) or TL (n=60) approach to resection of VS greater than 2cm.

Interventions: RS or TL approaches.

Main Outcome Measures: House-Brackmann (HB) score at discharge, cerebrospinal fluid (CSF) leak, extent of tumor resection, length of stay and adverse neurologic outcomes (hemorrhage, stroke, thrombosis, seizure, infection).

Results: At pre-operative baseline, the RS group had significantly ($p<0.05$) smaller mean tumor size (22mm) and higher rates of AAO Class A hearing (85%) compared to the TL group (28mm and 65%). There were no significant ($p>0.05$) differences in HB score at discharge (HB I/VI: RS: 85%; TL: 73%), CSF leak rate (RS: 4.9%; TL: 10%), length of stay (RS: 3.27 days; TL: 3.26 days) or adverse neurologic outcome (RS: 2.4%; TL: 1.7). between the approaches. Rates of gross total resection were significantly ($p=0.045$) higher in the RS group (85%) vs TL group (73%).

Conclusions: The RS and TL approaches to acoustic neuroma resection achieve similar surgical outcomes across several metrics. The smaller mean tumor size in the RS group may account for higher rates of HB I/VI facial function and gross total resection compared to the TL group. The RS approach to VS excision may provide a comparably safe and effective alternative to the TL approach for patients with serviceable hearing valuing hearing preservation with VS treatment.

***Professional Practice Gap & Educational Need:** This study compares surgical outcomes and overall safety of RS versus TL resection of medium to large tumors and provides evidence supporting the safe use of the RS approach for tumor resection comparable to the TL approach in those with serviceable hearing. This point is relevant for those patients with medium to large tumors wishing to pursue a microsurgical treatment of VS with the potential for preservation of residual acoustic hearing, as is afforded by the RS approach.

***Learning Objective:** To evaluate the differences in surgical outcomes between the RS and TL approaches to excision of medium to large VS.

***Desired Result:** Acquire adequate knowledge of differences and similarities in broad surgical outcomes between the RS and TL approaches to excision of medium to large VS in order to enhance patient counseling regarding treatment of VS.

***Level of Evidence –** Level IV

***Indicate IRB or IACUC :** IRB #180978, University of California San Diego

HOUSE/HITSELBERGER LIFETIME ACHIEVEMENT AWARD

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.

Derald E. Brackmann, MD
House Ear Clinic - Los Angeles, CA

Prof. Ugo Fisch, MD
Fisch International Microsurgery Foundation
Zurich, Switzerland

Emilio García-Ibáñez, MD
Instituto De Otologia Garcia-Ibanez - Barcelona, Spain

Michael E. Glasscock, III, MD
The Otology Group, Nashville, TN
The Glasscock Hearing Center - Houston, TX

Malcolm D. Graham, MD
Emory University - Atlanta, GA

David A. Moffat, PhD, FRCS
Addenbrooks Hospital - Cambridge, UK

Joseph B. Nadol, Jr., MD
Massachusetts Eye & Ear Infirmary - Boston, MA

Prof. Mario Sanna, MD
Gruppo Otologico, Piacenza-Rome, Italy

Prof. Jean-Marc Sterkers, MD
Paris, France

RECIPIENTS OF THE NOEL L. COHEN AWARD FOR SIGNIFICANT CONTRIBUTIONS TO OTOLOGY AND NEUROTOLOGY

Through a generous gift from our late colleague, ANS has established the Noel L. Cohen, M.D. Award for Significant Contributions to Otology and Neurotology. The establishment of the award is a fitting tribute to Dr. Cohen — a gifted physician, surgeon, academician, educator, administrator and a leader. His contributions brought distinction to Otology & Neurotology, New York University, and our society. The first recipient of this esteemed award, Dr. Thomas Balkany, was announced at the 55th Annual virtual Fall meeting on Sept 12, 2020.

Thomas J. Balkany, MD – 2020 – Miami, FL
University of Miami Miller School of Medicine

Robert K. Jackler, MD – 2021 – Palo Alto, CA
Stanford University

NEUROTOLOGY FELLOWSHIP AWARD

Colin L.W. Driscoll, MD - 1998, Palm Beach, FL

Robert M. Owens, MD - 1999, Palm Desert, CA

Katrinia R. Stidham, MD - 2000, Orlando, FL

Zoran Becvarovski, MBBS - 2001, Palm Desert, CA

John S. Oghalai, MD - 2002, Boca Raton, FL

Anthony O. Owa, MD - 2002, Boca Raton, FL

Richard J. Kennedy, MD - 2003, Nashville, TN

Ana H. Kim, MD - 2006, Chicago, IL

Marc D. Eisen, MD - 2007, San Diego, CA

Benjamin T. Crane, MD, PhD - 2008, Orlando, FL

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

Michael S. Harris, MD – 2017, Indianapolis, IN

Kathryn Y. Noonan, MD – 2018, Los Angeles, CA

Enrique Perez, MD – 2018, New York, NY

Ksenia A. Aaron, MD – 2019, Stanford, CA

James G. Naples, MD – 2019, Boston, MA

Matthew G. Crowson, MD, MPA – 2020,

Kenny F. Lin, MD – 2020, Houston, TX

Matthew A. Shew, MD – 2021, St. Louis, MO

Alexander L. Luryi, MD – 2021, Farmington Hills, MI

ANS TRAINEE AWARD

Thomas R. Pasic, MD - 1990, Palm Beach, CA
University of Washington, Seattle, WA

Charles A. Syms III, MD - 1991, Hawaii, HI
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 - l995, Palm Desert, CA
University of Manitoba, Winnipeg, Manitoba Canada

Greg A. Krempl, MD - l997, 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

James Naples, MD - 2015, Boston, MA
University of Connecticut, Farmington, CT

Jacob B. Hunter, MD - 2016, Chicago, IL
Vanderbilt University, Nashville, TN

Yarah M. Haidar, MD – 2017, San Diego, CA
University of California at Irvine, Orange, CA

Ashley M. Nassiri, MD - 2018, National Harbor, MD
Vanderbilt University Medical Center, Nashville, TN

Matthew Shew, MD – 2019, Austin, TX
Washington University, St Louis, MO

Armine Kocharyan, MD - 2020, Cleveland, OH
Case Western Reserve University

John P. Marinelli, MD – 2020, Rochester, MN
Mayo Clinic

Susan E. Ellsperman, MD – 2021, Ann Arbor, MI
University of Michigan

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University of Iowa

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Michigan Ear Institute, Farmington Hills, MI

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University of Iowa Hospitals and Clinics, Iowa City, IA

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University of Minnesota, Minneapolis, MN

Thomas A. Salzer, MD - 1994, Palm Beach
Baylor College of Medicine, Houston, TX

Akira Ishiyama, MD - 1995, Palm Desert
UCLA School of Medicine, Los Angeles, CA

Anil K. Lalwani, MD - 1998, Palm Beach, CA
University of California, San Francisco, CA

Lloyd B. Minor, MD - 1999, Palm Desert, FL
Johns Hopkins University, Baltimore, MD

Vincent B. Ostrowski, MD - 2000, Orlando, FL
Northwestern University Medical School, Chicago, IL

D. Bradley Welling, MD, PhD - 2001, Palm Desert, CA
The Ohio State University, Columbus, OH

John P. Carey, MD - 2003, Nashville, TN
Johns Hopkins University, Baltimore, MD

John C. Li, MD - 2005, Boca Raton, FL
Loyola University Medical Center, Chicago, IL

Judith A. White, MD, PhD - 2006, Chicago, IL
The Cleveland Clinic, Cleveland, OH

Abraham Jacob, MD - 2007, San Diego, CA
The Ohio State University - Columbus, OH

Rahul Mehta, MD - 2014, Las Vegas, NV
Louisiana State University - New Orleans, LA

Benjamin T. Crane, MD, PhD - 2015, Boston, MA
University of Rochester Medical Center - Rochester, NY

Jeffrey D. Sharon, MD - 2016, Chicago, IL
Johns Hopkins University - Baltimore, MD

Anne K. Maxwell, MD – 2017, San Diego, CA
University of Colorado Hospital – Aurora, CO

Renee M. Banakis Hartl, MD – 2018, National Harbor, MD
University of Colorado Hospital – Aurora, CO

Tiffany P. Hwa, MD – 2020, Virtual
University of Pennsylvania- Philadelphia, PA

Steven D. Curry, MD, MPH – 2021 - Omaha, NE
University of Nebraska Medical Center

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Funding provided by Dr. Herbert Silverstein/ANS/AAO

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David R. Friedland, MD - 7/00-6/02
Johns Hopkins University

Rose Mary Stocks, MD - 7/02-6/204
University of Tennessee

Clifford R. Hume, MD, PhD - 7/03-6/05
University of Washington

Alan G. Micco, MD - 7/04-6/06
Northwestern University

Romaine Johnson, MD - 7/05-6/07
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Joseph P. Roche, MD - 7/08-6/10
University of North Carolina

Alan Cheng, MD - 07/10 - 06/12
Stanford University

Yuri Agrawal, MD - 07/10 - 06/12
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Nathan Schularick, MD - 07/12 - 06/14
The University of Iowa

Dylan Chan, MD, PhD - 07/14 - 06/16
University of California-SF

David H. Jung, MD, PhD - 07/16 - 06/18
Harvard University/ MEEI

David H. Jung, MD, PhD – 07/16 - 06/18
Massachusetts Eye and Ear Infirmary/Harvard Medical School

Elliot D. Kozin, MD - 7/18 - 6/20
Massachusetts Eye and Ear Infirmary/Harvard Medical School

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Up to three $25,000 annual awards; established in 2014/15
Funding provided by the American Neurotology Society

Christine T. Dinh, MD - 2015
"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

Dunia Abdul-Aziz, MD - 2019
"Targeting Epigenetic Modifying Enzymes for Hair Cell Regeneration"
Massachusetts Eye & Ear - Boston, MA

Douglas Bennion, MD and Megan (Foggia) Jensen, MD - 2020
"Durable Zwitterionic Thin Film Coatings for Cochlear Implant Biomaterials"
University of Iowa - Iowa City, IA

Courtney C.J. Voelker, MD, PhD – 2020
"In Vivo Neuronal Mapping of the Auditory Pathway in Pediatric Patients with Congenital Unilateral Sensorineural Hearing Loss and those with Normal Hearing"
University of Southern California - Los Angeles, CA

Tatiana Correa, MD, MPH - 2020
"Comparison of Surgical Routes for Localized Inner Ear Viral Vector-Mediated Gene Therapy in the Guinea Pig Using Helper-Dependent Adenovirus Type 5"
University of Iowa - Iowa City, IA

Ashley Kita, MD - 2021
"Prolonged Elution of Cytokines for Inner Ear Rehabilitation"
University of California (UCLA) - Los Angeles, CA

Bing Teh, MBBS, PhD - 2021
"The Impact of Vestibular Dose on Post Gamma Knife Balance Function"
Columbia and Cornell Universities - New York, NY

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. ANS may distribute up to three $25,000 grants each finding cycle. 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.

If you would like to submit a grant for consideration in 2023-24, the deadline for applications is March 1, 2023. Email a cover letter and application to Dr. Ronna Hertzano, RHertzano@som.umaryland.edu, Chair of the ANS Research Committee and ANS Admin, Kristen Bordignon.

NAMED LECTURES

WILLIAM F. HOUSE MEMORIAL LECTURE

William F. House, MD - 1988, Palm Beach, CA

Michael E. Glasscock III, MD - 1989, San Francisco, CA

Prof. Ugo Fisch, MD - 1990, Palm Beach, FL

Harold F. Schuknecht, MD - 1991, Hawaii, HI

Frederick H. Linthicum Jr., MD - 1992, Palm Desert, CA

William W. Montgomery, MD - 1993, Los Angeles, CA

Robert J. Keim, MD - 1994, Palm Beach, FL

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Antonio De La Cruz, MD - 1996, Orlando, FL

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Brian F. McCabe, MD - 1998, Palm Beach, FL

William Lo, MD - 1999, Palm Desert, CA

Jens Thomsen, MD - 2000, Orlando, FL

Mansfield Smith, MD - 2001, Palm Desert, CA

Bruce J. Gantz, MD - 2002, Boca Raton, FL

John W. House, MD - 2004, New York, NY

Professor Richard Ramsden - 2005, Boca Raton, FL

John K. Niparko, MD - 2006, Chicago, IL

Robert K. Jackler, MD - 2007, San Diego, CA

Richard A. Chole, MD, PhD - 2008, Orlando, FL

Lloyd B. Minor, MD - 2009, Phoenix, AZ

Jeffrey P. Harris, MD, PhD - 2010, Las Vegas, NV

Debara L. Tucci, MD - 2011, Chicago, IL

Paul R. Lambert, MD - 2012, San Diego, CA

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, Denmark

Professor Gerard M. O'Donoghue, FRCS 2017, Nottingham, UK

Robert F. Labadie, MD, PhD, MMHC – 2018, Nashville, TN

Nancy M. Young, MD – 2019, Chicago, IL

Paul Van de Heyning, MD, PhD – 2020 – Belgium

David S. Zee, MD – 2021 - Baltimore, MD

WILLIAM E. HITSELBERGER MEMORIAL LECTURE

William E. Hitselberger, MD - l999, Palm Desert, CA

Peter Dallos, PhD - 2000, Orlando, FL

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

David Fabry, PhD - 2002, Boca Raton, FL

Amin B. Kassam, MD - 2004, New York, NY

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

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

Takanori Fukushima, MD, DMSc - 2007, Wash DC

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

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

David A. Moffat, MD - 2010, Boston, MA

George T. Hashisaki, MD - 2011, San Francisco, CA

Karen I. Berliner, PhD - 2013, Orlando, FL

Dennis S. Poe, MD - 2014, Las Vegas, NV

Jeffrey W. Kysar, PhD - 2015, Boston, MA

Ali R. Zomorodi, MD - 2015, Dallas, TX

Marcus Atlas, MBBS, FRACS – 2017, Australia

Robert K. Jackler, MD - 2018, Stanford, CA

Bruce J. Gantz, MD – 2019, Iowa City, IA

Lisa L. Cunningham, PhD – 2021, Bethesda, MD

FRANKLIN M. RIZER MEMORIAL LECTURE

Stefan Heller, PhD - 2004, New York

Philip Theodosopoulos, MD -2006, Toronto, Canada

Charley C. Della Santina, MD, PhD - 2007, Wash. DC

Conrad Wall III, PhD - 2007, Wash. DC

Ebenezer Yamoah, PhD - 2008, Chicago, IL

Gerard O'Donoghue, MD - 2009, San Diego, CA

Saumil N. Merchant, MD - 2010, Boston, MA

Richard L. Goode, MD - 2012, Washington, DC

Richard A. Chole, MD, PhD - 2013, Vancouver, BC

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, New Orleans, LA

Craig A. Buchman, MD – 2018, St. Louis, MO

Michael J. McKenna, MD – 2019, Boston, MA

Jeffrey R. Holt, PhD – 2020, Boston, MA

Frank R. Lin, MD, PhD – 2021, Baltimore, MD

American Neurotology Society
Prolonged Elution of Cytokines for Inner Ear Rehabilitation

PI: Ashley Kita; Co-investigators: Michelle Hong BS, Kristen Echanique MD; Mentor: Larry Hoffman, PhD

The purpose of this work is to develop and test the ability of a prolonged local drug-eluting therapeutic to reduce the effects of ototoxic medications. This would be injected transtympanically in clinic for patients undergoing treatment with ototoxic medications.

Hypothesis I: Erythropoietin (EPO)-eluting microparticles can be incorporated into biopolymer microparticles and integrated into an injectable hydrogel, with elution profiles that extend at least 30 days.

Aim 1: Fabrication of microparticles. Using a specialized protocol for hydrophobic molecule microparticle creation developed with our bioengineering collaborators, microparticles were synthesized with 500 units of EPO (Figure 1). These were allowed to elute into phosphate-buffered saline for 30 days. These samples were then sent for mass spectrometry analysis which did not show a clear erythropoietin peak and thus could not quantify the amount of eluted EPO. We next performed ELISA analysis which also could not determine the amount of EPO in eluted samples. Due to concerns regarding possible degradation from elution at 37 degrees Celcius or from the microparticle fabrication process and lack of clear increased viability after injury in our *in vitro* model, the decision was made to create an N-acetyl cysteine (NAC) microparticle given its more promising *in vitro* results discussed in Aim 2 below.

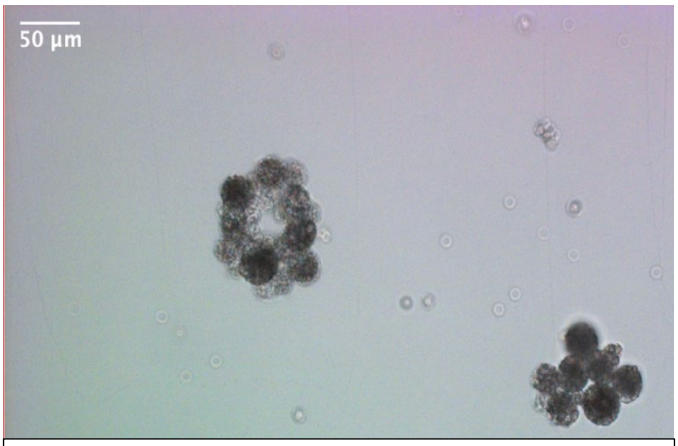

Figure 1: Light microscope image of EPO-containing microparticles at 63X magnification. Microparticle diameters ranged from 5-40uM.

NAC microparticles were synthesized by incorporating 4.5 mg of NAC utilizing a protocol for hydrophilic molecules previously used by our laboratory to synthesize melatonin microparticles. After lyophilization of the microparticles, NAC was eluted from microparticles in transwells and measurements taken for 18 days, as shown in Figure 2. This was able to be measured via spectrophotometry using Ellman's reagent to detect the sulfhydryl component of NAC. We next plan to measure and determine encapsulation efficiency, particle size distribution, and full elution for 2 months.

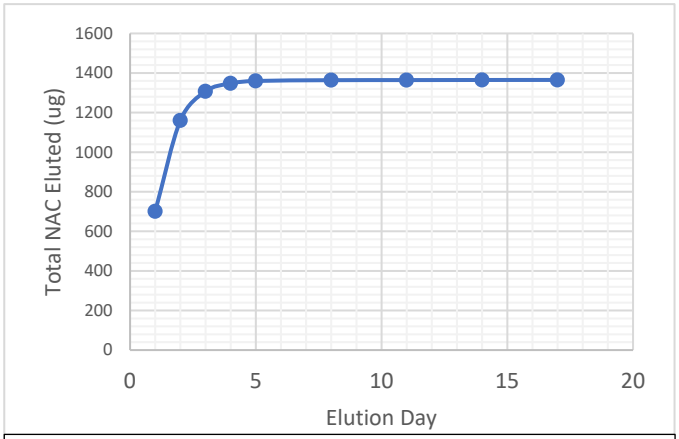

Figure 2: Summative curve of NAC microparticle elution over 18 days, measured at 412 nm absorbance with Ellman's reagent.

Hypothesis II: The EPO eluted from the microparticle-hydrogel exhibits similar bioactivity to non-eluted EPO.

Aim 2: Creation of bioactivity assessment assay. In both Sh-Sy5y human neuroblastoma and RT4-D6PT rat Schwann cell lines we found that the dose of gentamicin required to attain a lethal concentration of 50% of cells (LC_{50}) via MTT viability assay was 2.5mM, a dose which far exceeds that required to terminally damage afferent neurons, thus implying that the damage caused by gentamicin is likely from injury to afferent neurons rather than to Schwann supporting cells. For this reason we next investigated the LC_{50} of another common ototoxic medication, cisplatin. The LC_{50} of cisplatin for RT4-D6PT cells was calculated to be 15uM. We found that the concentration required to cause injury to Schwann cells was on the order of that seen with therapeutic concentrations of this medication. This suggests that inner ear injury from cisplatin may be in part due to injury to supporting cells.

After developing this assay of cell injury with cisplatin we screened five different medications for their ability to protect against the effects of cisplatin. The drugs tested included erythropoietin, melatonin, N-acetylcysteine, metformin, and cyclosporine. Cells were dosed with the drug of interest, then cells were dosed with cisplatin 24 hours later. Figure 3 compares cells dosed with cisplatin alone (Control) compared with cells pre-dosed with the drug of interest before cisplatin injury. We found that RT4-D6PT cells pre-dosed with N-acetylcysteine and cyclosporine demonstrated significant increased viability as compared to matched controls treated with 15uM cisplatin, while erythropoietin, metformin, and melatonin did

not show significant increase in viability. Figure 4 demonstrates visually the increase in cell density when cells are dosed with NAC prior to cisplatin injury when compared to cells injured with cisplatin alone. The development and results of this screening assay will be presented at a poster presentation at the Combined Otolaryngology Sections Meeting in Dallas, Texas in April.

We next plan to assess the bioactivity of NAC by dosing cells with eluted NAC and comparing this to that of resuspended NAC.

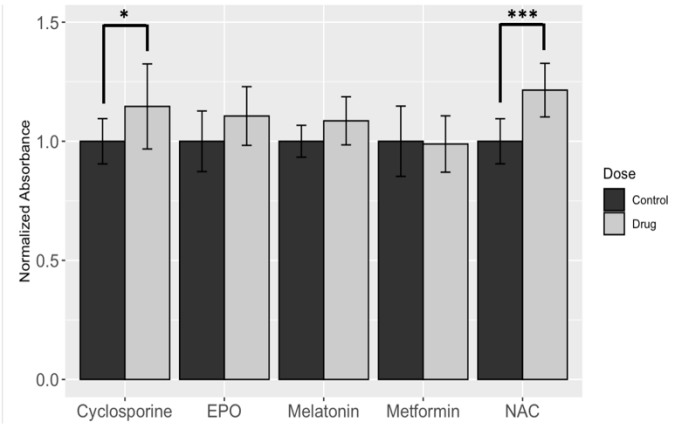

Figure 3: NAC is protective of cisplatin-mediated damage to Schwann cells. RT4-D2P6 cells were dosed with cisplatin only (Control) or with cisplatin and a potentially rehabilitative drug (Drug). Drugs tested include cyclosporine, erythropoietin (EPO), melatonin, metformin, and N-acetylcysteine (NAC). Cell viability measured with MTT assay and absorbances normalized to the average of the corresponding control wells containing cisplatin. * = p<0.05, *** = p<0.001 as determined by one-way ANOVA.

Hypothesis III: Drug-eluting hydrogels containing microparticles can be deployed onto the round window of chinchillas chronically prepared with a stainless-steel port providing access for sampling perilymph at specified post-implantation intervals, and these microparticles will continue to provide medication to the perilymph at least 6 weeks after implantation.

Aim 3: Determination of *in vivo* microparticle bioavailability in the inner ear. We have developed stainless steel implantable ports for serial sampling of chinchilla perilymph *in vivo*. Should eluted N-acetyl cysteine demonstrate increased viability in cell culture among RT4 Schwann cells similar to its resuspended counterpart we will next proceed to injecting a hydrogel containing NAC microparticles unilaterally on chinchilla round windows via transtympanic injection. Measures of inner ear function, such as acoustic brain reflexes (ABRs) will then be performed and compared between ears. At the termination of the sampling period histological analyses of vestibular and cochlear epithelia will be conducted to verify their health and integrity following the implantation and exposure to NAC. Our findings demonstrate that elution of NAC from microparticles for prolonged periods of time is feasible.

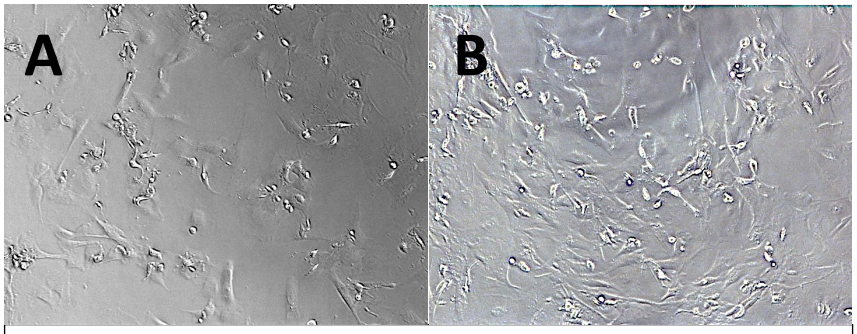

Figure 4: RT4-D6PT cells under light microscopy at 10X magnification dosed with 15uM of cisplatin. (A) shows cells dosed with cisplatin without NAC pre-dose, (B) shows cells dosed with 10uM NAC 24 hours prior to 15uM cisplatin injury.

The challenges encountered in this study have made us skeptical of whether EPO protects against the cytotoxic effects of gentamicin or cisplatin in our chosen cell line at our concentrations of interest and for our time periods of study. Furthermore we suspect that the mechanism of inner ear injury from gentamicin may not be driven by supporting Schwann cell damage given the concentrations required to induce damage in these cells *in vitro*. This led us to investigate cisplatin and screen several other medications to identify NAC and cyclosporine as possible otoprotective agents for cisplatin-induced inner ear damage.

The American Neurotologic Society's funding of this project allowed 1 medical school applicant, 1 medical student, and 1 resident to become involved and inspired to develop novel ways to topically deliver therapeutic medications for inner ear applications. It has also helped Dr. Kita to obtain an NIH K08 for a proposal exploring topical drug delivery to peripheral nerve injury sites in the head and neck.

American Neurotology Society Research Grant – Interim Progress Report

Impact of vestibular dose on post gamma knife balance function

Bing Teh MBBS, Stephen Leong BA, Ton Duong MEng, Michael Sisti MD, Tony Wang MD, Damiano Zanotto PHD, Anil Lalwani MD
Department of Otolaryngology, Head & Neck Surgery, Columbia University Irving Medical Center, New York.
Gamma Knife Center, Columbia University Irving Medical Center, New York.
Department of Mechanical Engineering, Steven Institute of Technology, New Jersey.
February 10th, 2022

Summary of Project

This prospective clinical study is a collaborative project bringing together a multidisciplinary team of neurotologist, neurosurgeon, radiation oncologist and engineers, who are experts in the treatment of Vestibular Schwannoma (VS) and gait biomechanics. The goal of our study is to assess the impact of vestibular radiation dose on gait and balance disturbance following gamma knife surgery (GKS). We hypothesize that, similar to the relationship between cochlear radiation dose and hearing loss, vestibular symptoms and gait disturbances following GKS is related to dose delivered to the vestibule and semicircular canals. We aim to 1) assess gait and balance function of VS patients pre and post GKS; and 2) determine if vestibular radiation dose is independently predictive of postoperative balance outcome following GKS. To address the first aim, patients' gait and balance were assessed using a novel, unobtrusive footwear-based gait analysis technology developed by Dr Zanotto's group. This has previously been validated in individuals with vestibular handicap. Specific testings include Dizziness Handicap Inventory (DHI), Functional Gait Assessment (FGA), 2-minute walk test (2MWT), and uneven surface walk (USW) test. To address the second aim, radiation dose to the tumor, vestibules and semicircular canals were measured. We aim to assess if radiation dose to the vestibules and semicircular canals is independently predictive of postoperative balance outcome following GKS. We expect that higher radiation dose will be associated with greater gait and balance disturbance post GKS. By studying and understanding gait and balance disturbance in patients with VS, we may be able to better plan for GKS treatment, which could significantly improve patients' quality of life, reduce fall risks and their associated morbidities.

Preliminary Results and Interpretation

The mean age of 9 VS patients undergoing GKS was 62.4±10.3 years with 62.1% being females. The average FGA score was 25.6±3.9. For both 2MWT and USW, stride length (r=0.81 for 2MWT, r=0.78 for USW, p<0.001), stride velocity (r=0.79 for 2MWT and r=0.73 for USW, p<0.001), normalized stride length (r=0.76 for 2MWT, r=0.75 for USW, p=0.002), and normalized stride velocity (r=0.75 for 2MWT and USW, p=0.001) were positively correlated with FGA score. For both 2MWT and USW, the coefficients of variability (i.e. how variable the metric was between steps) for stride length (r=-0.61 for 2MWT, r=-0.57, p=0.02), and stride velocity (r=-0.65 for 2MWT, r=-59 for UWS, p=0.01), were negatively correlated with FGA score. This showed that the use of instrumented insoles is useful in studying some parameters of the gait. In terms of correlation with DHI scores, 2MWT swing time (r=-0.60, p=0.04), and coefficient of variability for stride time (r=0.74, p=0.01), were significantly correlated. This suggests that patients with greater perception of balance handicap showed larger variability in gait pace Patients had significantly longer stride time (1.12s vs. 1.06s, p=0.001), shorter stride velocity (119.26cm/s vs. 130.59cm/s, p=0.01), normalized stride velocity (0.29cm/s vs. 0.32cm/s, p=0.01) and longer stance time (0.71s vs. 0.66s, p=0.001) performing the tests on an uneven surface compared to even surface. Patients also had significantly greater coefficients of

variability for stride time (0.06 vs. 0.05, p=0.03), stride length (0.09 vs. 0.55, p<0.001), and stride velocity (r=0.09 vs. 0.08, p=0.02), performing the tests on uneven surfaces compared to even surfaces. This suggests that VS patients are more unstable on uneven surfaces.

In terms of radiation received, a mean 15.9±4.0Gy (range 7.2-23.9Gy) was targeted to the tumor. Overall, collateral radiation to cochlea was 2.9±1.4Gy (range 1.3-6.7Gy), lateral semicircular canal was 2.2±1.1Gy (range 1.2-3.9Gy), posterior semicircular canal was 2.6±1.6Gy (range 1.4-5.3Gy), superior semicircular canal was 3.6±1.4Gy (range 2.3-5.4Gy), and vestibule was 3.5±1.5Gy (range 1.7-6.5Gy). This represents a relatively high dose of radiation to the balance apparatus comparatively. We would be studying the effect of the radiation on the gait and balance function as the next step.

Protocol extensions

We have also expanded our project to include VS patients undergoing conservative treatment or microsurgery, as well as non-VS patients undergoing GKS to further our understanding in the relationship of gait and balance in these patients. FGA scores and insole data were obtained for 12 patients with untreated VS. The average FGA score was 25.9±4.3 compared to 26.1±4.0, which were previously published metrics from the general population. FGA scores were significantly correlated with metrics obtained from the 2MWT, including normalized stride length (r=0.86, p=0.01), normalized stride velocity (r=0.83, p=0.02), and swing period (r=0.76, p=0.05). Compared to the 2MWT, on the USW, patients had significantly decreased normalized stride velocity (0.30 vs. 0.33, p=0.03) and swing period (37.8% vs. 39.9%, p=0.04). Our preliminary study in the assessment of gait in VS patients having conservative treatment compared to the general population showed that VS patients have significant gait disturbance on uneven surfaces that cannot be detected by standard assessment such as functional gait analysis. Instead, instrumented insoles have been shown to have greater sensitivity in identifying gait dysfunction in these patients.

AMERICAN NEUROTOLOGY SOCIETY PAST PRESIDENTS

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2000-01 Richard T. Miyamoto, MD
2001-02 Stephen G. Harner, MD
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2003-04 Paul R. Lambert, MD
2004-05 Robert K. Jackler, MD
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IN MEMORIUM
(in alphabetical order)

The ANS Administrative office was notified of the following members death since the 2021 Spring meeting.

Please take a moment of silence to remember these outstanding colleagues & friends.

C. Phillip Daspit, MD

Arvind Kumar, MD

Dan A. Sdrulla, MD, PhD

John J. Shea, III MD