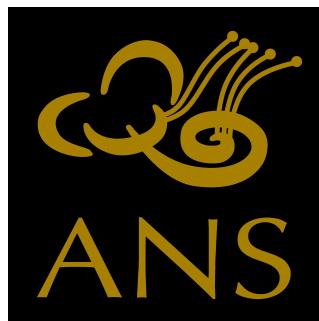


## ***SELECTED ABSTRACTS***

*IN ORDER OF PRESENTATION*

## ***ORAL PRESENTATIONS***



***53<sup>rd</sup> Annual Spring Meeting  
AMERICAN NEUROTOLOGY SOCIETY***

***April 20-22, 2018  
Gaylord National Resort  
National Harbor, MD***

## **Incidence and Risk Factors for Sigmoid Venous Thrombosis following CPA Tumor Resection**

*Hannah L. Kavookjian, MD; Matthew A. Shew, MD*

*Thomas J. Muelleman, MD; Kelly Dahlstrom, DO*

*James Lin, MD; Luke N. Ledbetter, MD*

*Hinrich Staeker, MD, PhD*

**Objective:** Our primary aim was to determine the incidence of sigmoid venous thrombosis (SVT). Our secondary aim was to determine risks factors and sequelae of SVT following cerebellopontine angle (CPA) tumor resection.

**Study Design:** Retrospective cohort study.

**Setting:** Academic tertiary care hospital.

**Patients:** Patients over 18 years of age who underwent resection of CPA meningioma or vestibular schwannoma from January 2005– April 2016 and had post-operative MRI.

**Intervention(s):** Diagnostic

**Main outcome measure(s):** Incidence of post-operative SVT from official radiology reports was compared to retrospective imaging review by our radiology colleagues. Data collected included age, length of stay (LOS), BMI, surgical approach, and post-operative complications.

**Results:** A total of 127 cases were identified. Official reports significantly underreported the incidence of post-operative SVT compared to retrospective review by Neuroradiologist (n=4 [3.1%] vs n=22 [17.3%]; p<0.001). There was a statistical trend toward increased risk for thrombosis in patients undergoing translabyrinthine and staged resection (p=0.068). CSF leak incidence in patients with thrombosis was significantly increased (n=9 [37.5%] vs n=13[12.6%]; p=0.007). There was no correlation between SVT and age (p=0.788), BMI (p=0.686), LOS (p=0.733), pre-operative tumor size (p=0.555), or increased postoperative ICP (p=0.645). Only 1 patient was symptomatic from sigmoid thrombosis compared to 21 who were not.

**Conclusions:** Incidence of SVT is significantly underreported and may predispose patients to increase risk for CSF leak. Staged and translabyrinthine approaches demonstrate an increased trend toward thrombosis risk. Our findings suggest it may not be necessary to treat SVT.

**Define Professional Practice Gap & Educational Need:** Lack of awareness regarding incidence of postoperative sigmoid venous thrombosis following cerebellopontine angle tumor resection, as well as impact of thrombosis on post-operative recovery.

**Learning Objective:** Describe post-operative incidence of sigmoid venous thrombosis following cerebellopontine angle tumor resection. Evaluate risk factors of sigmoid venous thrombosis and impact on post-operative recovery.

**Desired Result: (How will attendees APPLY the knowledge they learned from the presentation):** Improve post-operative patient care following resection of cerebellopontine angle tumors.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Audiometric and Radiologic Correlates to Auditory Brainstem Response in Treatment-Naïve Small Volume Cochleovestibular Schwannomas in Neurofibromatosis Type 2**

*Alvin T. deTorres, MD; Carmen C. Brewer, PhD*

*Chris K. Zalewski, PhD; Kelly A. King, PhD*

*Robert Walker, BS; Prashant Chittiboina, MD, MPH*

*H. Jeffrey Kim, MD*

**Objective:** To determine the relationship of auditory brainstem response (ABR) changes to hearing loss and tumor growth in patient-ears with small volume ( $<1000\text{mm}^3$ ), treatment-naïve cochleovestibular schwannomas (CVSs) in Neurofibromatosis Type 2 (NF2).

**Study Design:** Prospective, longitudinal cohort study.

**Setting:** Quaternary medical research institute.

**Patients:** 51 NF2 patients (78 ears) with small, treatment-naïve CVSs observed from July 2006 to July 2016.

**Intervention:** Serial ABR, pure tone thresholds, and magnetic resonance imaging (MRI).

**Outcome measures:** Changes in ABR latencies, thresholds at 2 and 4 kHz, 4-frequency pure tone average (0.5, 1, 2, 4 kHz) (4f-PTA), and tumor volume on MRI

**Results:** Mean follow-up was 3.7 years ( $SD 1.68$ ). Of 78 patient-ears, 40 (51%) experienced a significant change in wave V latency (increase in latency by  $\geq 0.2\text{ms}$ , loss of waveform). Median survival time from enrollment to change was 4.2 years. Analysis of variance demonstrated statistically significant differences ( $p<0.05$ ) in mean rate of hearing changes at 2kHz (3.5 vs 1.2 dB/year), 4kHz (4.0 vs 0.8 dB/year), and 4-fPTA (3.2 vs 0.77 dB/year) for groups with and without wave V changes, respectively. Statistically significant changes in posterior fossa ( $176.0$  vs  $37.7\text{mm}^3/\text{year}$ ) and total ( $228.4$  vs  $70.2\text{ mm}^3/\text{year}$ ) tumor volume growth rates were also found between groups with and without wave V changes. The difference in intracanalicular tumor volume growth rate (52.3 vs 32.5  $\text{mm}^3/\text{year}$ ) was not statistically significant between these groups.

**Conclusion:** Changes in ABR may be useful in predicting clinically significant audiometric changes or tumor growth in NF2 patients and help guide clinical decision making.

**Define Professional Practice Gap & Educational Need:** 1) Lack of contemporary knowledge of how auditory brainstem response (ABR) testing in small-volume ( $<1000$  cubic-millimeters), treatment-naïve, vestibular schwannomas in Neurofibromatosis type 2 (NF2) relate to changes in other diagnostic tests such as audiology and magnetic resonance imaging (MRI).

**Learning Objective:** 1) Discuss the ABR changes seen in small-volume, treatment-naïve, vestibular schwannomas in NF2 during serial follow-up. 2) Relate these findings to changes in pure tone thresholds and tumor volume growth on MRI. 3) Discuss how this information may be used to guide decision making regarding treatment (surgery, radiation, biologic) versus continued observation.

**Desired Result:** Attendees will understand the ABR changes seen in small-volume, treatment-naïve, vestibular schwannomas in NF2 as they relate to audiometric and MRI changes to guide treatment decision making.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Lateral Skull Base Density and Its Relation to Patients with Obesity and CSF Leaks**

*Jonathan L. Hatch MD, Heather K. Schopper BS,  
Isabel Boersma BS, Habib G. Rizk MD  
Paul R. Lambert MD, Theodore R. McRackan MD  
Ted A. Meyer MD, PhD*

**Objectives:** Evaluate temporal bone skull base density and its relation with obesity and spontaneous CSF leaks.

**Study Design:** Blinded retrospective case control series.

**Setting:** Tertiary care university setting.

**Interventions:** A control group consisting of age and gender matched non-obese subjects were compared to obese and CSF leak subjects. Two blinded reviewers measured the density at multiple locations along the tegmen using thin sliced high resolution CT scans. Additional density measurements were obtained from the temporal bone squamosa. The density, as measured with Hounsfield units (HU), was compared between the groups.

**Main outcome measure:** Lateral skull base density in obese and CSF leaks compared to non-obese controls.

**Results:** Sixty-nine (n= 69) subjects were included in the study. The control group (n=21) had an average density along the tegmen of 548 ( $SD \pm 309$ ) HU, obese (n=26) and CSF leak groups (n=22) had an average HU of 571 ( $SD \pm 215$ ) and 502 ( $SD \pm 142$ ), respectively ( $p=0.58$ ). There was no statistically significant difference in the temporal bone squamosa ( $p=0.52$ ). The correlations of the reviewers ranged from  $r=0.68$  to  $r=0.88$  meaning moderate to strong correlation

**Conclusion:** There appears to be no correlation between the density of the tegmen or squamosa of the temporal bone as it relates to obesity or spontaneous CSF leaks compared to normal weight controls. These findings suggest the bone density does not have a significant role in the development of lateral skull base thinning or dehiscence leading to CSF leaks.

**Define Professional Practice Gap & Educational Need:** There is limited knowledge regarding the density of the temporal bone as it relates to obesity and CSF leaks.

**Learning Objective:** Evaluate temporal bone skull base density and its relation with obesity and spontaneous CSF leaks.

**Desired Result:** Attendees will be able to apply these findings in patients with lateral skull base thinning or CSF leaks.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Contribution of Genomic Large Structural Variations to NF2 Tumorigenesis**

*Daniel S. Roberts, MD, PhD; Yuka Takemon*

*Jeremie Vitte, PhD; William H. Slattery, MD*

*Marc S. Schwartz, MD; Marco Giovannini, MD, PhD*

*Chia-Lin Wei, PhD*

**Hypothesis:** Large structural variants (SVs), as a consequence of genomic instability, predict clinical behavior of vestibular schwannomas (VS) in patients with Neurofibromatosis type-2 (NF2).

**Background:** Comprehensive genetic analysis of NF2-related VS through whole genome-wide sequencing has not been performed. VS in NF2 patients are caused by inactivation or loss of both alleles of the NF2 gene, representing an initiating event in tumor development. This usually involves a combination of single nucleotide variations (SNVs) or deletions, in conjunction with either a second SNV or loss of heterozygosity (LOH). Large SVs occur in genomes associated with malignancies, representing genomic instability and have not been characterized for NF2-associated VS.

**Methods:** From a tissue bank containing 75 VS, DNA was isolated from 10 blood-tumor pairs from the fastest and slowest growing tumors (5 each group,  $p=0.0005$ ). Whole-genome haplotype-specific structural variation analysis was performed using synthetic linked long reads generated through barcoding genomic DNA fragments coupled with high coverage parallel sequencing.

**Results:** Applying specialized SV bioinformatics analysis, all mutations and structural variations were identified. Unique tandem duplications were found harboring potential tumor suppressors associated with the aggressive subtype. NF2 tumor specific SNVs were identified in 9/10 cases indicating possible mechanisms of LOH. Five tumor-specific large SVs were present in one patient with a rapidly growing tumor, including one large 66kb deletion within NF2.

**Conclusions:** For the first time, the genetic landscape of NF2-related VS was investigated through whole genome-wide sequencing. Large SVs appear to be a genetic mechanism of LOH and suggests genomic instability in a subset of these tumors.

**Define Professional Practice Gap & Educational Need:** Lack of awareness of the genetic mechanisms that lead to vestibular schwannomas (VS) in patients with Neurofibromatosis type-2 (NF2).

**Learning Objective:** The objective is to demonstrate the importance of genomic large structural variants to vestibular schwannoma tumorigenesis in patients with NF2.

**Desired Result:** The participant will have a further understanding that large structural variants appear to be a genetic mechanism for vestibular schwannoma tumorigenesis in patients with NF2.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Evaluation of Outcome Variability Associated with Lateral Wall, Mid-Scalar, and Perimodiolar Electrode Arrays When Controlling for Pre-Operative Patient Characteristics**

*Joshua E. Fabie, BS; Robert G. Keller, MD  
Jonathan L. Hatch, MD; Ted A. Meyer, MD, PhD  
Shaun A. Nguyen, MD; Paul R. Lambert, MD  
Theodore R. McRackan, MD*

**Objective:** Determine the impact of electrode array selection on audiotmetric performance when controlling for baseline patient characteristics.

**Study design:** Retrospective evaluation of a prospective cochlear implant (CI) database (1/1/12-12/31/16).

**Setting:** Tertiary care university hospital

**Patients:** 446 adult CI recipients

**Interventions/main outcomes measured:** Hearing outcomes were measured through unaided/aided pure tone thresholds and speech recognition testing before and after cochlear implantation. All reported post-operative results were performed at least 6 months after CI activation. All device manufacturers were represented.

**Results:** Of the 446 patients, 305 received lateral wall (LW) arrays, 71 received perimodiolar (PM) arrays, and 70 received mid-scalar (MS) arrays. Patients receiving PM arrays had significantly lower pre-operative CNC word, CNC phoneme and AzBio quiet scores ( $2.9\% \pm 6.1$ ,  $9.7\% \pm 15.3$ , and  $6.8\% \pm 13.2$  respectively) compared to patients receiving LW arrays ( $7.9\% \pm 12.1$ ,  $17.4\% \pm 20.7$ , and  $10.2\% \pm 15.5$ ; all  $p < 0.04$ ). After controlling for pre-operative residual hearing and speech recognition ability, there was no statistically significant difference in audiological outcomes (CNC words, CNC phonemes or AzBio quiet) among the three electrode array types (all  $p > 0.05$ ). Subsequent multivariable regression analysis revealed better pre-operative aided AzBio quiet scores (OR 0.35 95%CI 0.09-0.61,  $p=0.009$ ) and decreased age at implantation (OR-0.25, 95%CI -0.48-0.03,  $p=0.03$ ) were associated with improved post-operative AzBio scores.

**Conclusion:** While prior studies have demonstrated superior postoperative speech recognition scores in LW electrode array recipients, these differences lose significance when controlling for baseline hearing and speech recognition ability. These data demonstrate the proclivity for implanting individuals with greater residual hearing with LW electrodes and its impact of post-operative results.

**Define Professional Practice Gap & Educational Need:** 1) Lack of knowledge regarding the baseline audiological characteristics of patients undergoing implantation with different CI electrode arrays. 2) Lack of knowledge regarding the association among baseline audiological characteristics, choice of CI electrode array, and hearing outcomes.

**Learning Objective:** 1) Attendees will better understand that preoperative hearing performance differs in patients implanted with lateral wall, mid-scala, and perimodiolar electrode arrays. 2) Attendees will better understand that differences in CI outcomes with various CI arrays are likely driven by differences in pre-operative hearing and speech recognition ability.

**Desired Result:** 1) Attendees will be better prepared to counsel patients with regard to expected CI outcome 2) Attendees will be able to use these results when designing future clinical studies.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Intra-Cochlear Electrococleography during CI Electrode Insertion is Predictive of Final Scalar Location**

*Kanthaiah Koka, PhD; Jourdan Holder, AuD*

*Robert Dwyer, AuD; Jack Noble, PhD*

*Oliver Adunka, MD; Craig Buchman, MD*

*Robert Labadie, MD, PhD*

**Hypothesis:** Patterns observed in electrococleography (ECochG) during cochlear implant (CI) electrode insertion provide information about scalar location of the electrode array.

**Background:** Conventional CI surgery is performed without actively monitoring potential damage to intracochlear structures. Intracochlear ECochG obtained directly through the CI may provide feedback for better hearing preservation.

**Methods:** Intracochlear ECochG was performed in 25 patients across 3 different clinics. During electrode insertion, a 50-ms tone burst acoustic stimulus was delivered with a frequency of 500Hz at 110dB SPL. The ECochG response was monitored from the apical-most electrode. The amplitude and phase changes for the first harmonic were categorized to understand the scalar electrode location and used in an algorithm to predict scalar location (scala tympani (ST) versus translocation/interaction with basilar membrane). Scalar location was verified using post-operative CT scans and image processing.

**Results:** CT analysis showed 18 subjects with ST position and 7 subjects translocating from ST to scala vestibuli. The ECochG algorithm correctly estimated CI electrode location in 22 out of 25 subjects with 3 subjects wrongly identified as translocation resulting in a specificity of 100%, sensitivity of 57%, false positive of 0%, and false negative rate of 17%. A significant difference in hearing preservation was observed between the translocations (36 dB loss) and scala tympani insertions (25 dB loss) ( $p<0.05$ )

**Conclusion:** Intracochlear ECochG may provide information about CI electrode location and hearing preservation.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge about cochlear implant electrode insertion trauma and hearing preservation

**Learning Objective:** The current presentation teaches about objective measurement of insertion trauma and hearing preservation using electrococleography

**Desired Result:** Attendees will be able to learn about objective electrococleography and use for hearing preservation.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 1

## ANS TRAINEE AWARD

### Intraoperative Evoked Compound Action Potential (ECAP) Levels in Hearing Preservation Cochlear Implantation

*Ashley M. Nassiri, MD, MBA; Robert J. Yawn, MD*

*Jillian B. Roberts, BHS; Max S. Gilbane, BA*

*Jack Murfee, BA; René H. Gifford, PhD*

*Marc L. Bennett, MD*

**Objective:** To evaluate the correlation between intraoperative evoked compound action potentials (ECAP) at the time of cochlear implantation and hearing preservation outcomes.

**Study Design:** Retrospective case review.

**Setting:** Tertiary otologic center.

**Patients:** Two hundred thirty-eight adult ears with residual hearing receiving cochlear implants (51 Advanced Bionics, 90 Cochlear, 97 MED-EL implants).

**Interventions:** Intraoperative ECAP testing and postoperative audiologic assessment.

**Main outcome measures:** Hearing preservation status (preservation of unaided air conduction thresholds at 250 Hz and 500 Hz) as correlated with intraoperative ECAP measurements (basal, middle and apical electrode thresholds and maximum amplitudes), while controlling for age and surgical approach. ECAP thresholds were determined via linear regression for Advanced Bionics and MED-EL and through extrapolation of regression based visual thresholds for Cochlear devices.

**Results:** Maximum amplitudes were significantly higher throughout all regions (basal, middle, apical) of the cochlea in patients that preserved low frequency acoustic hearing versus those that did not ( $p=0.007$ ,  $p=0.0003$ ,  $p=0.0004$ , respectively). Electrode thresholds were not significantly correlated with hearing preservation.

**Conclusions:** Maximum amplitudes detected through ECAP measurements are significantly higher in patients that preserve low frequency acoustic hearing thresholds versus those that do not. This may be suggestive of improved neural health.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge and information regarding the relationship of intraoperative evoked compound action potential (ECAP) levels as it relates to postoperative hearing preservation and patient hearing outcomes.

**Learning Objective:** Identify that ECAP thresholds are correlated with hearing preservation outcomes, and that this may be predictive of hearing outcomes.

**Desired Result:** Although this is a retrospective study, the relationship between ECAP thresholds and hearing preservation can be used in postoperative patient counseling, expectations, and cochlear implant programming.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Creation of a Formula to Convert between Consonant-Nucleus-Consonant (CNCw) and AzBio Test Scores Using Imputation in a National Cochlear Implant Database**

*Rahul K. Sharma, BS; Jedidiah J. Grisel, MD  
Justin S. Golub, MD, MS*

**Objectives:** In the era of big data, it is critical to aggregate results across different institutions. This is a major challenge for cochlear implant (CI) research given the existence of multiple, incompatible outcome measures. We utilize a large, national CI database to develop a formula to convert between the two most common measures: CNCw and AzBio.

**Study Design:** Analysis of a prospective, national, web-based database designed for CI outcome tracking (HERMES; HIPAA-secure, Encrypted, Research Management and Evaluation Solution)

**Setting:** Multi-centered at 32 US private practice and academic medical centers

**Patients:** CI patients (n=470 total, n=518 ears; age 10-102 years; mean: 64 years)

**Main Outcome Measures:** CNCw, AzBio

**Results:** Univariable linear equations ( $y=mx+b$ ) were generated in the form of CNCw Score = (m)(AzBio Score) + b for each time-point. Correlation coefficients ( $R^2$ ) between AzBio and CNCw scores were 0.71 at 3 mos, 0.69 at 6 mos, 0.63 at 12 mos, and 0.56 at 24 mos (all  $p<0.01$ ). Across all timepoints, the average difference between true and calculated (imputed) CNCw was 10.5% (95% CI=9.8-11.2). The average difference between true and calculated AzBio was 12.3% (95% CI=11.4-13.1).

**Conclusions:** We generated simple linear regression equations to calculate CNCw scores from AzBio scores, and vice versa, with good accuracy. It is anticipated that as the database grows, the accuracy using modeling will improve. This tool allows practitioners to study CI outcomes across centers on a national or international level despite the existence of different speech performance measures.

**Define Professional Practice Gap & Educational Need:** The use of different non-compatible CI outcome measures hinders quality improvement on a national level. There is no consensus on which measure to use. There is no current solution to this problem. **Educational Needs:** Clinicians must understand how having no universally accepted outcome measure impedes quality improvement and how this problem could be addressed with statistical techniques.

**Learning Objective:** To understand how AzBio and CNCw scores are related, and how they can be converted into each other using imputation with linear regression.

**Desired Result:** Clinicians will appreciate the need for a universal outcome measure for CI performance, and how statistical techniques can address this problem.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Hearing Preservation Surgery in Cochlear Implantation: Factors Associated with Improved Outcomes in a Single Center**

*Alexander Malone, MD; Kevin Wang, MD  
Nicholas Pritchard, MD; Loren Bartels, MD  
Kyle Allen, MD, MPH; Michelle Blanchard, AuD  
Christopher Danner, MD*

**Objective:** To assess for factors associated with improved outcomes in cochlear implantation with attempted hearing preservation.

**Study design:** Retrospective chart review.

**Setting:** Tertiary private otologic center.

**Patients:** Adult patients who underwent cochlear implantation with pre-operative residual hearing from January 2015 to December 2015.

**Intervention(s):** Cochlear implantation.

**Main outcome measure(s):** Hearing preservation classification using the HEARRING model was used. Secondary outcome measures included the effect of steroids (perioperative, intra-operative, and topical), sodium hyaluronate, antibiotics, insertion technique, and electrode array design on hearing preservation status.

**Results:** 53 patients and 54 ears met inclusion criteria. The average age was 65.7 years (range 26-88). Hearing preservation rates overall were 5 (9.3%) ears with complete preservation, 23 (42.6%) with partial preservation, 12 (22.2%) with minimal preservation, and 14 with (25.9%) no preservation. Logistic multivariate regression demonstrated a statistically significant association between the dosing of the perioperative prednisone steroid taper and a decreased likelihood of complete hearing loss ( $p<0.01$ ). When using multinomial multivariate regression to assess for the likelihood of an improved hearing classification level, the use of prednisone approached significance ( $p=0.05$ ). No other factors were associated with a statistically significant effect on hearing preservation. 11 of these patients met criteria for hybrid implant. Of these, 1 (9.1%) had complete hearing preservation, 7 (63.6%) had partial preservation, and 3 (27.2%) had minimal preservation.

**Conclusions:** In this cohort of patients the use of perioperative oral steroids was associated with increased rates of hearing preservation. This effect did appear to be dose dependent. Further prospective studies are needed to validate these findings.

**Define Professional Practice Gap & Educational Need:** There are inconsistencies with the techniques and methods used to promote hearing preservation in patients undergoing cochlear implantation.

**Learning Objective:** This abstract will demonstrate factors identified that were associated with improved hearing preservation outcomes in patients undergoing cochlear implantation.

**Desired Result:** Attendees will be able to apply the factors identified to contribute to improve outcomes to their practice. This could also identify areas ripe for further investigation.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Unique Clinical Language Patterns among Expert Vestibular Providers Can Predict Vestibular Diagnoses**

*Jake Luo PhD; Christy Erbe, MA  
David R. Friedland, MD, PhD*

**Objective:** To identify novel language usage by expert providers predictive of specific vestibular conditions.

**Study design:** Retrospective chart review and natural language processing. Level IV

**Setting:** Tertiary referral center

**Patients:** New patients seen for primary vestibular complaint.

**Intervention(s):** Machine learning assessments of semantic and syntactic patterns in clinical documentation and correlation analyses with vestibular diagnosis.

**Main outcome measure:** Unique semantic and syntactic elements associated with vestibular conditions.

**Results:** Natural language analyses on 866 physician-generated histories from vestibular patients found 3,286 unique common data elements (CDEs) of which 614 were used 10 or greater times. The top 15 semantic types represent only 11% of the all Unified Medical Language System semantic types but covered 86% of the CDEs in vestibular patient histories. A similar pattern was shown on the vocabulary level in which the top 50 CDEs covered 93% of all signs and symptoms found in vestibular patient histories. Machine learning algorithms, including the Naïve Bayes algorithm and the J48 Decision Tree algorithm, were applied to a subset of notes to correlate language usage with clinical diagnosis. The Naïve Bayes algorithm generated a stronger model showing an average sensitivity rate of 86.0% and a specificity rate of 93.0% in predicting common conditions, including migraine and BPPV.

**Conclusions:** These results indicate that expert providers utilize unique language patterns that are highly conserved. These patterns have strong predictive power toward specific vestibular diagnoses. Such language elements can thus be incorporated into clinical decision support systems to facilitate accurate vestibular diagnosis by non-expert providers.

**Define Professional Practice Gap & Educational Need:** 1) Poor recognition of specific vestibular disorders 2) Lack of knowledge regarding complete vestibular history taking

**Learning Objective:** 1) Recognize elements in patient histories used by expert providers. 2) Recognize elements in patient histories used to disambiguate specific vestibular conditions.

**Desired Result:** Attendees will be able to acquire more complete and accurate vestibular histories and use this information to make informed clinical diagnoses.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## Vestibular Testing: Patient Perceptions, Morbidity, and Opportunity Costs

*Elizabeth A. Kelly, MD; Carly M. Kempton, AuD  
Catherine D. Stocker, AuD; Darcia M. Dierking, AuD  
Hannah E. Fehlberg, AuD; Meredith E. Adams, MD*

**Objective:** To characterize patient tolerance and non-monetary cost burdens of vestibular testing. Rigorously acquired data are essential for patient counseling and to determine if proposed additions/modifications to current protocols improve quality, experience, and efficiencies of care.

**Study Design:** Prospective observational study.

**Setting:** Tertiary center.

**Patients:** Adults referred to audiology clinic for vestibular testing.

**Intervention(s):** Surveys administered to patients and audiologists immediately and one week following videonystagmography with caloric (VNG) and/or rotational chair testing.

**Main outcome measure(s):** Symptoms, visual analog scale ratings of dizziness, distress, and nausea during testing; test completion; opportunity costs (time, missed work).

**Results:** Of 113 patients enrolled (63% women, mean age 55 years), 61 (58%) experienced undesirable symptoms during testing, including nausea (48%), vomiting (3%), and headaches (9%). Distress and nausea ratings during VNG and rotary chair were low (<3/10). Fourteen (13%) patients were unable to complete testing, rating distress and nausea during VNG and rotary chair 2 to 3-times higher than those who completed testing ( $p<0.01$ ). Migraine history, sex, age, and nystagmus intensity were not significantly associated with dizziness, distress, or nausea ratings during testing. Test performance times were 68 [22] and 25 [12] minutes for VNG and rotary chair, respectively. Testing required 51% to miss work (range of 2 to 48 hours) and 79% obtained another's assistance to/from the appointment. Post-test symptoms included drowsiness/fatigue (36%), nausea (26%), and headache (32%).

**Conclusions:** While vestibular tests elicit patient distress ratings comparable to other in-office otolaryngology procedures, high frequencies of undesirable symptoms, post-test morbidity, and opportunity costs warrant efforts to modify current protocols.

**Define Professional Practice Gap & Educational Need:** There are proposals to modify the current vestibular test methods to limit duration of testing and patient discomfort, either by changing the administration of existing tests or by substituting new tests. However, the benefit of these modifications is not known due to the lack of knowledge and investigation of the frequency of incomplete vestibular tests due to patient morbidity, patient perceptions/experiences, and opportunity costs of these tests.

**Learning Objective:** 1. To describe patient morbidity associated with vestibular testing and the frequency with which it occurs. 2. To understand the non-monetary costs of vestibular evaluation.

**Desired Result:** The information obtained regarding the frequency of complications associated with vestibular testing and the patient morbidity will provide essential information for patient counseling prior to testing. This information will provide attendees with an understanding of the risks, patient tolerance, and the time consumption of this testing to ensure patients are receiving an efficient and quality evaluation, which may help inform practices of those ordering these tests. Additionally, it will provide more information on the need for additional modifications to our current testing and referral patterns for this testing to ensure optimal patient comfort and quality of the diagnostic evaluation and reduce indirect costs associated with specialized testing.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Mouse Magnetic-field Nystagmus in Strong Static Magnetic Fields is Dependent on the Presence of Nox3**

*Bryan K. Ward, MD; Yoon Lee; Dale C. Roberts, MA  
Ethan Naylor, MA; Americo A. Migliaccio, PhD  
Charles C. Della Santina, MD, PhD*

**Hypothesis:** Magnetic vestibular stimulation (MVS) elicits nystagmus in C57BL/6J mice but not *het* mice lacking Nox3, which is required for normal utricular and otoconial development.

**Background:** Humans have vertigo and nystagmus in strong magnetic fields within MRI machines. The hypothesized mechanism is a Lorentz force driven by utricular current, acting indirectly on crista hair cells via endolymph movement deflecting cupulae. We tested an alternate hypothesized mechanism: Lorentz action directly on crista hair cell stereocilia, driven by their currents independent of the utricle.

**Methods:** Before MVS, vestibulo-ocular reflex (VOR) responses of 8 C57BL/6J mice and 6 *het* mice were measured during whole-body sinusoidal rotations and tilts using video-oculography. Mice were then placed within a 4.7 Tesla magnetic field with the horizontal semicircular canals approximately Earth-horizontal for  $\geq 1$  minute in several head orientations, while eye movements were recorded via infrared video in darkness.

**Results:** Outside the magnet, both C57BL/6J and *het* mice had intact horizontal VOR, but only C57BL/6J mice exhibited static counter-roll responses to tilt. When placed in the magnet nose-first, C57BL/6J mice had left-beating nystagmus, lasting a median of 32.8 seconds. When tail-first, nystagmus was right-beating and similar duration (median 28.0s,  $p > 0.05$ ). In contrast, *het* mice lacked magnetic field-induced nystagmus ( $p < 0.001$ ).

**Conclusions:** C57BL/6J mice generate nystagmus in response to MVS, while mice deficient in Nox3 do not. Per the Lorentz force model of MVS, this suggests (1) utricular current is necessary, and (2) semicircular canal hair cell current is insufficient, to generate MVS-induced nystagmus in mice.

**Define Professional Practice Gap & Educational Need:** Lack of awareness of the relationship between strong magnetic fields like those of MRI machines and the vestibular system, and how MRI machines can cause dizziness and vertigo.

**Learning Objective:** To understand how strong magnetic fields like MRI machines induce dizziness in both humans and mice, and to demonstrate how mice can be used to study magnetic vestibular stimulation.

**Desired Result:** Participants will better understand how MRI machines cause vertigo and how a mouse model can help us better understand the mechanism.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** Does not apply- This is a basic science study using mice.

## **Comparison of Failure Rates for Intratympanic Dexamethasone and Gentamicin in Meniere's Disease**

*James G. Naples, MD; Jason A. Brant, MD  
Steven J. Eliades, MD, PhD; Michael J. Ruckenstein, MD*

**Objective:** To compare failure rates of intratympanic (IT) dexamethasone and gentamicin in Meniere's Disease (MD).

**Study Design:** Retrospective chart review

**Patients:** Adult patients with unilateral MD requiring IT therapy from 2005-2017.

**Intervention(s):** Prior to 2011, IT gentamicin (27mg/ml) was administered as primary therapy. Beginning in 2011, the treatment algorithm shifted to IT dexamethasone (10mg/ml) as initial treatment. Gentamicin was administered every 2 weeks (up to 3 injections) until objective testing revealed vestibular loss. Dexamethasone was administered weekly for 3 planned injections. Treatments were repeated if symptoms recurred after an initial response.

**Main Outcome Measures:** Failure rates of each treatment group were evaluated. Similar treatment algorithms within each cohort permits direct comparison. Failure was defined as persistent vertigo symptoms that required a more aggressive therapy.

**Results:** Fifty-six patients received IT dexamethasone and 100 patients received IT gentamicin. Dexamethasone patients received a mean of 3.2 injections compared to 2.4 in the gentamicin group ( $p=0.001$ ). Twenty-seven(48%) dexamethasone patients remained symptomatic after their last recorded injection compared to 13(13%) gentamicin patients ( $p=0.001$ ). There were 14(25%) failures in the dexamethasone group and only 7(7%) gentamicin failures ( $p=0.006$ ). No patients failed both treatments. The mean time to failure in the dexamethasone group was 3.5 months, while in the gentamicin group it was 27.3 months ( $p=0.011$ ).

**Conclusions:** IT gentamicin achieved higher rates of vertigo control and had significantly fewer failures than IT dexamethasone. The time to failure occurred sooner in the dexamethasone group. Further long-term data is necessary to understand the utility of IT dexamethasone in MD.

**Define Professional Practice Gap & Educational Need:** The professional practice gap that this research aims to addresses is to improve the understanding of failure rates of intratympanic (IT) therapies in Meniere's Disease. Since the introduction of IT dexamethasone to the treatment algorithm for Meniere's Disease, there is a lack of head-to-head comparisons of dexamethasone and gentamicin. In this research, we compare rates of failure in each group of patients.

**Learning Objective:** The learning objective is to improve understanding of the utility of IT dexamethasone and IT gentamicin in treating Meniere's Disease by comparing failure rates. This research will improve clinician expectations with each therapy, which will afford the opportunity for improved patient counseling for each therapy.

**Desired Result:** The desired result is that clinicians gain a better understanding of the failure rates of IT dexamethasone as compared to IT gentamicin, which will allow them to better counsel their patients about treatment expectations. The application of this research has potential to change therapeutic discussions between the patient and physician.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4



## The Role of Hyperbaric Oxygen Therapy for Idiopathic Sudden Sensorineural Hearing Loss

*Galit Almosnino, MD; James R. Holm, MD  
Seth R. Schwartz, MD, MPH; Daniel M. Zeitler, MD*

**Objective:** Evaluate hearing outcomes following adjuvant hyperbaric oxygen therapy (HBO2) for idiopathic sudden sensorineural hearing loss (ISSHL).

**Study Design:** Retrospective, case-control

**Setting:** Tertiary referral teaching hospital

**Patients:** Adult patients undergoing treatment for ISSHL between 2014-2017 (n=59). Patients with autoimmune disease (n=4), Meniere's disease (n=3), or patients with ISSHL who did not undergo treatment (n=12) were excluded. A total of 40 patients were included. Twenty patients were treated with HBO2 with oral and/or IT steroids (Group 1). The remaining 20 patients received oral and/or IT steroids alone (Group 2). There were no significant differences in age, gender or hearing between groups.

**Intervention:** HBO2 with steroids vs. steroid therapy alone.

**Main Outcome Measure:** Improvement in pure tone average (PTA) and speech discrimination scores (SDS). Non-serviceable hearing was defined as SDS < 50%.

**Results:** There was no significant difference in mean post-treatment PTA between Group 1 (60.4 dB) and Group 2 (52.7 dB). There was no significant difference in mean post-treatment SDS between Group 1 (42.3%) and Group 2 (51%). Twenty percent of patients receiving HBO2 (Group 1) went from non-serviceable hearing to serviceable hearing. Twenty five percent of controls (Group 2) went from non-serviceable to serviceable hearing.

**Conclusion:** In this study, there were no significant differences in hearing outcomes between patients receiving HBO2 and steroids vs. patients receiving steroid therapy alone. There was a low rate of complications in both groups. Larger, prospective randomized trials are needed to help quantify the outcomes of HBO therapy and establish guidelines for treatment of ISSHL.

**Define Professional Practice Gap & Educational Need:** 1. Inconsistencies in published outcomes following hyperbaric oxygen therapy for treatment of idiopathic sudden sensorineural hearing loss (ISSHL).

**Learning Objective:** 1. Evaluate hearing outcomes following adjuvant hyperbaric oxygen therapy (HBO2) for treatment of idiopathic sudden sensorineural hearing loss (ISSHL). 2. Compare outcomes of present study regarding use of hyperbaric oxygen therapy for treatment of ISSHL to outcomes in the literature.

**Desired Result:** 1. Increase physician knowledge regarding management trends for idiopathic sudden sensorineural hearing loss (ISSHL) 2. Improve knowledge and awareness of the potential benefits as well as associated costs and risks of adjuvant hyperbaric oxygen therapy for treatment of ISSHL.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Noise-Induced Trauma Produces a Temporal Pattern of Change in Serum Levels of the Outer Hair Cell Biomarker Prestin**

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Mathieu Petremann, MS; Christophe Tran Van Ba, MS  
Charlotte Romanet, MS; Audrey Broussy, MS  
Jonas Dyhrfjeld-Johnsen, PhD*

**Hypothesis:** After intense noise exposure serum levels outer hair cell (OHC) protein, prestin, gradually decrease over days.

**Methods:** After assessing ABR thresholds and reduced DPOAE levels, rats were exposed to intense octave band noise for 2 hours at either 110 or 120 dB SPL. Auditory function was assessed 1 and 14 days later. Blood samples were collected at baseline, 4, 24, 48, 72 hrs and 7 and 14 days post exposure and prestin concentrations were measured using ELISA.

**Results:** Functional measures showed temporary hearing loss 1 day after exposure in the 110 dB group, but permanent loss through Day 14 in the 120 dB group. Prestin levels temporarily increased 5% at 4 hrs after 120 dB exposure, but only 1% in the 110 dB group. There was a gradual decline in prestin levels in both groups thereafter, with prestin being below baseline on Day 14 by 5% in the 110 dB group and more than 10% in the 120 dB group ( $p = 0.043$ ). Closer inspection of the data showed that only a subset of subjects had increased prestin levels at 4 hrs after trauma. In that subset, DPOAE level on Day 1 was lower by about 8 dB.

**Conclusion:** There is a temporal pattern of change in serum prestin level after noise-induced hearing loss that is related to severity of hearing loss. These results suggest that in the era of personalized medicine, circulatory levels of prestin may be able to act as surrogate biomarker for hearing loss involving OHCs.

**Define Professional Practice Gap & Educational Need: (Examples:** At present there are no inner-ear specific serological biomarkers available for research or clinical utilization.

**Learning Objective:** To inform participants on potential application of serum levels of prestin as a biomarker for hearing loss.

**Desired Result:** The learner will recognize potential applications of serum biomarkers to inner ear disorders

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## NEUROTOLOGY FELLOW AWARD

### Is Eustachian Tuboplasty Anatomically Safe in Children? A Histopathologic Comparison between Pediatric and Adult Temporal Bones

Kathryn Y. Noonan, MD; Fred H. Linthicum, MD  
Mia E. Miller, MD

**Hypothesis:** In children, the distance between the carotid canal (CC) and Eustachian tube (ET) is not significantly narrower than the adult population.

**Background:** ET dysfunction treated with ET dilation is FDA approved for adults. Several studies describe the close relationship between the CC and the ET in adults, but the anatomy of the ET has not been well defined in children. This study seeks to investigate these relationships in the pediatric population.

**Methods:** Histologic sections from 23 temporal bones of pediatric patients ages 0-18 were reviewed by two independent observers. The distance between the CC and the cartilaginous Eustachian tube (CET), bony-cartilaginous junction (BCJ), and bony Eustachian tube (BET) were measured. Fifteen adult temporal bones were used as a control group.

**Results:** The distance to the CC was narrowest at the BET, and was actually higher in the pediatric population when compared to adults (0.5mm and 0.2mm, respectively,  $p=0.06$ ). The CC-CET distance was smaller in the pediatric group (2.3mm vs 3.3mm,  $p<0.01$ ). The bony-cartilaginous junction is often the region of most concern during dilation. There was no significant difference between the CC-BET distance in pediatric and adult groups (1.9mm vs 2.3mm,  $p=0.20$ ).

**Conclusions:** CET-CC is smaller in the pediatric population, as expected due to smaller anatomic structures. However, the variable incline of the ET results in a CC-BCJ distance that is similar to the adult population. Although imaging studies are necessary to validate ET-CC *in vivo*, ET dilation may be safe in the pediatric population.

**Define Professional Practice Gap & Educational Need:** Eustachian tube dysfunction is increasingly being treated with Eustachian tube dilation. Currently the FDA has approved devices for adults ages 18 and older. There are published retrospective reviews totaling 86 pediatric patients (Jenckel 2015, Leichtle 2017, Tisch 2013) who were treated with Eustachian tube dilations however this anatomic relationship is yet to be explored. Several studies describe the close relationship between the carotid and various portions of the ET in adults (Ozturk 2012, Savic 1985, Olander 2017). This study seeks to investigate these relationships in the pediatric population.

**Learning Objective:** Determine the relationship between the carotid artery and the Eustachian tube in children  
Compare the distances between these two structures at key portions in children and adults

**Desired Result:** Understanding the relationship of the Eustachian tube and carotid artery will aid in the decision-making process when treating pediatric patients with Eustachian tube dysfunction.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Factors Associated with Maintaining Serviceable Hearing in Conservatively Managed Vestibular Schwannoma Patients**

*Jacob B. Hunter, MD; Brendan P. O'Connell, MD*

*Marc L. Bennett, MD; Alejandro Rivas, MD*

*George B. Wanna, MD; Reid C. Thompson, MD*

*David S. Haynes, MD*

**Objective:** To characterize the risk of progression to non-serviceable hearing in patients who elect to observe vestibular schwannomas (VS).

**Study Design:** Retrospective case series.

**Setting:** Tertiary care center.

**Patients:** VS patients with serviceable hearing who underwent at least two audiograms and two MRI studies prior to intervention or loss to follow-up.

**Main outcome measure(s):** Serviceable hearing, defined as the pure tone average less than 50 dB HL and word recognition score (WRS) greater than 50%.

**Results:** Two-hundred and forty-nine patients (mean age of 56.2 years and median tumor diameter of 0.84 cm) had serviceable hearing at presentation and were followed for a median of 29.7 months. At the last visit prior to intervention or loss to follow-up, 195 (78.3%) patients maintained serviceable hearing. Presenting age (OR 1.062), presenting tumor diameter (OR 1.962), tumor growth greater than 2 mm (OR 1.969), and absence of a fundal cap (OR 1.858) were all significantly associated with loss of serviceable hearing. Kaplan-Meier analysis found a significant (log rank p<0.001) monotonic increase in developing non-serviceable hearing with poorer WRS at presentation. Of those patients with 100% WRS at presentation, 93.9% maintained serviceable hearing at last follow-up. If the WRS is  $\geq$  90%, 88.7% maintained serviceable hearing at last follow-up.

**Conclusions:** In VS patients who elect observation, the majority maintain serviceable hearing during observation. For patients with excellent word recognition scores, particularly those with smaller tumors, younger age, and the presence of a fundal cap, initial observation prior to intervention should be considered.

**Define Professional Practice Gap & Educational Need:** Previous data from one international center has demonstrated that patients with vestibular schwannomas and "normal speech discrimination" should undergo treatment when tumor growth is demonstrated. This has not been re-explored or expanded upon, let alone at a separate center with a comparably sized cohort.

**Learning Objective:** We explored the relationship of serviceable hearing and sporadic vestibular schwannomas, identifying and quantifying a number of factors as to who maintains serviceable hearing in those patients who elect to observe their tumors.

**Desired Result:** This presentation will enable attendees to better understand the natural course of hearing outcomes in patients with sporadic vestibular schwannomas, hopefully helping them to improve their counseling of patients who present with serviceable hearing.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Quality of Life in Sporadic Vestibular Schwannoma: A Cross-sectional Survey of 1,288 Patients Using a Disease-Specific Inventory**

*Matthew L. Carlson, MD; Nicole M. Tombers, RN  
Panagiotis Kerezoudis, PhD; Maria Peris Celda, MD, PhD  
Christine M. Lohse, MS; Michael J. Link, MD*

**Objective:** To evaluate quality-of-life (QoL) in patients with sporadic vestibular schwannoma (VS).

**Study Design:** Cross-sectional survey, Penn Acoustic Neuroma Quality of Life (PANQOL) instrument.

**Setting:** Acoustic Neuroma Association and a single tertiary referral center.

**Patients:** Patients with sporadic VS.

**Main Outcome Measures:** Domain-specific and total PANQOL scores comparing treatment modalities after adjusting for baseline covariates of interest.

**Results:** Among all 1,288 respondents there were 229 (18%) who were recently diagnosed and had not yet selected a treatment modality, 303 (24%) who were observed, 185 (14%) who underwent radiosurgery alone, 507 (39%) who underwent microsurgery alone, and 64 (5%) who underwent radiosurgery and microsurgery. After adjusting for covariates of interest, total PANQOL scores were highest for the observation cohort (65;95% CI 62-68), lowest for patients treated with multimodality therapy (56;51-61) and those recently diagnosed (58;55-62), and intermediate for those who received microsurgery alone (60;58-62) and radiosurgery alone (61;57-64) (global comparison, P=0.001). When comparing groups that received single-modality therapy, there were no statistically significant differences in total PANQOL scores at short (0-5 years), intermediate (6-10 years), or long-term ( $\geq 11$  years) follow-up after adjusting for baseline covariates (all, P>0.05). Pairwise comparisons between treatment modalities will be presented.

**Conclusion:** The period of time immediately after diagnosis, before an initial management strategy has been chosen, is associated with poor overall QoL. Differences in QoL during observation and following radiosurgery and microsurgery are small. Initial observation should be used in those patients who qualify, as active treatment does not appear to confer a QoL advantage.

**Define Professional Practice Gap & Educational Need:** Lack of contemporary knowledge regarding disease-specific quality-of-life outcomes in patients with vestibular schwannoma.

**Learning Objective:** 1. To ascertain disease-specific quality-of-life outcomes after observation, microsurgery, radiosurgery and multimodality therapy in a large cohort of patients with vestibular schwannoma. 2. To ascertain the impact of initial diagnosis (before treatment) on quality-of-life.

**Desired Result:** Attendees will apply this knowledge to patient counseling regarding treatment modality selection.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Does a “Fundal Fluid” Cap Predict Successful Hearing Preservation in Vestibular Schwannoma Resections via the Middle Cranial Fossa Approach?**

*Daniel Q. Sun MD; Raymond W. Kung MD  
Marlan R. Hansen MD; Bruce J. Gantz, MD*

**Objective:** To determine the association between radiographic cerebrospinal fluid (CSF) cap in the lateral internal auditory canal (IAC) and success of hearing preservation in middle cranial fossa (MCF) vestibular schwannoma (VS) surgery.

**Study Design:** Retrospective chart review

**Setting:** Academic tertiary referral center

**Patients:** One hundred thirty eight consecutive patients (mean age/standard deviation, SD, 50/11 years; mean tumor size/SD, 9.7/3.9mm) who underwent MCF VS resection.

**Intervention(s):** MCF VS excision

**Main outcome measure(s):** Size of fundal fluid cap on pre-operative magnetic resonance imaging (MRI), pre- and post-operative pure tone average (PTA) and word recognition score (WRS).

**Results:** Mean tumor and fundal fluid sizes were 9.7mm (SD 3.9mm) and 2.8mm (SD 1.7mm), respectively. On bivariate analysis, only inferior vestibular nerve tumor origin was associated with worse post-operative PTA ( $p=0.005$ ) and WRS ( $p=0.005$ ). Fundal fluid size was associated with larger tumor size ( $p=0.005$ ) but not changes in post-operative PTA ( $p=0.56$ ) or WRS ( $p=0.19$ ). When fundal fluid size was stratified as small (<2mm), medium ( $\geq 2$ mm and <4mm), or large ( $\geq 4$ mm), no significant differences were seen in rates of hearing preservation. Using multivariate linear regression models adjusting for patient age, gender, tumor nerve of origin, neurofibromatosis type II status, and pre-operative PTA and WRS, several definitions of “hearing preservation” were explored and larger fundal fluid size was not associated with improved likelihood of preserved hearing regardless of classification.

**Conclusions:** Presence or size of CSF fluid cap may not be a reliable prognostic indicator for hearing preservation in MCF VS resection, with important implications for patient counseling.

**Define Professional Practice Gap & Educational Need:** 1. lack of awareness 2. inconsistencies in patient counseling 3. lack of contemporary knowledge

**Learning Objective:** Understand how lateral CSF fluid cap is measured on MRI 2. Discuss the relationship between CSF fluid cap and hearing preservation

**Desired Result:** Better recognition of CSF fluid cap when reviewing MRI and understand its implications for patient counseling

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 4

## **Shared Decision Making and Decisional Conflict in the Management of Vestibular Schwannoma**

*M. Elise Graham, MD; Brian D. Westerberg, MD, MHSc,  
Jane Lea, MD; Paul Hong, MD, MSc; Simon Walling, MBCHB  
Andrea L.O. Hebb, MSc, PhD, RN; Manohar Bance, MB, MSc*

**Objective:** To determine the extent to which patients with vestibular schwannomas experience decisional conflict when deciding between surgery or non-surgical management, and factors influencing the degree of conflict.

**Study Design:** Survey-based study.

**Setting:** Tertiary ambulatory skull-base clinic.

**Patients:** Inclusion criteria: patients with newly diagnosed or newly growing vestibular schwannoma presenting to the clinic.

**Intervention:** Patients were given a demographic form and the decisional conflict scale (DCS), a validated scale to assess degree of difficulty making medical decisions. The degree of shared decision making (SDM) experienced by the patient and physician were assessed via the SDM-Q-10 and SDM-Q-Doc questionnaires, respectively. Surveys and demographic information were correlated with DCS.

**Outcome measures:** DCS score, SDM-Q-10 score, SDM-Q-Doc score

**Results:** Seventy-seven patients participated: 55% female, aged 37 to 81 years, VS size range 2mm to 50mm. Significant decisional conflict (DCS score 25 or greater) was experienced by 22% of patients. Patients reported an average SDM score of 86. Physician and patient SDM scores were weakly correlated ( $p=0.045$ , correlation coefficient 0.234). DCS scores were lower with a decision to pursue surgery, presence of a trainee, and SDM-Q-10 score. DCS was increased with female gender. Using logistic regression, the SDM-Q-10 score was the only variable associated with decreased DCS.

**Conclusions:** About one fifth of patients deciding how to manage their vestibular schwannoma experience a significant degree of decisional conflict. Involving the patients in the process through shared decision-making significantly reduces the degree of conflict patients experience. Physicians do not estimate patient's perception of SDM well.

**Define Professional Practice Gap & Educational Need:** Lack of awareness of the importance of shared decision making in the decision making process for the management of vestibular schwannomas. Lack of knowledge about the concept of decisional conflict in patient care

**Learning Objective:** - To improve awareness of the role of shared decision making in reducing the decisional conflict experienced by patients considering surgical versus non-surgical management of vestibular schwannomas. - To explore other factors that may influence patient's degree of decisional conflict in vestibular schwannoma management

**Desired Result:** It is hoped that neurologists attending this presentation will increase the degree of shared decision-making in their consultations, to improve the patient experience when deciding how to manage their vestibular schwannoma. They will also be able to look for other predictors of decisional conflict in their patient populations. This could potentially be applied to other surgical scenarios in which surgery and non-surgical management are both options, with risks and benefits to weigh on both sides.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 3

## **Factors That Affect Length of Hospital Stay after Vestibular Schwannoma Surgery**

*Nopawan Vorasubin, MD; Thomas H. Alexander, MD, MHSc  
Bill Mastrodimos, MD; Roberto A. Cueva, MD*

**Objective:** To identify perioperative factors that influence hospital length of stay (LOS) after resection of vestibular schwannoma (VS).

**Study design:** Retrospective case review.

**Setting:** Tertiary skull base referral center.

**Patients:** Patients who underwent acoustic neuroma resection between January 1, 2007 to January 1, 2014.

**Interventions:** Approaches used for VS resection included translabyrinthine and retrosigmoid.

**Main outcome measures:** LOS and several perioperative factors that may delay hospital discharge were examined. Factors included were patient demographics (age and gender), tumor characteristics (size), surgical factors (operative time, approach, revision surgery, date of surgery), and immediate postoperative factors (presence of vertigo or immediate postoperative complications).

**Results:** 288 patients underwent VS resection during the study period. 255 patients had complete charts available for review. LOS ranged from 1 to 10 days with an average of 2.66 days and mode of 2 days. 131 patients were admitted for  $\leq 2$  days and 124 patients stayed longer. Of the perioperative factors examined with univariate analysis, female gender ( $p=0.0266$ ) and presence of postoperative vertigo ( $p<0.0001$ ) were statistically significant factors associated with LOS  $>2$  day. On multivariate logistic regression analysis with odds ratios (OR), older patient age (OR=1.028,  $p=0.0177$ ), female gender (OR=1.810,  $p=0.0314$ ), longer operative time (OR=1.424,  $p=0.0007$ ) and presence of postoperative vertigo (OR=4.904,  $p<0.0001$ ) carried a statistically significant increased odds towards a LOS  $>2$  days.

**Conclusions:** VS surgery and postoperative care can be carried out efficiently with a minimal LOS. Identifying factors that may prolong LOS may help the operative team anticipate and address needs to optimize LOS.

**Define Professional Practice Gap & Educational Need:** Epidemiological data on outcomes for patients undergoing vestibular schwannoma surgery for the state of California in surgical centers treating a high volume of patients with acoustic neuromas reported the mean length of stay for patients was 4.7 to 5.4 days. Lower volume centers ranged from 6.8 to 9.2 days. A review of a national database in 2012 found a range of mean length of stay for vestibular schwannoma surgical patients to be 5.4 to 8.7 days. These studies illustrate the current lack of standardization with a wide range of average length of stay after vestibular schwannoma surgery even among high-volume skull base centers.

**Learning Objective:** We aim to report our experience with acoustic neuroma surgery from 2007- 2014 and describe our patient presentations, surgical findings, and outcomes. We intend to carefully analyze our length of stay data and assess for factors that impact deviations from the mean.

**Desired Result:** To initiate a discussion within and among skull base centers on how the length of hospital stay after vestibular schwannoma surgery can be minimized without compromising patient outcome.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## **Individualized Learning Plan (ILP) is an Effective Tool in Assessing Achievement of Otology-related Subcompetency Milestones**

*Maja Svrakic, MD*

**Objective:** To investigate the Individualized Learning Plan (ILP) as a tool in assessment of residents' milestone achievements as they pertain to Otology subcompetencies: Chronic Ear Disease, Pediatric Otitis Media and Hearing Loss.

**Study Design:** Prospective study.

**Methods:** Twenty Otolaryngology residents were instructed to utilize an ILP and identify 6 milestones from three Otology-related subcompetencies to focus on during the course of a 3-month rotation. They were also asked to plan out specific activities which would help them achieve these milestones, to specify whether or not they successfully achieved them, by what instructional or learning methods and if to identify any barriers. The completed ILPs were reviewed by a faculty member. The effectiveness of the ILP was assessed by response compliance rate, corroboration of self-reported milestone achievement with faculty evaluations and the ability to set attainable milestones.

**Results:** There was 90% compliance in utilizing an ILP to achieve milestones. Self-reported milestone scores corresponded to the faculty evaluations in a large majority (87.3%) of cases, and tended to be underestimated by the residents. Out of 114 total milestones identified, 24 (21.5%) were not achieved, with particular overestimation in the use of independent study as a learning method.

**Conclusions:** The ILP is an effective tool in measuring residents' achievement of Otology-related milestones, and could possibly be used to supplement or replace faculty assessment. The ILP provides valuable information on barriers to achieving milestones and informs trainees on how to set attainable goals as they pertain to patient care and medical knowledge in Otology.

**Define Professional Practice Gap & Educational Need:** 1. Lack of data on utilizing Individualized Learning Plans as a means of assessing Otolaryngology residency milestone achievements as they pertain to Otology subcompetencies (Chronic Ear Disease, Pediatric Otitis Media and Hearing Loss). 2. Lack of data on what instructional/learning methods are most conducive to achievement of specific milestones within the Otology subcompetencies

**Learning Objective:** 1. Describe why the Individualized Learning Plan is a successful method of assessment of achievement of Otology subcompetency milestones 2. Recognize the instructional/learning methods which are most and leadt conducive to achievement of Otology subcompetency milestones

**Desired Result:** 1. Implement the Individualized Learning Plan as a method of assessment of achievement of Otology subcompetency milestones 2. Implement the successful instructional/learning methods to help residents achieve Otology subcompetency milestones

**IRB or IACUC Approval:** Exempt

**Level of Evidence:** 3

## **The Clinical Stage Otoprotectant SENS-401 Effectively Reduces Hearing Loss in Rats When Administered up to 96 hours after Severe Acoustic Trauma**

*Mathieu Petremann, MS; Charlotte Romanet, MS  
Christophe Tran Van Ba, MS; Audrey Broussy, MS  
Jonas Dyhrfjeld-Johnsen, PhD*

**Hypothesis:** SENS-401 can protect against acoustic trauma induced SSNHL in rats with delayed administration.

**Background:** SENS-401 is an orally administered small molecule which reduces death of outer hair cells. It has orphan status for treatment of Sudden Sensorineural Hearing Loss and Platinum-induced Ototoxicity. A challenge for treatment of SSNHL patients is the delay between onset, diagnosis and treatment start. The goal of this study was to evaluate whether SENS-401 could effectively treat acoustic trauma-induced SSNHL with delayed administration.

**Methods:** After baseline audiology Wistar rats were subjected to severe acoustic trauma (120 dB octave band noise, 8-16 kHz, 2hrs). Following audiometric characterization at 24hrs, rats were assigned to receive 13.2 mg/kg SENS-401 bid for 28 days starting at 24 or 96 hrs post trauma or placebo control. Final hearing outcome was evaluated at D32-33.

**Results:** Mean ABR threshold shifts at 24h after acoustic trauma were above 60 dB and placebo treated animals displayed mean ABR threshold recovery of less than 10 dB at the end of the study. SENS-401 significantly increased ABR threshold recovery as a function of treatment initiation time after acoustic trauma with improvements of 200% (24hrs group) and 90% (96hrs group) compared to placebo treatment.

**Conclusions:** Twice daily, oral SENS-401 treatment significantly improved recovery of hearing loss in rats when initiated up to 96hrs after severe acoustic trauma. This suggests an acceptable treatment window for the management of SSNHL patients who may not seek medical help immediate after the onset of hearing loss.

**Define Professional Practice Gap & Educational Need:** There is a lack of knowledge and awareness of whether the clinical stage otoprotectant SENS-401 can be effective as a therapeutic agent for the treatment of SSNHL.

**Learning Objective:** At the conclusion of this presentation, the attendees will learn that clinical stage otoprotectant SENS-401 significantly reduced hearing loss in rats when administered up to 96 hrs after severe acoustic trauma and can be further developed as a treatment of SSNHL in patients.

**Desired Result:** The attendees may be able apply this knowledge by recognizing that SENS-401 may be a promising future therapeutic agent for treating SSNHL.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** Does not apply- The abstract only contains preclinical data

## Anatomical Progression of Otosclerosis Analyzed by High Resolution CT on Surgically Confirmed Patients

*Chihiro Yagi, MD; Yuka Morita, MD, PhD*

*Kuniyuki Takahashi, MD, PhD; Manabu Ogi, MD*

*Shinsuke Oshima, MD, PhD; Yutaka Yamamoto, MD, PhD*

*Arata Horii, MD, PhD*

**Objective:** To clarify the anatomical progression of the otosclerosis lesion in relation to age and hearing level.

**Study Design:** Retrospective chart review.

**Patients:** Ninety-five patients with surgically confirmed uni- or bilateral otosclerosis.

**Main Outcome Measures:** Otosclerotic loci were defined if hypodense area was observed in otic capsule by high resolution computed tomography (HRCT). Location and the number lesions were examined and their correlation with age and hearing level at the time of CT was tested.

**Results:** Among 115 operated ears, otosclerotic lesions were observed in 77 ears. Anterior part of the oval window (ant-OW), anterior part of the internal auditory canal (ant-IAC), and the pericochlear area (PCochA) were the three most affected sites. In 77 ears with lesions, ant-OW was affected in 74 ears (96.1%), ant-IAC in 36 ears (46.8%), and PCochA in 20 ears (26.0%) with overlaps. Ant-OW was solely affected in 37 ears (48.1%), ant-IAC in 3 ears (3.9%), and PCochA in no case. Among 74 ears with ant-OW lesion, overlap with ant-IAC lesion (33 ears, 44.6%) was more frequently seen than with PCochA (20 ears, 27.0%). Triple sites disease was seen more in the latter 20 ears (80%) than the former 33 ears (48.5%). There were no differences in age and hearing level between patients those affected with only ant-OW and with triple sites.

**Conclusion:** Otosclerosis lesions may extend from ant-OW to ant-IAC followed by PCochA. Progression of the disease may vary within individuals, resulting in no correlation between the number of disease sites and age/hearing level.

**Define Professional Practice Gap & Educational Need:** The progress of the recent imaging technology is remarkable, the extent of disease progression in the patients with otosclerosis can be accurately evaluated by high-resolution CT scan. Lack of awareness of CT findings in otosclerosis patients can result in delays in diagnosis and failure in prognostic prediction. Our understanding of CT findings will increase with awareness of the anatomical progression of otosclerosis.

**Learning Objective:** 1) Review CT findings and sex, age, hearing level in otosclerosis patients. 2) Discuss the anatomical progression of otosclerosis.

**Desired Result:** 1) Increased awareness of CT findings in otosclerosis patients. 2) Increased ability to correctly diagnose and forecast of prognosis in otosclerosis patients.

**IRB or IACUC Approval:** Approved

**Level of Evidence:** 5

## NEUROTOLOGY FELLOW AWARD

### Fluorescent Detection of Merlin-Deficient Schwann Cells and Primary Human Vestibular Schwannoma Cells Using Sodium Fluorescein

*Enrique Perez, MD; Olena Bracho, BS*

*Paula Monje, PhD; Cristina Fernandez, PhD*

*Fred F. Telischi, MD; Christine T. Dinh, MD*

**Hypothesis:** Merlin-deficient mouse Schwann cells (MTC) and primary human vestibular schwannoma cells (VSC) have selective uptake of sodium-fluorescein, allowing better direct visualization when compared to wild-type Schwann cells (WT-SCs).

**Background:** sodium-fluorescein is a fluorescent compound used in the field of Neurosurgery for fluorescent-guided resection of malignant gliomas due to preferential uptake by the tumor. Fluorescein can also potentially improve detection of the tumor-nerve interface in vestibular schwannomas (VS). The utility of sodium-fluorescein in fluorescent-guided VS surgery has not been assessed.

**Methods:** MTC, VSC, and WT-SCs were cultured at different cell densities and treated with sodium-fluorescein at several drug concentrations and durations. Fluorescence following blue-light excitation was quantified. The threshold of visual detection of fluorescent cells was determined from blinded observers using a four-point Likert scale. Kruskal-Wallis Test with multiple pairwise comparisons, as well as inter-rater and intra-rater reliabilities were calculated.

**Results:** Higher sodium-fluorescein concentrations resulted in a dose-dependent increase in the relative fluorescent units (RFU) of MTC and VSC in vitro, compared to WT-SCs. In addition, RFUs increased proportionately to the density of MTC and VSCs. The Likert scale was validated using independent observers with good inter-rater and intra-rater reliability. Observers detected MTC and VSCs at concentrations as low as 50,000 cells-per-well. No observable fluorescence was visualized in WT-SCs. Duration of drug exposure augmented fluorescent measurements.

**Conclusion:** MTC and VS cells demonstrate preferential uptake of sodium-fluorescein allowing direct visualization of the cell fluorescence when compared to WT-SCs. Further investigations into the utility of fluorescein-guidance in VS surgery using a pre-clinical animal model is warranted.

**Define Professional Practice Gap & Educational Need:** 1. Persistent challenges in defining the tumor-nerve interface during vestibular schwannoma surgery 2. Lack of contemporary knowledge on the feasibility of fluorescent-guided surgery for vestibular schwannomas 3. Specifically- lack of in vitro studies to serve as the foundation for future preclinical research using fluorescein to target and better visualize vestibular schwannomas

**Learning Objective:** 1. Have a better understanding regarding the efficacy of using sodium to selectively target and visualize merlin-deficient mouse Schwann cells and primary human vestibular schwannoma cells compared to wild type schwann cells. 2. Grasp the overall concept of utilizing this fluorescent marker for improving visualization of the tumor-nerve interface during vestibular schwannoma surgery.

**Desired Result:** 1. Discuss future preclinical studies to further determine the feasibility of using sodium fluorescein for vestibular schwannoma surgery. 2. Consider other possible applications in skull base surgery for which fluorescent-guidance may prove useful.

**IRB or IACUC Approval:** Exempt

**Level of Evidence:** Does not apply- Basic science in vitro research