ABSTRACTS

VIRTUAL POSTER SESSION PRESENTATIONS

55th Annual Spring Meeting

AMERICAN NEUROTOLOGY SOCIETY

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Posters are submissions from selected poster and podium presentations
Participation was optional for both poster and podium presenters

Preoperative Sudden Hearing Loss May Predict Hearing Preservation after Retrosigmoid Resection of Vestibular Schwannoma

Kareem O. Tawfik, MD; Joe Saliba, MD, MSc; Thomas Alexander, MD, MHSc
Bill Mastrodimos, MD; Roberto A. Cueva, MD

Objective: Describe the effect of sudden hearing loss (SHL) on likelihood of hearing preservation (HP) after retrosigmoid resection of vestibular schwannoma (VS) with anatomic preservation of the cochlear nerve.

Methods: Adult patients (≥18 years) who underwent retrosigmoid VS resection with attempted HP between February 2008 and December 2018 were retrospectively reviewed. All patients had preoperative word recognition score (WRS) of at least 50%. HP was defined as postoperative WRS of ≥50%. Regression analysis was used to determine the effect of SHL on HP, accounting for tumor size and preoperative AAO Class hearing. Patients with a history of neurofibromatosis 2, previous microsurgical resection or radiosurgery, or insufficient audiometric data were excluded.

Results: Of 160 patients who underwent retrosigmoid VS resection during the study period, 153 met inclusion criteria. Mean tumor size was 14.0 (+/-6) mm. Hearing was preserved in 41.8% (n=64). Forty patients (26.1%) had a history of preoperative SHL. Rates of HP did not significantly differ between patients with and without SHL. However, among 138 patients (90.2%) in whom the cochlear nerve was anatomically preserved, HP was achieved in 61.8% of those with SHL (21 of 34) and 41.3% of those without SHL (43 of 104) (p=0.0480). On univariate and multivariate analysis (accounting for tumor size and preoperative AAO Class hearing), SHL was a significant positive predictor of HP (odds ratio 2.292, p=0.0407 and odds ratio 2.778, p=0.0032, respectively).

Conclusions: Among patients with VS and serviceable hearing, SHL is an independent positive predictor of HP after retrosigmoid microsurgical resection.

Define Professional Practice Gap & Educational Need: Sudden sensorineural hearing loss is common among patients with vestibular schwannoma. The degree to which a history of sudden hearing loss can predict hearing preservation success after tumor resection is unknown.

Learning Objective: Participants will be able to describe the effect of preoperative sudden hearing loss on likelihood of successful hearing preservation outcomes after retrosigmoid vestibular schwannoma resection.

Desired Result: To increase awareness of the effect of sudden hearing loss on likelihood of hearing preservation after surgical resection of vestibular schwannoma.

Level of Evidence – Level IV

Indicate IRB or IACUC : Kaiser Permanente Southern California IRB # 028473

Factors Associated with Failure of Pharmacotherapy and Progression to Botulinum Toxin Treatment in Management of Patients with Vestibular Migraine

Yuan F. Liu, MD; David Macias, MD (presenter); Lane Donaldson, MD
James R. Dornhoffer, MD; Habib G. Rizk, MD

Objective: Find factors associated with failure of pharmacotherapy and progression to botulinum toxin injections (BTI) in vestibular migraine (VM) patients.

Study Design: Retrospective cohort

Setting: Vestibular neurotology clinic

Patients: Definite VM patients from 9/2015-7/2019 who completed the Dizziness Handicap Inventory (DHI) at least 6 weeks apart.

Interventions: Nortriptyline, topiramate, venlafaxine, propranolol, verapamil, magnesium, BTI, and vestibular rehabilitation (VR).

Main Outcome Measures: DHI scores.

Results: 47 patients were included, with a mean age of 50.2±15.8 years, and mean follow-up of 6.0±6.0 months. Mean pre-treatment DHI score was 57.5±23.5, with a mean reduction of 17.3±25.2 ($p<0.001$) at last follow-up. 5 (10.6%) patients eventually underwent BTI. Oscillopsia ($r=0.458$, $p=0.007$), failure of first medication ($r=0.518$, $p=0.001$), and pre-treatment DHI question 15 score ($r=0.364$, $p=0.019$) were the only variables significantly correlated with failure of pharmacotherapy and progression to BTI, while the following did not: sex, race, insurance, age, time lived with dizziness, chronic disequilibrium, cervicalgia, tinnitus, BPPV, depression, anxiety, hypertension, diabetes, medication, VR, VR compliance, caloric testing, and change in DHI scores. Failing the first medication had a 100% sensitivity and 85.7% specificity for progression to BTI, while on question 15 ("Because of your problem, are you afraid people may think you are intoxicated?") a score of 2 ("sometimes") had a 80-100% sensitivity and 57.1-78.6% specificity and a score of 4 ("always") had a 0-80% sensitivity and 78.6-100% specificity.

Conclusion: Motion hypersensitivity (such as in oscillopsia) and fear of social stigmatization (a component of catastrophizing perception) suggest decreased treatment response. These symptoms may require more aggressive treatment at an earlier stage.

Professional Practice Gap and Educational Need: There is no standardized treatment protocol for VM. More evidence is needed to guide which therapies should be used at which times and to target which specific symptoms in VM.

Learning Objective: To appreciate how different patient factors influence their response to treatment and potential failure of treatment and progression to BTI.

Desired Result: To assess for motion hypersensitivity and catastrophization in patient thinking in those with VM, to counsel patients on potential need for trials of different treatments, and to consider more aggressive treatment earlier on. Also physicians should be wary of using only the DHI to assess VM severity and treatment outcomes. Research is needed in designing more VM disease-specific outcome measurement tools.

Level of Evidence: IV

IRB: Pro00050097 Medical University of South Carolina

Characterization of the Relationship between Sickle Cell Disease and Sensorineural Hearing Loss in Adult Patients: A Systematic Review and Meta-analysis

Elina Kapoor, BA; David Strum, BA; Timothy Shim, BS
Sunny Kim, BA; Parisa Sabetrasekh, MD
Ashkan Monfared, MD

Objectives and Main Outcome Measures: To determine the prevalence of Sensorineural Hearing Loss (SNHL) attributable to Sickle Cell Disease (SCD) in the global adult population and to identify factors contributing to its severity.

Study Design: Systematic Review and Meta-analysis

Methods: A comprehensive literature search for scientific articles in Pubmed, Scopus, CINAHL, Web of Science, and the Cochrane Library that reported the incidence of hearing loss in populations over 18 years of age with SCD was conducted. The specific inclusion criteria are retrospective cohort or prospective studies with control groups involving adult patients with 1) hemoglobin electrophoresis demonstrating SCD status and 2) audiogram or acoustic emissions testing. Only English language articles available in full text were included.

Results: 54 studies were identified that met the inclusion criteria with 12 studies utilized for data analysis. A total of 636 SCD patients and 360 controls were included in the Cochrane Review Manager 5.3 meta-analysis. There was a statistically significant increase in the prevalence of SNHL in adults with SCD compared to the general population with a cumulative risk ratio of 6.03.

Conclusions: This is the first systematic investigation of the relationship between SCD and SNHL in adult patients across the globe. SNHL is more prevalent in patients with SCD, specifically those of the HbSS genotype, than the general population likely due to the pathophysiology of the disease and its effects on labyrinthine microvasculature. The increased prevalence of SNHL in the adult SCD population warrants future research into the predictors of SNHL severity and merits routine audiometric monitoring of adult SCD patients.

Professional Practice Gap & Educational Need: 1. Lack of overall knowledge regarding the prevalence of SNHL in association with SCD and 2. Inconsistencies in reporting SCD genotype across the globe, particularly with respect to haplotype and genotype reporting of patients with concomitant SNHL.

Learning Objective: To determine the prevalence of SNHL attributable to Sickle Cell Disease (SCD) by region of the world and determine factors contributing to its severity.

Desired Result: A comprehensive and statistically-significant evaluation of global adult SNHL associated with SCD.

Level of Evidence – Level III – Systematic review and meta-analysis of cohort and case-control studies.

Indicate IRB or IACUC : Exempt

Vestibular Schwannoma Practice Patterns: An International Cross-Specialty Survey

Robert J. Macielak, MD; Colin L.W. Driscoll, MD; Michael J. Link, MD
David S. Haynes, MD; Christine M. Lohse, MS; Matthew L. Carlson, MD

Objective: To assess vestibular schwannoma (VS) practice patterns within a multi-disciplinary international cohort.

Study Design: Cross-sectional survey.

Setting: 8th Quadrennial International Conference on Vestibular Schwannoma and Other CPA Tumors.

Subjects: Otolaryngologists and neurosurgeons who specialize in the management of VS.

Main Outcome Measures: Responses to questions on the management and anticipated outcomes of VS for a series of common clinical scenarios were compared among groups, including specialty (otolaryngology vs. neurosurgery), level of experience, scope of practice (surgery vs. radiation and surgery), and geographic location (United States vs. International).

Results: Responses from 110 participants were analyzed. Overall, 53% of respondents were otolaryngologists, 60% had greater than 10 years of experience, and 57% of respondents practiced within the United States. Responses between groups were largely consistent overall. Globally, 86% of respondents would pursue initial observation for themselves if diagnosed with a 4 mm distal intracanalicular VS; however, practicing radiosurgeons were more likely to select stereotactic radiosurgery for this scenario compared to providers who do not perform radiosurgery (p=0.032). Otolaryngologists and neurosurgeons alike report that radiosurgery should not be considered a long-term hearing preservation strategy. Otolaryngologists were more optimistic regarding microsurgical hearing preservation outcomes for small distal intracanalicular tumors compared to neurosurgeons (p=0.007). In total, 95% of respondents prioritized facial nerve outcome over complete disease removal in the context of microsurgical resection of large tumors.

Conclusions: Management decisions and expected outcomes for various clinical scenarios were largely consistent in this survey of experts. These data are congruent with other reports demonstrating a shift toward conservatism in the management of VS.

Define Professional Practice Gap & Educational Need: To capture the different opinions and recommendations on the management of vestibular schwannomas in a diverse group of experts.

Learning Objective: Identify the need for a consensus statement among experts in the management of vestibular schwannomas and the strong likelihood that this could be obtained among providers.

Desired Result: A greater understanding of the variations among providers in vestibular schwannoma management.

Level of Evidence: V

Indicate IRB or IACUC: Exempt

Office Based Eustachian Tube Balloon Dilation: Safety and Feasibility

Roya Azadarmaki, MD; Colin Dean, BS; Andrew How, BA

Objective: Eustachian tube balloon dilation is a technique used to restore natural ventilation of the middle ear and mastoid in patients with chronic Eustachian tube dilatory dysfunction. This study focuses on outlining a protocol that allows for a safe and well tolerated procedure in the office-based setting.

Study Design: A retrospective review of the electronic medical records of patients who underwent Eustachian tube balloon dilation in the office setting from January 2017 to October 2019 was performed.

Setting: Office based specialty care

Patients: Patients undergoing Eustachian tube balloon dilation under local anesthesia in an office-based setting.

Interventions: Eustachian tube balloon dilation under local anesthesia.

Main Outcome Measures: Tolerability and safety of Eustachian tube balloon dilation under local anesthesia in an office-based setting.

Results: A total of 145 Eustachian tubes were dilated in 81 patients in the office-based setting without any immediate complications or adverse effects. 64 patients underwent bilateral dilation. The average age of patients undergoing the procedure was 58 years (Age range 26-87 years). The procedures were performed with local and topical anesthesia.

Conclusions: Eustachian tube balloon dilation is a safe and well tolerated procedure under local anesthesia in the office-based setting. Live feedback from patients can be used as a means of assuring proper catheter and balloon placement within the cartilaginous Eustachian tube.

Define Professional Practice Gap & Educational Need: The need for more literature on experience with Eustachian tube balloon dilation under local anesthesia and protocols outlining methods and techniques to establish patient comfort in a safe setting.

Learning Objective: Provide a protocol of methods and techniques for a safe and well-tolerated Eustachian tube balloon dilation procedure in an office-based setting.

Desired Result: Demonstrating safety and tolerability of office-based Eustachian tube balloon dilation under local anesthesia.

Level of Evidence - Level V

Indicate IRB: Exempt.

Proposal of a Staging System for Skull Base Osteomyelitis: CT-Based Classification Showing Correlation with Prognosis

Kuniyuki Takahashi, MD; Yuka Morita, MD; Chihiro Yagi, MD; Shinsuke Ohshima, MD
Shuji Izumi, MD; Tatsuya Yamagishi MD; Arata Horii, MD

Objective: The objective of this study was to analyze prognostic factors and to discuss the usefulness of a CT-based staging system for skull base osteomyelitis (SBO).

Study Design: Retrospective chart analysis.

Setting: University hospital.

Patients/Interventions: Twelve patients (10 male and 2 female) diagnosed with SBO underwent long-term antibiotic therapy (8 weeks intravenous, followed by more than 6 months oral administration). They were divided into disease-controlled or uncontrolled groups based on clinical symptoms, otoscopic findings, and the level of CRP at the last follow-up (mean, 23 months).

Main Outcome Measures: Patients' background, laboratory data, symptoms, pathogen, treatments, and pretreatment CT/MRI images were compared between groups. CT images were classified into four stages according to the cortical bone destruction: limited in the petrous bone (stage 1), extending to less than half (stage 2), more than half (stage 3), and whole of the clivus (stage 4). MRI-based staging was performed according to the signal intensity of bone marrow.

Results: CT-based classification showed that there were 5, 1, and 1 patients of stage 1, 3, and 4, respectively, in the disease-controlled group and 1 and 4 patients of stage 2 and 4, respectively, in the uncontrolled group, demonstrating significant correlation between stage and disease control. The same results were obtained by MRI-based staging, although with less sensitivity than CT. No other factors showed correlation with disease control.

Conclusions: We proposed a CT-based staging system for SBO showing correlation with disease control.

Define Professional Practice Gap & Educational Need: Clinical outcomes and prognosis for skull base osteomyelitis (SBO) differ among reports. So, we need to know the predictive factors of prognosis of SBO.

Learning Objective: The readers can predict the prognosis of SBO from the pretreatment CT images.

Desired Result: CT-based staging system for SBO showing correlation with disease control.

Level of Evidence - Level V

Indicate IRB or IACUC : This study was conducted under the approval of Institutional Review Board of Niigata University Medical and Dental Hospital.

Pentoxifylline and Tocopherol in the Management of Temporal Bone Osteoradionecrosis: A Case Series

Benjamin D. Lovin, MD; Jonathan S. Choi, MD; Nathan R. Lindquist, MD
Paul W. Gidley, MD; Marc-Elie Nader, MD

Objective: Temporal bone osteoradionecrosis (TBORN) is a rare, chronic complication of head and neck radiation. Initial treatment consists of conservative management, with surgical resection of necrotic bone indicated for cases of severe, symptomatic, or progressive disease. Recently, pentoxifylline-tocopherol (PENTO) has demonstrated utility for osteoradionecrosis at other head and neck subsites. Herein, we report on five TBORN cases utilizing this protocol.

Study Design: Retrospective case series

Setting: Tertiary referral center

Patients: This case series describes five localized TBORN cases in which the PENTO protocol was used in conjunction with conservative management. All patients were female and average age was 61±8 years.

Interventions: All patients received a daily dose of 800mg of pentoxifylline and 1g of tocopherol. Four of the five patients received systemic and/or ototopical antibiotics as an antiseptic regimen prior to or during the PENTO protocol.

Main Outcome Measures: Details regarding the total duration of protocol, improvement in symptoms, exposed bone and radiographic changes, and duration until first improvement of exposed bone were collected retrospectively.

Results: The average duration of PENTO protocol was 287±162 days. Four of the five patients demonstrated a decrease in exposed ear canal bone. Three of the five patients had stable or improvement in otologic symptoms of TBORN. One patient had progression of disease to diffuse TBORN. Average duration until first improvement in exposed bone was 193±137 days.

Conclusions: PENTO protocol may be a useful adjunct to conservative measures in the management of localized TBORN. We recommend trialing the protocol for at least 12 months.

Define Professional Practice Gap & Educational Need: 1. There are professional practice gaps in how otolaryngologists treat localized TBORN. As such, there is an education need to inform otolaryngologists regarding standard management and adjuvant therapies, such as PENTO protocol, for difficult-to-treat cases of TBORN. 2. There is a paucity of research regarding PENTO use for TBORN.

Learning Objective: 1. To understand the updated pathophysiology of ORN and how pentoxifylline and tocopherol etiologically targets it. 2. To recognize the utility and potential benefit of adding PENTO protocol to conservative management for cases of localized TBORN.

Desired Result: Attendees will have a better understanding of the updated pathophysiology of ORN, of the classification and general management of this disease as it relates to the temporal bone, and of the important etiologic role of pentoxifylline and tocopherol in its management. In addition, attendees will gain knowledge of the current state of the literature regarding the use of these medications for ORN and be equipped to possibly utilize them for localized TBORN in their practice, thereby stimulating future research in this realm.

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

Indicate IRB or IACUC: Approved by University of Texas MD Anderson Institutional Review Board (PA19-0106).

Migraine Features in Patients with Recurrent Benign Positional Vertigo

David Bruss, MS; Mehdi Abouzari, MD, PhD; Jack Birkenbeuel, BS
Brooke Sarna, BS; Khodayar Goshtasbi, BS
Harrison W. Lin, MD; Hamid R. Djalilian, MD

Objectives: To identify migraine features present in a cohort of patients with recurrent benign positional vertigo (BPV).

Study Design: Retrospective cohort.

Methods: Patients presenting to a tertiary neurotology clinic with recurrent BPV were instructed to complete detailed questionnaires on headache and dizziness. Recurrent BPV was defined as 3 episodes or greater in 6 months prior to presentation, where there was resolution of each episode after canalith repositioning maneuver. The data obtained in the surveys were used to determine if the patients also had migraine headache or vestibular migraine features according to the guidelines set forth by the International Classification of Headache Disorders (ICHD).

Results: Sixty-two patients with recurrent BPV were included in this study with a mean age of 55 ± 17 years. There were 46 females (74%) and 16 males (26%). Twenty-nine patients (47%) fulfilled ICHD criteria for migraine headache. Thirty-three patients (53%) did not meet the criteria for migraine headache. Of those patients who did not meet ICHD migraine headache criteria, a majority experienced symptoms of migraine such as motion sickness (54%), recurrent sinus headache (24%), neck stiffness (54%), and mental confusion (24%), among others.

Conclusions: A majority of patients with recurrent BPV presented with concurrent migraine symptoms. The high comorbidity of migraine headache in our BPV cohort (47%) as well as the high prevalence of migraine symptoms experienced by patients who did not fulfill ICHD criteria for migraine disorders may suggest that BPV may have a relationship with migraine. It may be beneficial to evaluate patients with recurrent BPV for migraine and to control their migraine symptoms.

Define Professional Practice Gap & Educational Need: A large proportion of vertigo patients with migrainous features do not meet the ICHD criteria for vestibular migraine. We believe that this overlapping symptomatology is best explained as a result of diagnostic criteria rather than intrinsic features unique to the cohorts. As such, BPV may exist on a spectrum of the migraine disorders and therefore warrant the same treatment protocols.

Learning Objective: To educate ANS members on a series of patients with BPV presented with concurrent migraine symptoms to propose an association between BPV and migraine and potential treatment strategies for recurrent BPV.

Desired Result: Informing neurotologists of a possible migrainous phenomenon of recurrent BPV that can be a stepstone for future treatment options in patients with recurrent BPV.

Level of Evidence - V

Indicate IRB or IACUC: The study has IRB approval from the UC Irvine under the PI name of Hamid R. Djalilian.

The Association of Pre-Operative Tumor Volume with Facial Nerve Outcomes following Surgical Removal of Vestibular Schwannoma

Daniel E. Killeen, MD; Samuel L. Barnett, MD; Bruce E. Mickey, MD
Jacob B. Hunter, MD; Brandon Isaacson, MD; J. Walter Kutz, Jr., MD

Objective: To explore the relationship between tumor size and facial nerve outcomes following vestibular schwannoma (VS) resection.

Study Design: Single institutional retrospective chart review.

Setting: Tertiary referral center.

Patients: All adult patients with sporadic VS who underwent surgical resection from 2008 to 2018 with pre-operative magnetic resonance imaging (MRI) and 10 months of post-surgical follow-up.

Interventions: VS resection

Main Outcome Measures: Facial nerve outcome as assessed by post-operative House-Brackmann score.

Results: One hundred seventy-five patients, 54.9% female, with a median age of 50 years (21 – 74 years), were identified who underwent VS resection. Surgical resection was performed via translabyrinthine (76%), middle cranial fossa (13.7%), retrosigmoid (8%), and transpromontorial (2.3%) approaches. The median tumor diameter and volume were 24.6 mm (4.1 – 47.1 mm) and 3.17 cm3 (0.01 – 30.6 cm3), respectively. The median follow-up was 23.7 months (10 – 114.2 months). Gross total resection was performed in 77.1% of cases, with residual tumor identified on MRI in 17.9% of cases. For patients with tumors <3 cm3, 91.9% had grade 1 or 2 facial function after at least 10 months follow-up, compared to 80.9% for those with tumors >3 cm3 (univariate logistic regression OR=2.7, p=0.04). Increased tumor diameter was significantly associated with facial weakness on univariate analysis but not multivariate analysis. Tumor volume >3 cm3 was predictive of facial weakness on multivariate regression analysis (OR=4.0, p=0.041) when controlling for surgical approach, age, gender, and extent of resection.

Conclusions: Tumor volume >3 cm3 is associated with poorer facial nerve outcomes 10 months following surgical resection.

Define Professional Practice Gap & Educational Need: Knowledge of factors influencing facial nerve outcomes after vestibular schwannoma resection

Learning Objective: Gain knowledge of predictive factors in facial nerve outcomes following vestibular schwannoma resection

Desired Result: Improve patient counseling and inform patient decisions regarding optimal treatment of vestibular schwannoma

Level of Evidence - V

Indicate IRB or IACUC : University of Texas Southwestern Medical Center IRB STU 112016-040 – approved on 8/28/2019

ANS POSTER F013

Percutaneous Bone-Anchored Hearing Implants - Minimally Invasive or Traditional

Sean P. Holmes, MD; Camille Berry, AuD; Gauri S. Mankekar, MD, PhD

Objective: To compare outcomes for various surgical techniques in percutaneous bone-anchored hearing implant surgery

Study Design: Retrospective cohort

Setting: Tertiary referral center

Patients: Electronic chart review of all patients who underwent either percutaneous Minimally-invasive Ponto Surgery (MIPS) or traditional bone-anchored hearing surgery between 6/2017 - 2/2019 was completed. Median age of our study population was 51 years (range 5-83 years). 22% of patients were African American, while 74% were Caucasian.

Interventions: Patients in cohort 1 underwent Minimally Invasive Ponto Surgery (MIPS) while those in cohort 2 underwent percutaneous bone-anchored hearing implant surgery by traditional technique.

Main Outcome Measures: Rates of complication, types of complications, the need for revision surgery, post-operative aided speech recognition thresholds across 500-3000 Hertz (Hz), and patient's use of the device after surgery.

Results: 50 patients met inclusion criteria, 24 underwent MIPS while 26 underwent traditional technique. Minor complication rates for standard technique and MIPS were 42% and 13%, respectively. Revision surgery was required 30% of the time after standard technique, compared to 13% for MIPS group. Minor complications included infection, keloids/scarring, wound dehiscence, and failed osseointegration. Rates of device usage were over 90% for both treatment groups. Average aided Speech Recognition Thresholds were obtained from 10 patients after MIPS and standard technique, which were 18dB and 20dB, respectively.

Conclusions: Both the MIPS and traditional techniques are safe and effective. MIPS was found to have a lower rate of minor and major complications. Aided thresholds after standard technique were marginally higher.

Define Professional Practice Gap & Educational Need: Currently there are variations in the surgical treatment options for bone-anchored hearing implant surgery, each with their own risks and benefits.

Learning Objective: To better understand the outcomes for surgical techniques in bone-anchored hearing implant surgery

Desired Result: To provide a better of knowledge of the options for bone-anchored hearing implant surgery and how they may benefit future patient populations

Level of Evidence - Level IV

IRB: Approval from IRB was obtained prior to any data collection, Number: 00000880, Institution: LSU HSC Shreveport

Intraoperative Electrocochleography during Cochlear Implantation: A Systematic Review

Jason H. Barnes, MD, Linda X. Yin, MD, Aniket A. Saoji, PhD
Matthew L. Carlson, MD

Objective: To evaluate the utility of intraoperative electrocochleography (ECochG) as a predictive tool for postoperative hearing outcomes.

Data Sources: A systematic search of multiple databases (Ovid MEDLINE, Embase, EBM Cochrane, and Scopus) was conducted from database inception to August 1, 2019. English language studies in humans were included.

Study Selection: All articles were reviewed by two independent authors according to PRISMA guidelines (title, abstract and full text review). Studies were excluded if they did not include intraoperative ECochG or were not obtained during cochlear implantation.

Data Extraction: Extracted variables included: number of patients, study design, ECochG recording technique, ECochG stimulus employed, success rate of obtaining ECochG potentials, intraoperative changes in ECochG waveform, and postoperative hearing outcomes.

Data Synthesis: Among 540 eligible articles, 19 met inclusion criteria. Eight studies featured extracochlear measurements, 7 featured intracochlear measurements, and 4 featured both. 459 unique patients were identified. Extracochlear ECochG had an average (SD) recording success rate of 92.2% (14.3) while intracochlear ECochG had an average (SD) recording success rate of 92.6% (9.9). 114 patients from 6 studies had complete intraoperative ECochG data with post-operative behavioral audiometry. Despite heterogeneity among studies in the definitions of ECochG signal disturbance, decreases in intraoperative ECochG signal were able to predict post-operative hearing loss (pure-tone average change >10dB) with a sensitivity of 42.3%, specificity of 80.7%, positive predicate value of 75%, and negative predictive value of 50.5%.

Conclusions: Intraoperative ECochG recordings can be obtained in the majority of cases. Decreases in intraoperative ECochG signal changes can predict post-operative hearing loss with reasonable specificity but poor sensitivity.

Define Professional Practice Gap & Educational Need: ECochG is a rapidly advancing technique in the field of cochlear implantation as it pertains to hearing preservation. There is currently no consensus on its efficacy in predicting postoperative hearing outcomes.

Learning Objective: To provide a comprehensive review of the literature on intraoperative ECochG for cochlear implantation, and a better understanding of the utility of ECochG in predicting hearing preservation.

Desired Result: This systematic review will summarize the current evidence regarding ECochG and its applications in cochlear implantation.

Level of Evidence – Level II

Indicate IRB or IACUC : Exempt.

ANS POSTER F015

Does Auditory Environment Predict Speech Perception Outcomes in Elderly Cochlear Implant Patients?

Kevin Chow, BA; Vivian F. Kaul, MD; Jillian Levine-Madoff, AuD
George B. Wanna MD; Maura K. Cosetti, MD

Objective: To analyze the relationship between cochlear implant (CI) patient age, natural auditory environment, and post-implantation speech perception among older adults

Study Design: Retrospective chart review

Setting: Tertiary referral center.

Patients: Post-lingually deafened CI recipients ≥50 years old (n=115)

Interventions: Datalogging of Cochlear® Nucleus 6, Nucleus 7 sound processors

Main Outcome Measures: Time (hours per day) in listening environment (automatic scene classification/SCAN) and loudness (SPL dB); open set word recognition in quiet (Consonant-nucleus-consonant, CNCw)

Results: Mean age was 68 years (range 50 - 95 years). Average daily implant use was 10.8 hours and was not significantly correlated with age (p=0.23, Spearman's rho). Age was positively correlated with hours spent at <40 dB and 40-50 dB and negatively correlated to hours spent at higher volume (60-70 dB, 70-80 dB, and >80 dB; r_s=0.21, 0.20, -0.20, -0.35, -0.43; p=0.021, 0.036, 0.033, <0.001, <0.001, respectively). Age was positively correlated with time in the Quiet scene (r_s=0.26, p=0.006) and negatively correlated with scenes containing Speech and Noise (r_s=-0.19, -0.25; p=0.046, 0.007). Correlations between scene classification and speech perception improvement were not significant. Time spent at 40-50 dB and 50-60 dB was significantly correlated with improved CNC-word scores at 90% confidence (r_s=0.43, 0.35; p=0.025, 0.077, Spearman's rho).

Conclusions: This data supports a relationship between auditory environment and age, with older CI recipients spending more time in quiet. Elder CI users demonstrated greater improvement in speech perception when their most common auditory environment ranged from 40-60 dB.

Define Professional Practice Gap & Educational Need: Changes in population demographics make older adults a growing proportion of cochlear implant (CI) candidates. Datalogging capabilities of contemporary speech processors afford a better understanding of the natural auditory environment of our patients. This study attempts to use this technology to better characterize their routine sound exposure and understand how this may impact speech perception outcomes among elderly CI patients

Learning Objective: To analyze the relationship between cochlear implant (CI) patient age, natural auditory environment and post-implantation speech perception among older adults

Desired Result: To recognize that the natural auditory environment of adult CI users may vary by age and to consider additional therapies and technologies that may support the older population and maximize their post-implantation outcomes

Level of Evidence – Level IV

Indicate IRB or IACUC : 19-04441, Icahn School of Medicine at Mount Sinai, 6/7/2019

Preoperative Cochlear FIESTA Signal Attenuation Predicts Degree of Hearing Loss after Middle Cranial Fossa Resection of Acoustic Neuroma

Kareem O. Tawfik, MD; Marin McDonald, MD; Yin Ren, MD, PhD
Omid Moshtaghi, MD; Marc S. Schwartz, MD; Rick A. Friedman, MD, PhD

Objective: Examine the impact of preoperative cochlear Fast Imaging Employing Steady-state Acquisition (FIESTA) signal intensity on hearing outcomes after middle cranial fossa (MCF) resection of acoustic neuroma (AN).

Methods: Adult patients (≥18 years) who underwent MCF AN resection for hearing preservation (HP) between November 2017 and September 2019 were retrospectively reviewed. All patients had preoperative word recognition score (WRS) ≥50%. HP was defined as postoperative WRS ≥50%. A neuroradiologist blinded to patients' clinical and audiometric outcomes reviewed patients' preoperative magnetic resonance images. Ipsilateral-to-contralateral cochlear FIESTA signal intensity ratios were determined using hand-drawn regions of interest including the basal and middle turns of the cochlea. Preoperative and postoperative pure tone average (PTA) and WRS were reviewed.

Results: Fifty-one patients were reviewed (60.8% female). Mean age was 47 years and mean tumor size 9.2 mm (+/-3.8). Hearing was preserved in 56.9% (n=29). FIESTA signal ratios did not significantly differ between patients with and without HP. Decreasing FIESTA signal intensity correlated with greater declines in hearing ($r=0.322$, $p=0.011$ for PTA; and $r=0.384$, $p=0.004$ for WRS). On multivariate analysis accounting for tumor size and preoperative PTA/WRS, decreases in FIESTA (per 0.1 decline) signal independently predicted greater decline in hearing by PTA (OR=10.1, $p=0.012$) and WRS (OR=7.6), although the latter result was not statistically significant ($p=0.078$).

Conclusions: Cochlear FIESTA signal intensity may be a predictor of postoperative hearing loss after MCF AN resection. In this cohort, degraded preoperative cochlear FIESTA signal strongly predicted postoperative hearing loss.

Define Professional Practice Gap & Educational Need: Cochlear FIESTA signal is poorly studied as a possible predictor of audiometric outcomes after hearing preservation surgery for patients with acoustic neuroma. To our knowledge, this is the largest analysis exploring the relationship between preoperative cochlear FIESTA signal and hearing outcomes after AN resection.

Learning Objective: Participants will be able to describe the degree to which cochlear FIESTA signal can predict successful hearing preservation after middle fossa resection of acoustic neuroma.

Desired Result: To increase providers' awareness of cochlear FIESTA signal intensity as a practical predictor of hearing outcomes after middle fossa resection of acoustic neuroma.

Level of Evidence – Level IV

Indicate IRB or IACUC : University of California San Diego IRB # 180978XL

The Cost of Otologic Procedures: Variation in Price Markup by Surgical Procedure and Geography

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Objective: To characterize and analyze variation in price markups of 8 common otologic surgeries within and between procedures and different US states.

Study Design: Analysis of Centers for Medicare and Medicaid Services (CMS) database of 2017 Medicare Provider Utilization and Payment Public File.

Setting: Inpatient and outpatient centers delivering Medicare-reimbursed services.

Patients: Full 2017 sample of patients undergoing procedures with Medicare fee-for-service final action claims.

Interventions: Eight procedures (myringotomy, tympanoplasty, mastoidectomy, tympanomastoidectomy with/without ossicular chain reconstruction, stapedectomy/stapedotomy, cochlear implant, bone-anchored hearing aid)

Main Outcome Measures: Markup ratio (MR) is defined as ratio of total charges to Medicare-allowable-costs. Variation in markup ratio is analyzed using coefficient of variation (CoV).

Results: Among all providers, the median markup ratio (MR) was 2.7 (interquartile range (IQR): 1.9 – 3.1). MR varied significantly by procedure, from 2.3 for myringotomy to 5.0 for mastoidectomy ($P < 0.01$). MR also varied significantly within procedure, with the least variation found in myringotomy (CoV=0.19), and the greatest in cochlear implantation (CoV=0.45). Using the national average as baseline, MR varied 71% between states, ranging from 1.75 to 6.24. Within the same state, significant variation was also noted, varying by 27% (CoV=0.27) in Maine compared with 57% (CoV=0.57) in New York.

Conclusions: There was significant variation in the price of otologic surgery across geographic regions and procedures. The MR for otology is lower or comparable to that reported in other surgical fields. Variation is likely driven by procedural complexity, practice environment, and patient factors.

Define Professional Practice Gap & Educational Need: The need to better understand interprocedural and geographic variation of prices in neurotology procedures as continued health policies and reforms are considered.

Learning Objective: Ability to identify and describe the variation of care both by region and by procedure along with associations with underlying drivers.

Desired Result: Increased understanding of the complexity and variation of price of operations in neurotology.

Level of Evidence – Level IIc per EBM guidelines (https://www.cebm.net/2009/06/oxford-centre-evidence-based-medicine-levels-evidence-march-2009/)

Indicate IRB or IACUC: Exempt (Mount Sinai Hospital IRB)

Impact of IAC Reconstruction with Hydroxyapatite Bone Cement on CSF Leak Rate in Retrosigmoid Approach to Vestibular Schwannoma Resection: A Review of 169 Cases

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Jason A. Brant, MD; Douglas C. Bigelow, MD
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Objective: To assess the impact of internal auditory canal (IAC) reconstructive technique on the incidence of cerebrospinal fluid (CSF) leak following retrosigmoid approach to acoustic neuroma resection.

Study Design: Retrospective case series.

Setting: Academic Tertiary Referral Center

Patients: A cohort of 1200 patients with acoustic neuromas presented to our institution from 2005-2018. The 196 of these 1200 patients who underwent surgical resection via a retrosigmoid approach were analyzed.

Intervention: Retrosigmoid approaches to acoustic neuroma resections. At our institution, IAC reconstruction was performed with bone wax and muscle plug or Norian™ hydroxyapatite bone cement from 2005 to 2013. Starting in 2014, a newer model of bone cement, Cranios™ hydroxyapatite, was used exclusively for reconstruction.

Main Outcome Measures: Rates of CSF leak were evaluated across different methods of IAC reconstruction and types of bone cement.

Results: The total post-operative CSF leak rate among patients who did not receive bone cement for reconstruction was 18% (6/32). The leak rate amongst patients who received Norian™ bone cement was 8% (5/63). After introduction of Cranios™ bone cement, the total leak rate decreased to 1% (1/101).

When compared to all other types of closure, Cranios™ had a significantly reduced rate of post-operative CSF leak ($p<0.01$). The leak rate following Cranios™ versus Norian™ was also significantly reduced ($p<0.05$). Leak rate was not affected by tumor size ($p=0.30$) or age ($p=0.43$).

Conclusion: CSF leak rate following acoustic neuroma resection was significantly reduced by reconstruction of the IAC with Cranios™ hydroxyapatite bone cement.

Define Professional Practice Gap & Educational Need: Assessment of bone cement outcomes between different types of hydroxyapatite bone cement; assessment of cerebrospinal fluid (CSF) leak rate after modern techniques in reconstruction of the internal auditory canal

Learning Objective: Demonstrate differences in CSF leak rate between various closure techniques; Demonstrate that not all hydroxyapatite bone cement appears to yield equivalent outcomes

Desired Result: Reduction in overall CSF leak rate after retrosigmoid approach to acoustic neuroma resection

Level of Evidence – Level IV

Indicate IRB or IACUC : Approved by the University of Pennsylvania Institutional Review Board. Approval# 828500. Date of Approval 2/8/2018.

Reduction of Tinnitus in Sigmoid Sinus Dehiscence Repair: Use of Isolated Reinforced Bone Cement Without Autologous Material Versus Autologous Fascia and Cartilage Graft

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Michael J. Ruckenstein MD

Objective: To evaluate the efficacy of using only reinforced bone cement in elimination of pulsatile tinnitus (PT) secondary to sigmoid sinus dehiscence.

Study: Case series; retrospective chart review

Setting: Academic tertiary referral center

Patients: 13 consecutive patients with PT undergoing sigmoid sinus dehiscence repair over 6 years

Interventions: Fascia and cartilage or reinforced bone cement were used to repair the bony defect

Primary Outcome Measure: Elimination of PT.

Results: Nine (69.2%) patients were repaired with reinforced bone cement alone while the remainder were repaired with a combination of fascia and cartilage. The average size of dehiscence was 1.56 cm as measured on axial-cut CT scan. Twelve (92.3%) were female. Average age at repair was 34 years. Of the patients treated with only bone cement, all 9 (100%) had resolution of their PT immediately after surgery. One patient later developed recurrent symptoms and was found to have developed a new dehiscence. In contrast, only 2 (50%) patients treated with cartilage and fascia repair had complete resolution while the remaining 2 (50%) reported a partial reduction in PT. Patient-reported elimination of pulsatile tinnitus was significantly higher with isolated bone cement ($p<0.05$). When patients were surveyed with the Tinnitus Handicap Inventory (THI), patients who received reinforced bone cement also had significantly lower scores compared to those who received cartilage and fascia ($p<0.05$).

Conclusions: We demonstrate the successful elimination of pulsatile tinnitus secondary to sigmoid sinus dehiscence using reinforced bone cement alone, with lower THI scores and rate of PT elimination than traditional usage of cartilage and fascia.

Define Professional Practice Gap & Educational Need: To report a novel technique and outcomes in pulsatile tinnitus in the surgical management of sigmoid sinus dehiscence

Learning Objective: Isolated bone cement without autologous material is a technique that yields excellent results in the elimination of pulsatile tinnitus secondary to sigmoid sinus dehiscence

Desired Result: Elimination of pulsatile tinnitus

Level of Evidence – Level IV

Indicate IRB or IACUC: Approved by the University of Pennsylvania Institutional Review Board. Approval # 833916. Approval date 8/12/2019

Sensory Integration for Postural Control in Monaural Hearing: Does Context Matter?

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Marta Gospodarek, MS; Agnieszka Roginska, PhD

Objective: The mechanism underlying the relationship between hearing loss and falls is unclear and may be elucidated by perturbing vision and sound simultaneously in proper contexts via Head Mounted Displays.

Study Design: cross-sectional laboratory study

Setting: Human motion research lab

Patients: 44 patients: unilateral vestibular hypofunction and normal hearing (VH, n= 7, 5F, mean age 54); diverse monaural hearing (MH, n=7; 2 F, mean age 53); 31 healthy controls (C, 20F, mean age 29).

Interventions: Participants stood naturally on a stable force plate and looked at 2 environments via the Oculus Rift (abstract 'stars'; busy 'street') with 2 levels of visuals (static [still]; dynamic [moving]) and 2 levels of sounds via the Rift headphones (none; dynamic [white noise or city sounds]).

Main Outcome Measures: medio-lateral (ML), anterior-posterior (AP) postural sway path; 6 head path directions

Results: We found significant differences in sway for: VH and C in ML ('street': dynamic, P=0.009; static, P=0.04) and AP ('street'& 'stars': dynamic only, P=0.002, P=0.02); and MH and C in AP ('street' & 'stars': dynamic only, P=0.04, P=0.02). Significant head path differences were seen between: VH and C (ML, AP, pitch or roll, dynamic only); MH and C (roll, 'street': dynamic, P=0.04); and VH and MH (ML, 'stars': dynamic, P=0.006).

Conclusions: Similar postural sway between individuals with vestibular hypofunction and those with hearing loss suggests that people with monaural hearing should be screened for balance performance. Future studies should isolate each sensory modality effect and match age. Certain head patterns with mild sensory perturbations may be specific to vestibular loss.

Define Professional Practice Gap & Educational Need: Hearing loss has been shown to reduce balance performance and could be one modifiable risk factor for falls. The mechanism behind this link is poorly understood and may involve auditory input for postural control. This pilot compares postural sway and head path between patients with monaural hearing, unilateral vestibular loss and controls in an established, context dependent paradigm that allows for manipulation of vision and sound.

Learning Objective: To appreciate the potential role of auditory input for balance and postural control and the value of sophisticated, context dependent paradigms (vs. standing on foam with eyes closed) to examine this complex relationship

Desired Result: Participants will become familiar with the concept of sensory integration and recognize the potential role of auditory cues for balance and postural control.

Level of Evidence - IV

Indicate IRB or IACUC: Mount Sinai: GCO # 18-0914 NYU: IRB-FY2016-155

Role of Early Post-Operative MRI in Assessment Of Residual Tumor Size in Vestibular Schwannoma Surgery

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Gregory P. Lekovic, MD: Mia E. Miller, MD

Objective: Incomplete excision of vestibular schwannomas (VS) is sometimes inevitable to preserve facial nerve function or integrity. We aimed to evaluate the correlation between intra-operative assessment of residual tumor and early post-operative MRI findings.

Study Design: Retrospective chart and MRI review

Setting: Tertiary referral center

Patients: VS surgery cases in the past 2-years were included. Neurofibromatosis II, revision cases, and those without pre- or post-operative MRIs were excluded.

Interventions: Surgical excision of VS

Main Outcome Measures: Data regarding surgical approach, degree of resection, and residual size were extracted. Residual size was calculated and compared to pre-operative tumor volume to determine radiographic gross-total (R-GTR, undetectable residual), near-total (R-NTR, residual≤5%) or sub-total (R-STR, residual>5%) resection.

Results: Of 109 VSs, gross-total resection was achieved in 84 while residual was left behind in 25 cases (near-total in 22 and sub-total in 3). All preoperative and postoperative MRIs were analyzed. The average pre-operative volume was 7.26 cm^3 (range 0.83 – 24.97 cm^3). The intra-operative estimate of residual size varied from 1 to 10 mm. Volumetric analysis revealed that of 22 near-total cases, 8 were R-GTR and 9 were R-STR (average 11.9%), while 5 remained R-NTR (average 1.8%). Of 3 sub-total cases, 2 were R-GTR while 1 remained R-STR (7.3%). Of cases with radiographic residual, 7 had linear and 7 had nodular residuals.

Conclusions: Intra-operative assessment of the degree of VS resection may be inaccurate. Obtaining early post-operative MRI establishes a baseline for residual tumor prior to scar formation and provides a critical comparison for long-term surveillance.

Define Professional Practice Gap & Educational Need: When near- or sub-total resection of vestibular schwannoma is performed, the estimated residual size and shape as seen on MRI is used as baseline for long-term follow-up. Potential future residual growth may necessitate treatment by radiosurgery or revision microsurgery. The intra-operative assessment of degree of resection may be inaccurate and assessing for residual tumor with immediate post-operative MRI may improve evaluation of residual tumor.

Learning Objective: To better understand the differences between intra-operative assessment of residual size and post-operative MRI findings.

Desired Result: At the end of presentation, the audience will develop an understanding of the concepts of near-total and sub-total excision of vestibular schwannomas and the advantages and limitations of volumetric analysis based on early post-operative MRI.

Level of Evidence – IV

Indicate IRB or IACUC: Protocol IRB# 19-022, approved by St. Vincent Medical Center Institutional Review Board

Surgical Technique and Outcomes of Sigmoid Sinus Resurfacing for Pulsatile Tinnitus at a Tertiary Care Center Hospital

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Craig A. Buchman, MD; Cameron C. Wick, MD

Objective: To evaluate the surgical technique, radiographic findings, and outcomes of sigmoid sinus resurfacing

Study Design and Setting: Retrospective chart review at tertiary care hospital

Patients: Adults ≥18 years of age with unilateral pulsatile tinnitus and imaging findings consistent with sigmoid sinus dehiscence who underwent resurfacing procedure between 01/2010 to 09/2019. Patient's with middle ear pathology were excluded.

Intervention(s): Transmastoid sigmoid resurfacing with bone cement.

Main Outcome Measure(s): Resolution of tinnitus, audiologic outcomes, and surgical complications

Results: A total of fifteen patients (87.3% females) were included. The average size of the sigmoid sinus dehiscence on imaging was 6.0 mm (range: 1-10 mm). All patients had documented sigmoid dehiscence on CT; six patients had a concurrent sigmoid sinus diverticulum and one patient had additional dehiscence along the jugular bulb. Of note, 13.3% of the radiographic findings were accurately identified by radiology. Low frequency hearing loss was measured at frequencies of 250, 500, and 1000 Hz. There was a significant improvement in low frequency pure tone average (PTA) following resurfacing (18.3 versus 10.2 dB, p= 0.003). The majority of patients had complete resolution of tinnitus symptoms (12/16, 67%). Of the remaining, 3 patients had partial resolution and 1 patient had no improvement. There were no significant complications.

Conclusions: Sigmoid sinus dehiscence represents a common vascular cause of pulsatile tinnitus. Sigmoid sinus resurfacing is a safe and effective treatment that may improve low-frequency hearing. Radiographic findings of dehiscence are often overlooked without a high index of clinical suspicion. Quality of imaging and awareness of the pathological ramifications are necessary for proper diagnosis.

Define Professional Practice Gap & Educational Need: Surgical management of sigmoid sinus dehiscence remains varied. The current study attempts to demonstrate that simple resurfacing of the sinus with bone cement is a safe and effective procedure**.** Sigmoid sinus dehiscence can present with a low frequency hearing loss that is often improved following surgery. Radiologic findings of sigmoid dehiscence are subtle and require a high index of suspicion

Learning Objective: Appropriate workup and management of unilateral pulsatile tinnitus. Representative CT scans to help clinicians identify subtle signs of sigmoid sinus dehiscence. Demonstrate that transmastoid resurfacing with bone cement is a safe and effective procedure without the need for bipolar cautery of sinus or gelfoam packing.

Desired Result: Improvement in low frequency hearing loss following surgery. Resolution of tinnitus following transmastoid resurfacing of sigmoid dehiscence

Level of Evidence – Level V

Indicate IRB or IACUC : Approved by institutional IRB (ID: 201910051)

Understanding Frailty in Vestibular Schwannoma Surgery

Geoffrey C. Casazza, MD; Matt McIntyre, BS; Hilary C. McCrary, MD
Clough Shelton, MD; Christian A. Bowers, MD; Richard K. Gurgel, MD

Objective: Understand the frailty for vestibular schwannoma surgical patients and how frailty impacts clinical course.

Study Design: Retrospective case-control.

Setting: Single tertiary academic hospital.

Patients: All patients undergoing vestibular schwannoma surgery.

Intervention: The modified frailty index (mFI) was calculated for all patients undergoing surgery for vestibular schwannoma between 2011 and 2018. Patient demographics and medical history, perioperative course, and post-operative complications were obtained from the medical record.

Main Outcome Measures: Basic statistical analysis was performed. Receiver operator curves (ROC) were generated to determine discriminatory value of parameters and Area under the curve (AUC) was used to compare the discriminatory power of frailty index with an AUC of 1.0 considered perfect discrimination and 0.5 equal to chance. ROC significance was determined using the Wilson and Brown method.

Results: 218 patients were identified. Mean age was 48.1±0.9 (range 12-77). 110 patients were male (50.5%). Mean ICU length of stay (LOS) (days) was 1.6±0.1 while mean total hospital LOS was 4.3±0.2. 145 patients (66.5%) had an mFI of 0 while 73 (33.5%) had an mFI of ≥1. Using the threshold of mFI of ≥1, frailty was associated with a prolonged hospital stay (≥6 days; OR=2.204; 95%CI: 1.065-4.503; p=0.0482) but not prolonged ICU stay (OR=0.9333; 95%CI: 0.3650-2.43; p>0.99). Frailty was not associated with post-operative complications (mFI ≥1: OR=0.9527; 95%CI: 0.4988-1.878; p>0.99; mFI ≥2: OR=1.363; 95%CI: 0.5325-3.604; p=0.61).

Conclusion: Increasing frailty is associated with longer hospital stays but not increased post-operative complications. This may reflect the overall health of patients undergoing surgery for vestibular schwannoma.

Define Professional Practice Gap & Educational Need: The literature on frailty and surgical outcomes has exploded over the past 5 years and has demonstrated the effect of frailty on surgical outcomes. No studies have evaluated frailty in vestibular schwannoma patients.

Learning Objective: Understand the levels of frailty in patients undergoing surgical for vestibular schwannoma surgery and how that frailty may impact surgical outcomes.

Desired Result: Develop an understanding of how frailty impacts vestibular schwannoma surgical outcomes and be able to incorporate this into clinical decision making.

Level of Evidence: Level IV

Indicate IRB or IACUC : University of Utah IRB 00045048

Assessment of Inter- and Intra-Rater Reliability of Tablet-Based Software to Measure Cochlear Duct Length

Shayna P. Cooperman, BA; Ksenia A. Aaron, MD
Matthew B. Fitzgerald, PhD; Nikolas H. Blevins, MD

Objective: OtoPlan® is a tablet-based software used to measure cochlear duct length (CDL) from computerized tomography (CT) scans. A previous investigation suggested good inter- and intra-rater reliability in a small cohort of cochleae (n=20). Here, we investigate the intra- and inter-rater reliability of OtoPlan® in a larger cohort of cochleae (n=192).

Study Design: Retrospective chart review study.

Setting: Tertiary referral center

Patients: Ninety-six adult pre-operative cochlear implant recipients were included in the study. Both cochleae were measured for each patient (n=192).

Interventions: Two raters measured the CDL of 192 cochleae to determine the inter- and intra-rater reliability of measurements made with the OtoPlan® software. To obtain a measurement of CDL, each rater individually identified the following parameters using the OtoPlan® interface: cochlear modiolus, angle of basal turn, cochlear height, round window and lateral wall. Inter-rater reliability was obtained by comparing the CDLs obtained from two independent raters. Intra-rater reliability was obtained by having each rater measure CDL for each cochlea on two separate occasions at least two weeks apart.

Main Outcome Measures: The primary outcome measure is the strength of the inter- and intra-rater reliability.

Results: Preliminary results suggest good inter- and intra-rater reliability for CDL measurements with the OtoPlan® software. Both inter- and intra-rater analyses revealed significant significant linear regression line slopes ($p < 0.05$ in each case).

Conclusions: OtoPlan® appears to produce reliable measurements of CDL. This result supports its potential use as a clinical instrument for selection of cochlear implant arrays based on patient anatomy.

Define Professional Practice Gap & Educational Need: It has been suggested that large discrepancies between cochlear duct length (CDL) and cochlear implant (CI) electrode length may negatively affect speech understanding outcomes. CDL is known to be highly variable across patients, ranging from ~ 25 to 35 mm. Software that can estimate CDL, such as OtoPlan®, therefore has the potential to facilitate the surgeon's ability to select the most appropriate electrode for a given patient. To date, OtoPlan® has only been validated in a small number of cochleae (n=20). However, its clinical utility will ultimately rest on how well it can accurately and faithfully report and replicate CDL in patients. Here, we address this issue by examining the inter- and intra-rater reliability of OtoPlan® in a large number of cochleae (n=192).

Learning Objective: At the conclusion of this session, learners will be able to describe the intra- and inter-rater reliability of the OtoPlan® software for measuring CDL.

Desired Result: Physicians and scientists will consider OtoPlan® as a tool to estimate CDL, which may allow for greater customization of cochlear implantation to individual patient anatomy.

Level of Evidence – Level IV: Historical Cohort or Case-Control Study

Indicate IRB or IACUC : IRB 50388 (approved 7/25/19), Stanford University

Arachnoid Granulations Predispose to Spontaneous CSF Leaks in Older Non-Obese Patients

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Monica L. Bodenstab, BS; Rita Bhatia, MD; Simon Angeli, MD

Objective: To compare demographics and clinical variables in patients with spontaneous cerebrospinal fluid (sCSF) otorrhea with and without arachnoid granulations (AG)

Study Design: Retrospective chart review of patients presenting with sCSF otorrhea at this institution from 2012 to 2019

Setting: Tertiary Referral Center

Patients: All patients with sCSF otorrhea

Main Outcome Measures: Clinical records were assessed for age, sex, race, body mass index (BMI), symptoms, radiographic findings, and operative findings

Results: 22 patients met criteria for sCSF of which 11 (50%) were found to have AG on imaging. Patients with AG were older in age (80.5 ± 5.2 years vs 49.3 ± 11.2 years, $p<0.001$) and with lower BMI (26.4 ± 2.1 vs 38 ± 3.7, $p<0.001$) compared to those without AG. There were no statistical differences between gender and race. All 22 patients (100%) had radiographic dehiscence of the tegmen on CT. Seven (64%) patients without AG, and 8 (73%) patients with AG had radiographic evidence of meningoencephalocele on MRI. Overall, hearing loss (9/11, 81.8%), otorrhea (7/11, 63.6%), and aural fullness (7/11, 63.6%) were the most common presenting symptoms.

Conclusions: Aberrant AG can occur in the middle cranial fossa, and over time can result in dehiscence of the skull base predisposing patients to meningoencephaloceles and sCSF leaks. In this cohort, we demonstrate the relationship of AG as the likely cause for sCSF in older non-obese patients, highlighting the importance of maintaining a high suspicion for sCSF in patients presenting with hearing loss and otorrhea in this demographic group.

Define Professional Practice Gap & Educational Need: Dehiscence of the tegmen of the temporal bone is an uncommon condition which can lead to herniation of brain tissue into the temporal bone with and without CSF otorrhea. This may result in life threatening sequelae such as meningitis and cerebral abscesses. Although dehiscence of the tegmen may arise from various causes, up to 18% are spontaneous. Prior studies have reported on the role of idiopathic intracranial hypertension as a common underlying cause commonly seen in young obese females. AG commonly occur in the middle fossa and over time can lead to dehiscence of the petrous pyramid, eventually becoming sites of CSF fistula or brain herniation. Thus, it is important for clinicians to have suspicion for tegmen bony defects in patients who present with hearing loss and otorrhea. This study demonstrates that AG can predispose patients to sCSF who are often older and of lower BMI as compared to the traditional young obese females with idiopathic intracranial hypertension. Furthermore, patients with AG related sCSF often require a middle cranial fossa approach for repair which predisposes to additional post-operative complications, particularly in the elderly

Learning Objective: To understand the role of AGs in predisposing patients to sCSF otorrhea, particularly in older non-obese patients. To learn the management of AG-related sCSF in the elderly. To discuss the options for repair of AG related sCSF leaks and its post-operative complications, particularly in the elderly population.

Desired Result: We hope that physicians will consider AG as a cause of a bony tegmen defects in older non-obese patients presenting with hearing loss and otorrhea. This would lead to more rapid identification and counseling to prevent serious life threatening sequelae.

Level of Evidence – Level IV, Historical Cohort or Case-Control Studies

Indicate IRB or IACUC : Approved. University of Miami, IRB # 20191057

Preservation of Serviceable Hearing after the Middle Cranial Fossa Approach to Vestibular Schwannomas: A Meta-analysis of 2,960 Surgeries

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C. Matthew Stewart, MD, PhD

Objective: Middle cranial fossa surgery (MCF) is a hearing preservation approach for removal of vestibular schwannomas (VS). The objective of this meta-analysis is to analyze the rate of successful serviceable hearing preservation (HP) after MCF.

Data sources: PubMed, Embase, Scopus, Web of Science, and Cochrane databases were queried in October 2019 for studies in English reporting outcomes or hearing results after middle fossa approach for vestibular schwannoma.

Study selection: Studies were eligible for inclusion if stratified pre- and postoperative hearing levels were available for ≥10 patients. Non-overlapping cohorts were selected for institutions with multiple publications.

Data extraction: Case volume and years, patient population characteristics, tumor size (intracanalicular or ≤1 cm vs. >1cm), reported HP rate, and hearing classes were recorded.

Data synthesis: 35 eligible studies representing 2,960 operated ears were identified from 1,075 publications. Serviceable HP rates were calculated as maintenance of preoperative hearing ≤50db PTA and ≥50% WRS (AAO-HNS Class A-B, Gardner-Robertson Class I-II) as well as by ≥50% WRS (WRS Class I-II). Pooled effect size for HP rate was computed via random effects models for the overall cohort and by tumor size.

Conclusions: Overall hearing preservation was 60% (CI 0.56-0.64) for AAO-HNS Class A-B and 71% (CI 0.65-0.76) for ≥50% WRS. For intracanalicular / small tumors, HP was 64% (CI 0.56-0.71) vs. 52% (CI 0.43-0.61) for tumors >1cm. There was significant cross-study heterogeneity (I^2=76.76%, τ^2=0.05, p=0.00, χ^2=146.31, p=0.00) but no significant publication bias. The MCF offers high rates of successful hearing preservation for removal of vestibular schwannomas, although a tumor size effect may be present.

Define Professional Practice Gap & Educational Need: Vestibular schwannomas are benign tumors but may cause significant impairment in patients' quality of life due to hearing and balance dysfunction. An increased emphasis has been placed on resection via hearing preservation techniques, such as the middle cranial fossa approach; however, the overall rate of hearing preservation for this approach has not been systematically analyzed across a large cohort of patients. This meta-analysis investigates the rate of serviceable hearing preservation after middle fossa surgery across the English literature.

Learning Objective: The middle cranial fossa approach for resection of vestibular schwannomas offers a 60% overall rate of hearing preservation (and as high as 71% for patients willing to wear amplification devices) for patients with serviceable hearing preoperatively.

Desired Result: Attendees will improve their ability to effectively counsel patients on the likelihood of serviceable hearing preservation associated with the middle fossa approach given preoperative hearing levels and tumor size characteristics.

Level of Evidence – III – Systematic review and meta-analysis of cohort studies

Indicate IRB or IACUC: Exempt.

Volumetric Analysis of Vestibular Schwannomas: Vestibular and Audiometric Correlates

Lucas G. Leonhard, MD; Gregory D. Avey, MD
G. Mark Pyle, MD; Joseph P. Roche, MD

Objective: To determine if vestibular schwannoma (VS) tumor volume, using volumetric analysis, is correlated with videonystagmography (VNG) and audiometric findings.

Study Design: Retrospective chart review series

Setting: Tertiary referral center

Patients and methods: Diagnosis codes were used to identify patients with VS over the last 15 years. Chart review was performed on all adult patients with MRI, VNG, and audiometric testing within one year of each other. Volumetric analysis was performed by a neuroradiologist using 3-dimensional software. Correlation coefficients were calculated for tumor volume, VNG, and audiometric results.

Main Outcome Measures: VNG measures included percent caloric weakness, peak warm and cold slow phase velocities, and inter-ear difference in peak warm slow phase velocity. Audiometric measures included inter-ear differences in pure tone averages (PTA) and word discrimination scores.

Results: 139 patients met final inclusion criteria. 88 patients had clinically significant (>20%) unilateral caloric weakness, with an average tumor volume of 2.94 mL. Patients without significant weakness had an average tumor volume of 0.46 mL ($p = 0.00002$). Tumor volume correlated with greater caloric weakness ($p < 0.00001$), lower warm and cold peak velocities ($p = 0.001072$ and 0.000164, respectively), and larger difference in warm peak velocity between the tumor and unaffected side ($p = 0.0154$). PTA difference did not correlate with tumor volume, but a decrease in word discrimination correlated with larger tumor volume ($p = 0.0056$).

Conclusions: Increasing tumor volume is correlated with decreased word discrimination and greater objective vestibular loss. This gives clinicians insight into patients' vestibular and hearing status based on tumor volume and may help guide expectations for post-treatment balance function.

Define Professional Practice Gap & Educational Need: Recent literature may suggest that pre-treatment vestibular status may predict postoperative recovery in patients with VS. Thus, correlating tumor volume and vestibular function may help guide expectations and decisions regarding patients' recovery following surgery. This is the first study to correlate 3-dimensional volumetric analysis of tumors with objective findings on VNG as well as with audiometric measures.

Learning Objective: 1). To describe the use of volumetric analysis in VS. 2). To report a correlation between VS tumor volume and objective vestibular function. 3). To report a correlation between tumor volume and audiometric measurements. 4)To discuss the use of this correlation and its impact on patient care

Desired Result: Attendees will gain an understanding of the correlation between VS tumor volume, vestibular status, and hearing, to better predict patients' vestibular and hearing deficits and to provide expectations in patients undergoing treatment.

Level of Evidence - V

Indicate IRB or IACUC : University of Wisconsin, Exempt

Cochlear Implant: Is Preoperative Imaging Necessary?

Diana Y. Lee, BS; James E. Saunders, MD

Objective: To determine utility of CT and MRI in cochlear implant candidates.

Study Design: Retrospective review.

Setting: Tertiary referral hospital.

Patients: 207 cochlear implanted patients with CT and/or MRI imaging.

Interventions: None.

Main Outcome Measures: Age vs. abnormal radiologic findings, imaging abnormality vs. postoperative outcomes, postoperative outcomes vs. electrode design for specific abnormalities, Cambridge Cochlear Implant Protocol (CCIP) status for imaging abnormalities, sensitivity/specificity of CT and MRI for cochlear occlusion and MRI for incomplete partitions.

Results: 174 patients were evaluated with CT and 68 with MRI (35 patients had both). 15.5% of CT scans had significant findings that might affect surgical intervention compared to 5.9% of MRI. No cases of cochlear nerve hypoplasia were identified. There was no age difference for relevant imaging abnormalities with either CT ($p = 0.972$) or MRI ($p = 0.2421$). CCIP status correlated with cochlear abnormalities ($p = 0.04002$); however, only 46.2% of radiographic abnormalities would be identified by these criteria. For detecting cochlear occlusion requiring surgical intervention, the sensitivity and specificity were 30% (95% CI 6.67-65.25) and 91.46% (95% CI 86.09-95.25) for CT and 50% (95% CI 1.26-98.74) and 96.97% (95% CI 89.48-99.63) for MRI. For detecting incomplete partitioning, the sensitivity and specificity of MRI were 25% (95% CI 0.63-80.59) and 100% (95% CI 88.78-100.00). There was no difference for post-op AzBio scores for higher grade imaging abnormalities ($p = 0.6012$) or different electrode design for those with incomplete partitioning ($p = 0.6739$).

Conclusions: Significant radiographic abnormalities are uncommon in cochlear implant patients on both CT and MRI. Neither age nor CCIP status predicts which patients are likely to have radiographic abnormalities. The sensitivity of imaging is quite low for significant intracochlear abnormalities and radiographic findings do not influence outcomes.

Define Professional Practice Gap & Educational Need: There is a lack of consensus on whether preoperative imaging is necessary in cochlear implant candidates.

Learning Objective: Practitioners will be able to consider using the CCIP in assessing which patients need a CT scan and may reconsider the trend toward MRI in adult cochlear implant candidates.

Desired Result: In patients who have higher chances of having normal radiologic findings based on the CCIP, preoperative imaging may be avoided, thus mitigating radiation exposure and costs.

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

IRB: Approved 2/6/2019, CPHS #STUDY00031568, Dartmouth-Hitchcock Medical Center

Current Management of CPAP after Otologic and Neurotologic Surgery

Nathan D. Cass, MD; Seilesh C. Babu, MD

Background: Obstructive sleep apnea (OSA) causes chronic hypoxia and sleep fragmentation, and is increasingly prevalent, affecting 17–24% of women and 34–49% of men. Continuous positive airway pressure (CPAP) reverses these respiratory disturbances and sleep fragmentation, but transmits high pressures to the middle ear via the Eustachian tube. Transient high middle ear pressures may have significant implications for CPAP users undergoing ear and lateral skull base surgery. In such patients, no guidelines exist for post-operative management of CPAP, nor is anything known of current management regarding this vitally important but potentially hazardous therapy.

Objective: We attempted to understand the current state of practice with regards to length and rationale of post-operative CPAP restriction in patients undergoing middle ear, stapes, cochlear implant, and lateral skull base surgeries.

Methods: ANS members were surveyed regarding their current management of post-operative CPAP for a variety of common otologic/neurotologic procedures.

Results: Few surgeons limit CPAP after cochlear implantation. Middle ear surgery and stapes surgery yield bimodal results, with many surgeons permitting immediate post-operative CPAP use, while others restrict for 1–2 weeks. Skull base surgery produces the longest average CPAP restrictions. With each procedure, some surgeons advocate immediate CPAP use post-operatively.

Conclusions: Current neurotology practice varies concerning CPAP management after otologic and lateral skull base surgeries, with regards to duration of CPAP abstinence and rationale for limitation. These results identify a clear need for further understanding the impact of administration or restriction of post-operative CPAP on surgical outcomes and both surgical and medical complications.

Define Professional Practice Gap & Educational Need: Despite a high population prevalence of OSA and known transmission of high pressure to the middle ear during treatment with CPAP, nothing is known of current practice regarding post-operative CPAP management in patients undergoing otologic or neurotologic procedures. Neurotologists would benefit from understanding the spectrum of current management strategies of post-operative CPAP. In addition, better understanding of current practice will help establish a baseline from which to further explore physiologic validity of rationales for CPAP restrictions.

Learning Objective: Describe practice variations in post-operative CPAP management among ANS members.

Desired Result: Recognize the need for further research regarding safety of post-operative CPAP use or restriction, in order to form evidence-based guidelines with which to administer more standard care for patients with OSA on CPAP.

Level of Evidence: 5

Indicate IRB or IACUC: Exempt

Intraoperative Predictors of Delayed Sensorineural Hearing Loss in Patients Undergoing a Middle Cranial Fossa Approach for Resection of Vestibular Schwannoma

Christopher Welch, MD, PhD; Gregory Mannarelli, AuD
Lindsay Koehler, AuD; Steven A. Telian, MD

Objective: To identify electrodiagnostic measures predictive of delayed progressive sensorineural hearing loss in the operative ear after undergoing a middle fossa approache (MCF) for resection of vestibular schwannoma.

Study Design: Retrospective review

Setting: Academic, tertiary referral center

Patients: Subjects with vestibular schwannoma who underwent a MCF approach for microsurgical resection between 2001 and 2019 were analyzed for individuals whose hearing was initially preserved but subsequently developed progressive sensorineural hearing loss in the operative ear. Thirty-one patients were identified for whom audiologic and electrodiagnostic data was available.

Hypothesis: Intraoperative electrodiagnostic measures will predict which subjects will develop delayed progressive sensorineural hearing loss in the operative ear

Main Outcome Measures: Pre- and post-operative audiologic evaluations, and intraoperative electrocochleography and auditory brainstem response (ABR) measures

Results: Sixteen subjects had progression of hearing loss in the operative ear comparable to the contralateral ear (speech reception threshold (SRT) difference of 10 dB or less), while in fourteen, an increase in the hearing asymmetry between the ears was noted (SRT difference of 15 dB or greater). There were no significant differences in tumor size or age between the two groups ($p > 0.05$). The final amplitude change of wave V of the ABR predicted delayed sensorineural hearing loss in the operative ear ($p < 0.05$, 7% improvement with symmetric hearing loss, 14% decline with progressive asymmetry), but transient changes did not ($p > 0.05$).

Conclusions: The final amplitude change of wave V of intraoperative ABR testing, rather than transient changes, predicts delayed progressive sensorineural hearing loss in the operative ear.

Define Professional Practice Gap & Educational Need: 1. Intraoperative measurements may provide counsel to patients after the middle fossa approach to resection of vestibular schwannoma regarding hearing stability but the current utility of these measures is poorly understood

Learning Objective: 1. Attendees will identify intraoperative measures that may provide counsel to patients regarding hearing stability after middle fossa approaches for resection of vestibular schwannoma with a goal of hearing preservation.

Desired Result: Attendees will understand the utility of intraoperative electrodiagnostic measures in predicting post-operative hearing stability or progressive hearing loss after the middle fossa approach to resect a vestibular schwannoma.

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

Indicate IRB or IACUC: Exempt – data utilized from a de-identified database

The Reality of Hearing Preservation in Cochlear Implantation: Who is Really Benefiting?

Elizabeth Perkins, MD; Jacyln Lee, BS; Matthew O'Malley, MD
Marc Bennett, MD; Alejandro Rivas, MD
David S. Haynes, MD; René Gifford, PhD

Objective: To define the proportion of subjects successfully fit with combined electroacoustic stimulation (EAS) in the setting of hearing preservation following cochlear implantation (CI). To report 12-month speech perception outcomes of subjects fit with EAS at a large tertiary referral center.

Study Design: Retrospective chart review

Setting: Tertiary referral center

Patients: 482 post-lingually deafened adults with bilateral SNHL and a pre-operative threshold 80 dB HL or better at 250 Hz.

Interventions: Subjects underwent CI from 2013-2018 with routine post-operative audiometric testing performed at 1-, 3-, 6-, and 12-months.

Main Outcome Measures: Hearing preservation was defined as thresholds of 80 dB HL or better at 250 Hz following activation. Pre- and post-operative CNC word recognition was analyzed over the first year of CI use in the implanted ear and bilateral condition.

Results: 45% (n=219) of subjects had hearing preserved at CI activation. Of those subjects, 30% were fit with EAS after activation. Mean pre-operative LFPTA (125-500 Hz) was 40 dB HL vs. 62 dB HL at 12-months (n= 55). Mean pre-operative CNC scores were 26% and 44% for the ear to be implanted and bilateral conditions, respectively. Mean post-operative CNC scores at 12 months was 54% and 74% for the implanted ear and bimodal/bilateral conditions ($p < 0.001$).

Conclusions: Despite a large number of patients with hearing preserved post-operatively, one-third of subjects were actually fit with EAS. Excluding the loss of residual acoustic hearing over time and patient preference, EAS is under-utilized. Combined EAS continues to demonstrate significant benefit for the CI user with improved word recognition at 12-months compared their pre-operative condition.

Define Professional Practice Gap & Educational Need: Within our field we have a tendency to report hearing preservation rates following cochlear implantation, but the question arises: how many patients actually benefit from hearing preservation? With this study we aimed to report the incidence of subjects fitted with combined EAS compared to those who had hearing preserved after CI.

Learning Objective: To develop a better understanding of the patients that may benefit from EAS and recognize the potential under-utilization of EAS.

Desired Result: Encourage surgeons and audiologists to consider fitting subjects with EAS who meet criteria.

Level of Evidence - IV

Indicate IRB or IACUC : Exempt

Preoperative Caloric Testing Is a Poor Predictor of Postoperative Dizziness

Isaac D. Erbele MD; Sara MacDowell, DPT
Moises A. Arriaga, MD, MBA

Objective: Preoperative vestibular testing can be used to determine the degree of residual vestibular function in a patient with a vestibular schwannoma. The presence of vestibular function is frequently used to educate patients on their expected vestibular insult and discomfort. This purpose of this study was to evaluate patient's perceived vestibular function as it related to their surgery, and how this relates to their preoperative caloric testing.

Study Design: Retrospective case series

Setting: Tertiary care center

Patients: Adults undergoing excision of vestibular schwannoma with preoperative caloric testing between January 2015 and August 2019.

Interventions: Diagnostic, Therapeutic

Main Outcome Measures: Unilateral vestibular weakness; dizziness handicap index obtained preoperatively, two weeks postoperatively, and more than three weeks postoperatively

Results: A total of 74 patients who received translabyrinthine, retrosigmoidal, or middle cranial fossa vestibular schwannoma excision during the study period. The average ipsilateral vestibular weakness on caloric testing was 51% (+/- 32%). The average dizziness handicap index at the preoperative, two weeks postoperative, and greater than three weeks postoperative time points were 26 (+/-27), 28 (+/-27), and 24 (+/-23), respectively. Correlation was not found between preoperative unilateral vestibular weakness and dizziness handicap index at the preoperative (0.14), two weeks postoperative (-0.07), or more than three weeks postoperative time points (0.15).

Conclusions: Preoperative caloric testing is a poor predictor of the degree of postoperative dizziness at two weeks and beyond.

Define Professional Practice Gap & Educational Need: Role of vestibular testing in vestibular schwannoma surgery

Learning Objective: Assess utility of preoperative caloric testing in predicting postoperative dizziness

Desired Result: Recognize that preoperative residual vestibular function may not correlate with patient's perceived dizziness after vestibular schwannoma excision.

Level of Evidence - Level IV

Indicate IRB or IACUC : Approved. Our Lady of the Lake Regional Medical Hospital, Baton Rouge, LA #10282

The Accuracy of High-Resolution Computed Tomography for the Evaluation of Stapes Prosthesis Dimension in Revision Stapedectomy

Peter Filip MD; Rocco Ferrandino MD
George B. Wanna MD; Azita S. Khorsandi, MD

Objective: to evaluate the accuracy of high-resolution computed tomography (CT) in stapes prosthesis length measurements for patients status post revision stapedectomy.

Study Design: A retrospective review investigating the accuracy of CT measurements of stapes prosthesis in revision stapedectomy

Setting: Tertiary center; ambulatory setting

Patients: 300 patients status post revision stapedectomy were reviewed. 38 had postoperative high resolution CT and were eligible for our study.

Interventions: retrospective chart review

Main Outcome Measures: Stapes prosthesis length and type were collected. Length of stapes prosthesis was calculated from postoperative CT by a neuroradiology attending. These measurements were compared using a two sample paired t-test.

Results: Based on a two sample paired t-test, on average, high resolution CT underestimates the length of these prosthesis by 0.52 mm (SD = 0.72, $p < 0.001$). Sub group analysis of prosthesis type yielded no significant differences.

Conclusions: High resolution CT does not provide an accurate estimation of prosthesis length in revision stapes surgery. Regardless of prosthesis subtype, measurement of insertion depth of prostheses in the vestibule should be interpreted with caution and clinical judgment is warranted in case of failure.

Define Professional Practice Gap & Educational Need: Controversy regarding the accuracy of CT on stapes prosthesis dimensions and placement exists in the literature due to a paucity of data, particularly in revision stapedectomy. Diverging conclusions exist and data is mostly cadaveric. High quality studies are needed to clarify this relationship and explore clinical implications.

Learning Objective: The length of CT measurements of stapes prostheses is inaccurately calculated from CT. The type of implant may not affect this accuracy.

Desired Result: accurate measurement of stapes dimensions using CT

Level of Evidence – Level IV

Indicate IRB or IACUC : IF2141732

Episodic versus Chronic Dizziness: An Analysis of Predictive Factors

Eric J. Formeister, MD, MS; Emily Wong, BS
Whitney Chiao, MD; Katrina Luong, AuD
Lauren Pasquesi, AuD; Jeffrey D. Sharon, MD

Objective: To explore the sociodemographic and clinical characteristics in those with episodic and chronic dizziness, in order to better understand differences between these two types of dizziness.

Study Design: Cross-sectional, observational.

Setting: Tertiary center.

Patients: The study consisted of 217 adults referred for dizziness evaluation at one tertiary center.

Interventions: N/a.

Main Outcome Measures: Chronic dizziness, as defined by >15 dizzy days per month.

Results: Two hundred and seventeen adults (average age, 53.7 years; 56.7% female) had complete histories, physical exams, audiometric testing, and vestibular testing available. One-third (n=74) met criteria for chronic dizziness. Dizziness handicap inventory (DHI) scores were significantly higher in those with dizziness compared to those with episodic dizziness (53.9 vs. 40.7; $p<0.001$). The most common diagnosis overall was vestibular migraine (46.1%), followed by vestibular hypofunction (15.2%) and Ménière's disease (13.4%). Comorbid depression and anxiety was more prevalent in those with chronic dizziness (44.6% and 47.3% versus 37.8% and 35.7%, respectively; $p>0.05$). Abnormal vestibular testing, including VNG calorics, VHIT, oVEMPs, and cVEMPS, as well as abnormal imaging studies, including CT and MRI, did not differ significantly between the two groups. However, abnormal audiograms were more prevalent in those with episodic dizziness (64.3%) versus those with chronic dizziness (45.9%; $p=0.009$). With the exception of Ménière's disease, specific diagnosis was not associated with episodic versus acute dizziness.

Conclusions: Those who suffer from chronic dizziness have significantly higher DHI scores and significantly lower rates of abnormal audiograms. Depression and anxiety are highly prevalent in those referred to tertiary vestibular centers, and higher in those with chronic dizziness compared to episodic dizziness.

Define Professional Practice Gap & Educational Need: Currently, little is known about factors that lead to the chronification of dizziness symptoms.

Learning Objective: To attempt to understand why some patients have episodic symptoms versus chronic symptoms with vestibular disorders.

Desired Result: To better understand what constitutes chronic dizziness and to illuminate characteristics that might predispose one to experiencing chronic dizziness.

Level of Evidence - III

Indicate IRB or IACUC: This study was approved by the University of California – San Francisco's Institutional Review Board (IRB# 18-25365).

Predicting Hearing Outcomes in Acoustic Neuroma Patients Utilizing Magnetic Resonance Imaging

A. Morgan Selleck, MD; Justin Rodriguez, MD
Kevin Brown, MD, PhD

Objective: Evaluate the relationship between hearing outcomes and fluid-attenuated inversion recovery (FLAIR) signal of the cochlea and cerebrospinal fluid (CSF) fundal cap in expectantly managed acoustic neuroma patients.

Study design: Retrospective chart review.

Setting: Tertiary academic referral center.

Patients: Three hundred and fifty-two adults with an acoustic neuroma who underwent expectant management with serial audiograms and magnetic resonance imaging (MRI)

Intervention(s): Audiogram and MRI

Main outcome measure(s): Hearing outcomes included pure tone average (PTA) and word discrimination score (WRS). Cochlear signal was measured as a ratio between the affected and non-affected cochlea. The CSF fundal cap was measured from the most lateral aspect of the tumor to the fundus of the internal auditory canal.

Results: Utilizing linear regression models and univariate regressions with the initial audiogram and MRI data, cochlear signal intensity was positively associated with increasing PTA ($p = 0.043$) and negatively associated with worsening WRS ($p = 0.001$). The change in hearing outcomes from the initial audiogram to a subsequent, greater than one year from the initial, was compared to the initial MRI data. As fundal cap size increased the average change in WRS decreased ($p = 0.037$). A similar, but non-significant, relationship was found between fundal cap size and average change in PTA ($p = 0.110$).

Conclusions: CSF fundal cap size predicts the natural history of hearing in acoustic neuroma patients. A smaller fundal cap may lean towards surgical intervention in attempts to preserve hearing that may otherwise be lost.

Define Professional Practice Gap & Educational Need: Lack of predictive factors for future hearing loss in patients with acoustic neuromas.

Learning Objective: 1. Attendees will understand the relationship between hearing outcomes and cochlear signal intensity and CSF fundal cap in the acoustic neuroma patient.

Desired Result: Attendees will appreciate the importance of the initial CSF fundal cap on predicting future hearing outcomes in the acoustic neuroma patient and utilize this as a part of the decision-making process.

Level of Evidence – Level IV – historical cohort or case-control studies

Indicate IRB or IACUC : Approved, UNC IRB, 18-1615 on 7/2/18

ANS POSTER F042

Association of Inner Ear Function and Extent of Pneumolabyrinth

Jennifer L. Anderson, MD, PhD; Philip L. Perez, MD
Andrew A. McCall, MD; Barton F. Branstetter, MD
Barry E. Hirsch, MD

Objective: Associate radiologic factors of pneumolabyrinth with clinical features

Study Design: Retrospective case series

Setting: Tertiary care institution

Patients: Patients with pneumolabyrinth on computed tomography obtained between 2010 and 2019 at our institution were eligible for inclusion.

Interventions: None

Main Outcome Measures: Data collected included extent and location of pneumolabyrinth, mechanism of pneumolabyrinth, clinical report of hearing loss, clinical report of vestibular symptoms, and audiometric data. Extent of pneumolabyrinth was graded from 1 to 5, ranging from punctate foci to involvement of entire vestibule.

Results: Thirty-nine patients were identified with pneumolabyrinth, with a median age of 29 (range 8-84) and 33% were female. Audiometric data and vestibular symptomatology were available for 33 and 35 patients, respectively. 66.7% of patients were anacoustic and 60% reported vestibular symptoms. Patients with higher grade pneumolabyrinth (4 or 5) trended toward a higher rate of anacusis (90%) compared to patients with lower grade (1 or 2) (56.3%, χ-square $P = 0.07$). Additionally, all three patients with pneumolabyrinth in the cochlea, vestibule, and semicircular canals were anacoustic. Patients with pneumolabyrinth involving the semicircular canals had a higher rate of vestibular symptoms (77.8%) compared to patients with pneumolabyrinth limited to vestibule and/or cochlea (41.2%, χ-square $P = 0.03$). Otic capsule violation was not significantly associated with hearing loss or vertigo.

Conclusions: Greater volume and distribution of pneumolabyrinth are associated with higher risk of anacusis and vestibular symptoms. A significant percentage of patients with pneumolabyrinth retain hearing and are not dizzy despite the presence of air within the inner ear.

Define Professional Practice Gap & Educational Need: Prognostication for pneumolabyrinth

Learning Objective: Identify radiographic features of pneumolabyrinth that affect clinical outcomes

Desired Result: Improved patient counseling

Level of Evidence - V

Indicate IRB or IACUC: UPMC STUDY19080261, approved 9/17/19

Music Perception in Bone Anchored Hearing Device Users

Eric Formeister, MD, MS; Divya Chari, MD; Amer Alsoudi, BS
Nicole Jiam, MD; Patpong Jiradejvong, MS; Charles Limb, MD

Objective: To compare music perception in bone-anchored hearing device (BAHD) users to normal hearing (NH) controls.

Study Design: Cross-sectional, observational.

Setting: Tertiary center.

Patients: The study consisted of 6 BAHD users with unilateral hearing loss and 11 NH controls.

Interventions: N/a.

Main Outcome Measures: Performance on seven basic tests of music perception, including pitch, harmonics, polyphonic pitch, timbre, rhythm, tempo, and melody.

Results: BAHD users performed comparably well on all tests of music perception in the unilateral condition with their device compared to the unilateral condition with their better hearing ear, though small differences were observed. Similarly, BAHD performance was not statistically significantly different from NH control performance for any of the 7 tests except for timbre identification (91.9±2.2% accurate in controls vs. 80.1±3.6% accurate in BAHD ear; p=0.01). The music perception tests with the largest performance gap between the better hearing ear and the BAHD ear were melodic contour identification (mean difference, 9.9±21.5%) and harmonic chord discrimination (mean difference, 7.3±8.8%). Interestingly, control subjects performed more poorly on tests of rhythm and tempo than BAHD subjects using their BAHD and their contralateral better hearing ear (performance gap range, 7.1–10.8±2.5–8.2%).

Conclusions: This pilot study reveals that BAHD users perform as well with their device as with their contralateral better hearing ear, and as compared to NH controls in most tests of basic music perception besides timbre, which could be due to the increased spectral complexity in this task. Further testing will establish specific music perception challenges that could help guide device improvement and enhance the musical experience in BAHD users.

Define Professional Practice Gap & Educational Need: Currently, almost no literature exists regarding music perception and bone-anchored technology in those with unilateral hearing loss.

Learning Objective: To describe the limitations in music perception for bone anchored hearing device users with unilateral hearing loss through seven perceptual tests of various musical elements.

Desired Result: Better understanding of how music perception may be limited in those who rely on bone anchored hearing devices, even with preserved contralateral hearing.

Level of Evidence – III

Indicate IRB or IACUC : This study was approved by the University of California – San Francisco's Institutional Review Board (IRB# 17-24141).

Cochlear Implantation After Prolonged Unilateral Auditory Deprivation

Joseph T. Breen, MD; Noga Lipshitz, MD
Nicole Ritter; Theresa J. Hammer, AuD
Lisa A. Wenstrup, AuD; Ravi N. Samy, MD

Objective: Review outcomes after cochlear implantation (CI) for patients with prolonged unilateral auditory deprivation.

Study Design: Retrospective chart review (2016-2019).

Setting: Academic medical center.

Patients: Adults meeting traditional CI criteria in either ear who were not utilizing a hearing aid in one ear with severe to profound hearing loss for at least 5 years prior to implantation.

Interventions: Cochlear implantation.

Main Outcome Measures: Percentage correct on aided speech testing. Performance in the bilateral best aided preoperative condition was compared to postoperative performance with the CI only.

Results: Fourteen patients met criteria (mean deprivation time = 19.3y, median 17.5y) - 9 implanted on the side of prolonged deprivation and 5 implanted on the non-deprived side. In the deprived ear group, mean CNC word score improved slightly from 18.9% to 29.8% ($p = 0.24$) and mean AzBio sentence score decreased from 31.7% to 25% ($p = 0.58$). In the non-deprived ear group, mean CNC improved from 7% to 53% ($p = 0.0007$), and mean AzBio increased from 17% to 53% ($p = 0.29$). A trend towards better postoperative CNC ($p = 0.069$) and AzBio (0.19) scores were seen in the non-deprived ears compared to the deprived ears. Three additional deprived side patients were not using their device at last follow up.

Conclusions: While a subset of deprived-side implantees experienced significant benefit, the majority performed worse with their CI than with binaural hearing aids preoperatively, and non-deprived ear implantees saw greater absolute gains in hearing with implantation than the deprived ear group.

Define Professional Practice Gap & Educational Need: Patients with longstanding asymmetric hearing loss not amenable to hearing aids on the worse side may become cochlear implant candidates after contralateral hearing decline. Patients may hesitate to implant the only ear that provides any benefit from a hearing aid, despite generally lower expectations for implant performance on the long-deprived side. There is a gap in the literature regarding hearing outcomes after prolonged asymmetric hearing loss with unilateral complete auditory deprivation.

Learning Objective: Understand outcomes after cochlear implantation for a subset of patients with unilateral prolonged auditory deprivation.

Desired Result: The audience will be able to compare hearing outcomes seen after cochlear implantation on the deprived side with those on the non-deprived side for patients with prolonged unilateral auditory deprivation and choose the optimal ear to implant in their own similar patients.

Level of Evidence - IV

Indicate IRB or IACUC : University of Cincinnati 2017-3890
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Circulatory Otologic Biomarkers in Meniere's Disease and Vestibular Migraine

James G. Naples, MD; Khalili Rahman, BS; Drew Soda, BS
Michael J. Ruckenstein, MD; Kourosh Parham, MD, PhD

Objective: There is emerging evidence to suggest a role for prestin and otolin-1 as peripheral biomarkers of otologic disorders. Meniere's disease (MD) is a peripheral otologic disorder that can be difficult to distinguish from central disorders that cause vertigo such as Vestibular Migraine (VM). Here we evaluate a potential role for prestin and otolin-1 as peripheral otologic-specific biomarkers in differentiating MD from VM.

Study Design: Prospective, cohort study

Setting: High-volume, University setting

Patients: 19 patients with Definite/Probable MD based on AAO-HNS criteria and 12 patients with VM based on ICHD-3 criteria were included in the study.

Interventions: Peripheral blood draw was performed, and serum evaluated with enzyme-linked immunosorbent assay (ELISA) to obtain prestin and otolin-1 values. Qualitative statistical analysis was performed between groups using independent samples t-test.

Main Outcome Measures: Prestin and otolin-1 levels between cohorts

Results: There were 19 MD and 12 VM patients who had serum collected for analysis. One of the VM patient samples was hemolyzed and removed from analysis. In the 19 MD patients, the mean prestin level was 2.33±0.81 ng/ml (mean ± SEM) compared to 0.64±0.10 ng/ml in the VM patients ($p=0.011$). Similarly, otolin-1 levels in MD patients (109.67±42.5 pg/ml) were significantly elevated relative to VM patients (30.96±6.00 pg/ml) ($p=0.037$).

Conclusions: Prestin and otolin-1 levels were elevated in MD subjects relative to VM subjects. These results suggest that otologic biomarkers may have a role in differentiating between MD and VM subjects.

Define Professional Practice Gap & Educational Need: Meniere's disease is a peripheral otologic disorder that has symptoms which overlap with the central disorder of vestibular migraine. Emerging research has raised the prospect of inner-ear-specific biomarkers in circulation, such as prestin and otolin-1, which may have applications to otologic disorders. Application of these biomarkers would address the practice gap of differentiating MD and VM by potentially offering a tool to determine if the symptoms are otologic or central in nature.

Learning Objective: To recognize an emerging role for inner ear biomarkers in circulation as a potential tool to differentiate MD from VM.

Desired Result: The desired result is that physicians learn of the potential utility of inner ear biomarkers in differentiating patient with MD and VM. Additionally, we hope that these results lay the foundation for the possibility of offering biomarkers as a resource to improve diagnosis of MD and VM.

Level of Evidence – Level III

Indicate IRB or IACUC : IRB Protocol # 829041

Single versus Multiple Cycles of Canalith Repositioning Procedure for Benign Paroxysmal Positional Vertigo: Randomized Controlled Trial

Suwicha Isaradisaikul Kaewsiri, MD; Sanathorn Chowsilpa, MD
Charuk Hanprasertpong, MD; Tayaporn Rithirangsriroj, MD

Objective: To compare the treatment outcomes and complications of single versus multiple cycles of canalith repositioning procedure (CRP) for unilateral posterior canal benign paroxysmal positional vertigo (PSC BPPV).

Study Design: Randomized controlled trial.

Setting: Tertiary academic center.

Patients: 143 PSC BPPV adults with unilateral positive Dix-Hallpike test (DHT)
Interventions: Single versus multiple cycles of CRP.

Main Outcome Measures: Rate of negative DHT, symptom improvement, complications, and dizziness handicap inventory score (DHI) after CRP at day 0, 7 and 28.

Results: Between single cycle and multiple cycle groups; patients' characteristics included age (57.1 and 55.0 years), female to male ratio (2.35:1 and 2.64:1), numbers of vertigo attacks per day (2 and 2.5), affected ear (right vs. left; 1:1.2 and 1:1.2), DHI scores showed no difference. After CRP at day 7 and 28: 1) Rate of negative DHT (82.5% and 84.3%; *p*-value = 0.71, 89.5% and 88.9%; *p*-value = 0.84); 2) Rate of complete recovery or improved symptoms (96.5% and 92%; *p*-value = 0.37, 96.5% and 98.0% 0.62); 3) DHI grading scale (*p*-value = 0.08 and 1.0) between single cycle and multiple cycle groups showed no significant difference. Rate of complications in the single cycle group, day 0, (93.1%) was lower than in multiple cycle groups (78.9%); *p*-value = 0.014, power of test = 98.9%).

Conclusions: Single cycle of CRP is as effective as multiple cycle CRP, with a lower complication rate and decreased time for treatment. Single cycle CRP is a preferable treatment for unilateral PSC BPPV.

Define Professional Practice Gap & Educational Need: 1. CRP is a treatment of choice for PSC BPPV; variation of CRP technique has been reported. 2. Improvement of CRP technique with excellent treatment outcomes to maximize patient comfort should be investigated.

Learning Objective: 1. To confirm the effectiveness of this new technique of CRP and its complications. 2. Better CRP treatment techniques should improve patient care and shorten the physician's time while implementing CRP treatment.

Desired Result: 1. Consider the use of single cycle CRP to treat PSC BPPV. 2. Initiate other treatment outcomes, long term results and further studies to confirm the use of single cycle CRP

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

Indicate IRB or IACUC: Approved, research ID: 3601; Chiang Mai University Hospital.

Fluorescent Detection of Vestibular Schwannoma Using Intravenous Sodium Fluorescein In Vivo

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Xue-Zhong Liu, MD, PhD; Fred F. Telischi, MD
Michael Ivan, MD; Christine T. Dinh, MD

Hypothesis: Intravenous sodium fluorescein (SF) preferentially deposits in vestibular schwannomas (VS), helping surgeons differentiate tumor from normal surrounding tissue.

Background: Because VS are closely associated with the facial nerve, brainstem, and cerebellum, clear identification of the tumor-tissue interface could improve surgical outcomes in difficult cases. SF is a fluorescent compound with preferential uptake in various intracranial tumors, causing tumors to emit green fluorescence after blue light excitation.

Methods: Mouse merlin-deficient Schwann cells were grafted onto the cochleovestibular nerve of 8 immunodeficient rats. Rats were randomized to receive intravenous SF (7.5 mg/kg; n=5) or saline (n=3). Relevant tissues were harvested at 1 hour and photographed in white and blue light. Sixteen surgeons identified and marked the tumor-tissue interfaces on images in a blinded manner. Fluorescence intensities (in total flux) of different tissues were measured using an in vivo imaging system (IVIS). Confocal images were performed on tissue cross-sections.

Results: Under blue light, tumors from SF rats demonstrated brighter green fluorescence under direct visualization, significantly higher fluorescence intensity measurements on IVIS imaging ($p<0.001$), and significantly more SF deposition on tissue cross-sections ($p<0.001$), when compared to surrounding tissues and placebo rats. Furthermore, surgeons distinguished the tumor-tissue interfaces significantly better using blue light in SF rats ($p<0.05$).

Conclusions: In a xenograft model of VS, intravenous SF preferentially deposits in tumors, compared to normal surrounding tissue. Under blue light, tumors emit an intense green fluorescence that can help surgeons differentiate tumor from critical structures nearby, which may improve clinical outcomes in complicated VS surgery.

Research Support: Alpha Omega Alpha Postgraduate Research Award (Szczupak), NIH/NIDCD 1K08DC017508 (Dinh), and NIH/NIDCD R01DC017264 (Fernandez-Valle & Liu)

Define Professional Practice Gap: Difficulty identifying the tumor and brain/nerve interfaces during vestibular schwannoma surgery can lead to brainstem, cerebellar, and cranial nerve injuries, which are devastating clinical outcomes in patients with vestibular schwannoma.

Educational Need: There is a need to inform physicians that fluorescence-guided microsurgery could potentially improve surgical outcomes in patients with complicated vestibular schwannoma tumors.

Learning Objective: Understand the potential surgical utility of intravenous sodium fluorescein in detecting vestibular schwannoma and distinguishing tumor from critical structures nearby during vestibular schwannoma surgery.

Desired Result: Gain in physician knowledge that intravenous sodium fluorescein can preferentially deposit in vestibular schwannoma when compared to normal surrounding tissues. Gain in physician knowledge that intravenous sodium fluorescein and fluorescence-aided microsurgery can potentially improve surgical outcomes in complicated VS surgeries.

Level of Evidence: N/A

IACUC: University of Miami, IACUC #18-149

Consensus Statement on Sporadic Vestibular Schwannoma: A Multidisciplinary Delphi Study

Matthew L. Carlson, MD; Michael J. Link MD; Colin L.W. Driscoll, MD
David S. Haynes, MD, MBA; Heather A. Billings, PhD
and the Vestibular Schwannoma Delphi Panel

Objective: To address variance in clinical care surrounding sporadic vestibular schwannoma (VS), a series of consensus statements were created using a modified-Delphi method to inform the development of a consensus guideline.

Study Design: Modified Delphi Method

Methods: The multidisciplinary Delphi task force was established with deliberate representation from key stakeholder societies and comprised 16 VS experts (8 neurotology and 8 neurosurgery). The modified Delphi consensus method encompassed a four-step process, comprised of one pre-voting round to establish a list of focus areas, and 3 subsequent voting rounds to successively refine individual statements and establish levels of consensus. Thresholds for achieving moderate consensus, at >67% agreement, and strong consensus, at >80% agreement, were determined a priori. All voting was performed anonymously via the Qualtrics online survey tool and full participation from all Delphi members was required before procession to the next round.

Results: Through the Delphi process, candidate items were developed and voted upon, encompassing: hearing outcomes (N=49), tumor control and imaging surveillance (N=20), preferred treatment (N=24), operative considerations (N=4), and complications (N=6). As a result of item refinement, moderate (4%) or strong (96%) consensus was achieved in 103 statements. A flowchart outlining the course of item development and select representative statements will be presented.

Conclusions: This Consensus Statement on Sporadic Vestibular Schwannoma addresses clinically pragmatic items that have direct application to everyday patient care. This document is not intended to define standard of care or drive insurance reimbursement, but rather to provide a general framework to approach VS care for providers and patients.

Define Professional Practice Gap & Educational Need: Currently there exists tremendous disparity in vestibular schwannoma patient counseling and management.

Learning Objective: To present the results of a recent multidisciplinary consensus statement on sporadic vestibular schwannoma care.

Desired Result: To establish a general framework to approach vestibular schwannoma care for providers and patients

Level of Evidence: Not applicable

Indicate IRB or IACUC: Exempt.

Disease-specific Quality-of-Life in Sporadic Vestibular Schwannoma: A National Prospective Longitudinal Study Comparing Observation, Microsurgery, and Radiosurgery

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

Objectives: Traditional benchmarks used to assess vestibular schwannoma (VS) outcome include facial nerve function, hearing preservation, and tumor control. In recent years, quality-of-life (QOL) outcomes have come to the forefront of investigation.

Study Design: Prospective longitudinal study using the disease-specific Penn Acoustic Neuroma Quality-of-Life (PANQOL) index.

Setting: National survey

Patients: Patients diagnosed with unilateral VS who completed a baseline survey before treatment and at least one post-treatment survey.

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

Results: The 370 patients studied included 118 (32%) who elected observation, 172 (46%) with microsurgery, and 80 (22%) with stereotactic radiosurgery (SRS). Patients who underwent microsurgery were younger ($p<0.001$) and had larger tumors ($p<0.001$) than the observation and SRS groups, but there was no significant difference in duration of follow-up (average 2.1 years). After adjusting for age and tumor size, there were no statistically significant differences by treatment group in QOL changes from baseline for the facial ($p=0.10$), general health ($p=0.94$), balance ($p=0.82$), hearing ($p=0.43$), energy ($p=0.35$), and pain ($p=0.26$) domains or total score ($p=0.93$). However, there was a statistically significant difference for the anxiety domain ($p=0.038$). Specifically, the microsurgery group demonstrated significant improvement in anxiety from baseline to the most recent survey, improvement that was better than the observation ($p=0.037$) and SRS ($p=0.18$) groups.

Conclusions: In this first prospective study investigating differences in disease-specific QOL among VS treatment groups, treatment did not modify QOL for most domains. Microsurgery may confer an advantage with regard to patient anxiety, presumably relating to the psychological benefit of "cure" from having the tumor removed.

Define Professional Practice Gap & Educational Need: The management of vestibular schwannoma remains controversial and nuanced. To date, there is no compelling evidence to support one particular treatment strategy over another for small and medium-sized vestibular schwannoma.

Learning Objective: To present the results of a large national prospective disease-specific quality-of-life study in sporadic vestibular schwannoma that compares outcomes according to treatment modality.

Desired Result: Learners will understand the impact of treatment modality on vestibular schwannoma quality of life outcome, which in turn may inform patient counseling and choice of treatment.

Level of Evidence: Level II.

Indicate IRB or IACUC: 14-009331.

Magnetic Resonance Imaging Fluid Signal Intensity in the Diagnosis of Temporal Bone Cerebrospinal Fluid Leaks

Joseph T. Breen, MD; Arun Raghavan, BS (presenter)

Objective: To examine the utility of objectively measuring signal intensity created by middle ear or mastoid fluid on magnetic resonance imaging (MRI) sequences in differentiating cerebrospinal fluid (CSF) leaks from other chronic middle ear effusions (MEEs).

Study Design: Retrospective imaging analysis.

Setting: Academic medical center.

Patients: Adults with MEE seen on MRI who were diagnosed as having either CSF or non-CSF MEE.

Interventions: Custom MATLAB software automatically segmented fluid collections within the middle ear and mastoid imaged on volume-acquired T2-weighted (3DT2) MRI sequences (e.g. CISS, FIESTA). The mean, standard deviation, and range of fluid signal intensity were compared to those of adjacent CSF in the posterior fossa.

Main Outcome Measures: The ratio of the mean signal intensity of the MEE to that of CSF was calculated. Signal intensity similarity (ratio approaching 1) was assumed to be diagnostic of CSF leak. Receiver operator characteristic analysis was performed to determine the best ratio threshold for accurately differentiating CSF leaks from other MEEs.

Results: Twenty-one patient with CSF leaks and 14 patients with other MEEs and adequate 3DT2 MRI sequences were included. Mean signal intensity ratio was 0.738 (+/- 0.020) for the leak patients and 0.475 (+/- 0.153) for the other MEEs ($p = 0.00024$). When a threshold ratio for diagnosis of CSF leak of 0.498 was selected, a sensitivity of 100% and specificity of 80% was obtained, with an overall accuracy of 91.7%.

Conclusions: Comparison of signal intensity between effusion and CSF can accurately diagnose CSF leak in patients with undifferentiated effusions.

Define Professional Practice Gap & Educational Need: Definitive diagnosis of a temporal bone cerebrospinal fluid leak may require invasive testing (myringotomy for beta-2 transferring testing). MRI is routinely obtained by some surgeons in preparation for CSF leak repair, and some middle ear effusions are incidentally noted on scans obtained for other reasons. The utility of objectively comparing MRI signal intensity of fluid in the middle ear and mastoid to that of adjacent CSF is not known.

Learning Objective: To describe the utility of MRI signal intensity measurement as a diagnostic test for temporal bone CSF leak.

Desired Result: The audience will understand the sensitivity and specificity of MRI signal intensity measurement in differentiating temporal bone CSF leaks from other middle ear and mastoid effusions.

Level of Evidence – IV

Indicate IRB or IACUC : University of Cincinnati 2017-2418

Predicting Schwannoma Growth in a Mouse Flank Tumor Model Using Targeted Imaging

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Jason M. Warram, PhD; Erika M. Walsh MD

Hypothesis: In a murine tumor model, fluorescent imaging characteristics using immunotargets may predict schwannoma growth.

Background: Vestibular schwannoma (VS) is a common pathology encountered in neurotology clinics. Many patients are observed with a "wait and scan" approach. Prior efforts to determine radiographic indicators of future growth have been unsuccessful. Using a mouse flank tumor model, we seek to determine if fluorescent imaging with directed immunotargets could be used to predict schwannoma growth rate.

Methods: Anti-VEGFR2 and anti-Her2/Neu were covalently linked to a near-infrared probe (IRDye800). Immunodeficient mice underwent flank injections with a rat-derived schwann (R3) cell line. When tumor growth was evident, either Anti-VEGFR2-IRDye800, anti-Her2/Neu-IRDye800, or IgG Isotype-IRDye800 (control) were injected via tail vein. The mice were serially imaged in a closed field device (Pearl, LI-COR Biosciences, Lincoln, NB). Fluorescent data were analyzed for tumor signal and correlated with tumor growth.

Results: All mice grew clinically evident tumors with variable growth rate. In both study groups, there were strong correlations between day 1 mean tumor fluorescence and eventual maximum tumor volume ($p=0.002$, 0.001; $r^2=0.92$, 0.86). There was also strong correlation with maximum tumor signal and maximum tumor volume ($p=0.003$, 0.008; $r2 = 0.90$, 0.91) There was no such correlation in the control group.

Conclusions: VS is a challenging problem for neurotologists and patients alike, with many patients opting for observation. We seek to identify immunotargets in a murine model that show promise in predicting schwannoma growth with advanced imaging techniques. Both Her2/Neu and VEGFR2 are promising targets that merit further investigation. Assessing tumor heterogeneity may identify spatial regions of increase growth patterns.

Define Professional Practice Gap & Educational Need: Management of vestibular schwannoma relies heavily on imaging, specifically MRI. Functional imaging may eventually provide additional insight as to the nature of the tumor and factor in the clinician's management algorithm.

Learning Objective: Attendees will review current imaging modalities of vestibular schwannoma and learn of novel investigational imaging modalities that may have future applicability in clinical practice.

Desired Result: We seek to describe new imaging techniques which could eventually assist clinicians with diagnosis and management of vestibular schwannomas.

Level of Evidence - N/A – basic science study using animal model.

Indicate IRB or IACUC : IACUC 20327