

Abstracts

Podium: Otology 1 / Vestibular

Monday, June 8, 2015 @ 13:30-15:30

Cochlear Implantation in Adults with Hearing Exceeding Current Candidacy Criteria: Updated Clinical and Quality of Life Outcomes – E. Hwang, O. Hilly, D. Shipp, L. Smith, J. Nedzelski, J. Chen, V. Lin, Toronto, ON

Learning Objectives

At the conclusion of this presentation, the participants should be able:

1. To discuss the improvement in both clinical and quality of life outcomes of cochlear implant recipients whose pre-implantation hearing surpassed currently recommended candidacy criteria.
2. Consider the use of expanded candidacy criteria for cochlear implantation.

Objectives: To determine audiological results and qualitative satisfaction in post-lingually deafened adult cochlear implant recipients whose pre-implantation aided speech recognition scores exceeded current candidacy criteria. **Study Design:** Retrospective case series. **Methods:** All post-lingually deafened adult patients who were implanted between 2000 and 2014 and had been ineffective hearing aid users with a Hearing in Noise Test (HINT) score of at least 60% prior to cochlear implantation were included (N=132). Their pre-operative best aided hearing performance, including HINT score, was compared to their post-operative hearing performance with the cochlear implant at 12 months following activation. In addition, the Hearing Handicap Inventory questionnaire was distributed before and after implantation to measure the hearing-related handicap change perceived by the patients. **Results:** 119 patients were followed at one year of implant use and all demonstrated significant post-operative improvement in both audiological and qualitative outcomes. Their mean HINT score improved from 76.6% to 93.3% ($p < 0.001$). Individually, none of the patients had a decline in their HINT score post-implantation. In addition, their perceived hearing-related handicap was also significantly reduced. **Conclusions:** This updated and expanded series confirms that individuals whose hearing loss is not severe enough to meet the commonly accepted candidacy criteria (HINT score less than 60%) prove to be excellent candidates for cochlear implantation. In the past, these patients would suffer considerably from hearing impairment despite wearing optimally fitted hearing aids. The significant improvement in the post-operative speech recognition performance and hearing-related handicap in this cohort of hearing impaired individuals supports the expansion of our conventional cochlear implantation candidacy criteria.

Stability of Cochlear Implant Functional Outcomes in Elderly Patients – Long-Term Results – O. Hilly, E. Hwang, D. Shipp, J. Nedzelski, J. Chen, V. Lin, Toronto, ON

Learning Objectives

1. To discuss the long term effects of aging on cochlear implant outcomes.

Objectives Cochlear implantation has been demonstrated to be beneficial in elderly patients with profound hearing loss. However, limited long-term data raise concerns regarding the effect of aging processes, such as neurodegeneration and reduced plasticity, on audiometric outcomes. The aim of this study was to evaluate long-term outcomes of cochlear implantation in elderly patients and to examine whether function declined over years in this population, compared with younger patients. **Methods** Patients implanted at a provincial adult tertiary cochlear implant centre were divided into three age groups: ≤ 60 , 61-70 and ≥ 71 years old.

Hearing in Noise Test (HINT) scores were recorded at 1, 5 and 10 years after implantation. **Results** HINT scores at 1 year were available in 206 patients, and averages were similar in patients ≤ 60 , 61-70 and ≥ 71 years old (78, 84 and 73, respectively; $p=NS$). Follow-up of 5 years or more was available in 87 patients, with a mean follow-up period of 6.8 years. Average HINT scores at the most recent follow-up were 85, 85 and 77, respectively ($p>0.05$). HINT scores were stable ($<20\%$ change) or improved during follow-up in all patients above age 61 years, and in 97% of patients 60 years old or younger ($p=NS$). All groups demonstrated similar improvements in SF-36 health survey scores after implantation. **Conclusion** Outcomes in elderly patients with cochlear implants are similar to those seen in the younger population. The hearing and quality of life benefit in all age groups is stable over a long-term follow-up period.

Cochlear Implant Position within the Cochlea and Performance Outcome – O. Hilly, E. Hwang, D. Shipp, S. Symons, J. Nedzelski, J. Chen, V. Lin, Toronto, ON

Learning Objectives

1. To discuss the significance of cochlear implant electrode position within the cochlea.

Objective: To evaluate whether electrode position within the cochlea affects performance outcomes one year following cochlear implantation. **Methods:** 174 patients who were implanted with the Advanced Bionics HiFocus™ 1J electrode, which was designed for a single-turn insertion, were included in the study. Post-implantation images were retrospectively reviewed and the depth of insertion was measured in degrees from the round window to the electrode tip. Correlation between depth of electrode insertion and one-year post-implantation Hearing in Noise Test (HINT) scores was analyzed. **Results:** 102 patients were included in the final analysis after exclusion of patients with cochlear anomalies, bilateral implants, revision surgeries and patients who did not complete one-year follow-up. Depth of electrode insertion ranged from 180 to 630 degrees and HINT scores ranged from 0 to 100%. Spearman correlation did not reveal significant association between depth of insertion and HINT scores (correlation coefficient=0.17, $p=0.09$). Insertion of 270 degrees or less was associated with poor performance, compared with insertion of 271 to 449 degrees and 450 degrees or more (average HINT scores of 62, 75 and 78, respectively; $p=0.04$ for <270 vs. >450 groups). After excluding non-native English speakers and patients deafened in early adulthood ($n=60$), similar results (average HINT scores of 74, 86, 87 respectively; $p=NS$) were obtained. **Conclusions:** Deep insertion of a single-turn electrode is not associated with reduced post-operative HINT scores. Patients who have less than full insertion (≤ 270 degrees) have poorer performance. Full insertion of the electrode, and not the position within the cochlea, appears to be associated with performance outcome.

VEMP Testing for Clinicians – V. Wong, B. Blakley, Winnipeg, MB

Learning Objectives

1. After this session the participant will have a better understanding of the clinical application of VEMP test results.

Objective: To provide normal values for and assess the application of cervical vestibular evoked myogenic potentials (cVEMP) test parameters in clinical practice. **Study Design:** Forty-eight normal subjects with no history of hearing loss or vestibular symptoms underwent cervical vestibular evoked myogenic cVEMP testing. Measurement parameters were tabulated and compared to other sets of normal values in the literature.

The literature was reviewed to assess the clinical significance of abnormal cVEMP results. The distributions of threshold and symmetry ratios for normal subjects were compared to the distributions of ninety patients who underwent cVEMP testing. **Setting:** Tertiary academic center. **Subjects:** Residents, students, friends, and relative who volunteered for testing and had no history of ear problems, hearing loss or dizziness. **Patients:** Patients referred for cVEMP testing for a complete calendar year (2013). **Results:** Upper limits of 42% asymmetry ratio and the range of 65-90 dBHL for threshold were verified for our centre. The distributions for threshold and symmetry ratio were not different between normal and patient groups. **Discussion:** Our finding that the cVEMP data do not differ between normal and patient populations is disconcerting and suggests that cVEMP has significant weaknesses as a clinical test. Of course there could be many explanations that deserve further exploration. The use of cVEMP in detection of superior semicircular canal dehiscence appears to be the only clinical use for cVEMP that has literature support. **Conclusions:** For clinical purposes cVEMP “thresholds” should be reported. Other parameters may be reported but there should be some recognition that their clinical significance is unknown.

The Video Head Impulse Test and Bithermal Caloric Testing: Correlation and Clinical Usefulness – C. Wuesthoff, D. Pothier, Toronto, ON

Learning Objectives

1. Attendees will benefit from understanding the role that each one of these tests (video head impulse test and calorics test) really plays in the context of being clinical aids.
2. The role of caloric testing must be clarified, as it is not a complete and fail-proof diagnostic test for all vestibular disorders and must be used carefully and with an understanding of its limitations, in order to avoid missing lesions and deficits.
3. We want to present this to tests as complementary, never leaving behind the very important role of clinical judgement and correlation.

Background: Bithermal caloric testing and the video head impulse test (vHIT) evaluate lateral canal function, but these results do not always align, making clinical evaluations challenging. We aimed to quantify the level of correlation between these tests. **Materials and Methods:** Retrospective cohort study of 163 sequential adult patients at a tertiary referral center who underwent caloric and vHIT testing. Correlation between tests was determined using ipsilateral vHIT gain and the degree of canal paresis as measured by the Jonkees’ formula. The addition of overt and covert saccades provided an alternative determinant of a positive vHIT result. **Results:** Mean age was 53 years (SD=18.9), males accounted for 45% of the subjects. The most common diagnosis was Ménière’s disease (11.3%) or a recurrent or non-specific vestibulopathy (24.7%). 258/326 ears had a normal vHIT ($n \geq 0.8$). There was poor agreement between vHIT and caloric results; of the 106 normal caloric responses, vHIT found only 77 to be normal. Of the 57 abnormal caloric results, vHIT identified 29 as normal. Where both vHIT and caloric testing identified an abnormality, both tests agreed on the side of the lesion in 19 cases and but disagreed in 5. **Conclusions:** Our analysis showed a poor to moderate correlation between caloric and vHIT test results. These findings draw into question the validity of caloric testing as well as the value of vHIT testing.

Clinical Head Impulse Test vs. Video Head Impulse Test: How Accurate Are Our Observations? – C. Wuesthoff, D. Pothier, Toronto, ON

Learning Objectives

1. Attendees will get acquainted with the principles and usefulness of bedside Halmagyi head thrust maneuver to diagnose vestibulo-ocular reflex impairments. Quantification of

its clinical effectiveness would be performed through comparisons with the video head impulse test.

2. Attendees will get acquainted to the principles of video head impulse test and its applicability as a confirmatory method for suspected VOR impairments.
3. Take home points will include knowing the sensitivity and specificity of this test at a tertiary care level centre, this will hopefully give an idea of how this test should be applied, and be regarded as a diagnostic tool in our day to day clinical practice.

Background: The Halmagyi bedside head impulse test (HHT) is useful in identifying vestibulo-ocular reflex (VOR) deficits. HHT is operator-dependent and some catch-up saccades, particularly covert saccades, may be missed. We aimed to determine the accuracy of HHT when compared to the video head impulse test (vHIT). **Materials and Methods:** Retrospective cohort study of 86 sequential adult patients at a tertiary referral centre who underwent vHIT testing following complete neurotological examination that included a clinical HHT. Analysis was performed on 172 HHT and vHIT results (each ear) obtained from the cohort. **Results:** When HHT results were compared to vHIT gain (abnormal <0.8), HHT was 42% sensitive and 82% specific with a positive predictive value (PPV) of 41% and negative predictive value (NPV) of 83%. If vHIT results were deemed abnormal based not only on gain but also on presence/absence of catch-up saccades, sensitivity decreased (34%) but specificity increased (93%, PPV 87%, NPV 50%). Given that covert saccades are theoretically invisible to the naked eye, a new calculation was made excluding them from the analysis. With this modification, sensitivity (44%) and specificity (94%) varied slightly; PPV and NPV were found at 72% and 54% respectively. **Conclusions:** Clinical HIT is highly specific but not very sensitive when compared to vHIT. Using gain alone for the final analysis of vHIT will decrease its accuracy. HHT doesn't appear to be an acceptable screening test; however, in the absence of vHIT, experienced examiners can rely on HIT for the workup of patients with suspected VOR impairment.

Cost-effective Investigation of Unilateral Vestibular Weakness – P. Moore, J. Hochman, B. Blakley, Winnipeg, MB

Learning Objectives

By the end of the presentation, participants should:

1. Appreciate the incidence of vestibular schwannoma in patients with unilateral vestibular weakness
2. Understand the cost-effectiveness of MR imaging in this population
3. Be able to apply this knowledge to their clinical practice

Objectives: To determine the incidence of vestibular schwannoma in patients with unilateral vestibular weakness; and whether MRI is a cost-effective investigation for detecting these lesions in this population. **Methods:** Retrospective chart review. Patients with unilateral vestibular weakness (>25%) at our institution between 2012-2014 were identified. Our imaging database was employed to search for radiographic findings consistent with vestibular schwannoma in this cohort. Their clinical histories were also reviewed for any associated lateral skull base symptoms. **Results:** 236 patients with unilateral vestibular weakness were identified. 154 of them had adequate imaging to detect a vestibular schwannoma (MRI or infused CT). 5 of these patients had findings consistent with vestibular schwannoma. 4 of these 5 also demonstrated asymmetric sensorineural hearing loss (SNHL) on audiometry prior to imaging. Assuming an average cost of imaging to be \$1,200, this makes the average cost of identifying a patient with vestibular schwannoma based on caloric testing alone \$36,960. **Conclusions:** MR

imaging is very sensitive for detecting vestibular schwannoma, but is not a cost effective investigation for unilateral vestibular weakness alone.

Clinical Evidence for a Spectrum of Injury in Gentamicin Induced Vestibular Loss - O.

Ilan, M. I. Syed, P. J. Ranalli, D. Pothier, J. Rutka, Toronto, ON

Learning Objectives

At the end of the presentation the attendees will:

1. Be aware of the spectrum of gentamicin vestibulotoxicity.
2. Understand the different options for evaluation of patients with suspected gentamicin induced vestibular injury.
3. Be able to apply a structured approach to evaluation of gentamicin induced vestibular injury.

Objective: It has been previously demonstrated in animal models that gentamicin induced vestibular damage is directed to high velocity perception in the lateral semicircular canal and that injury precedes the damage to low velocity perception. We tested the hypothesis that this spectrum of injury also exists in humans. **Methods:** 47 consecutive patients seen in the Multidisciplinary Neurotology Clinic at a tertiary university hospital from 1996 – 2012 with gentamicin induced vestibular loss were investigated with vestibular testing. **Results:** Of the 47 patients, 42 had abnormal findings on the caloric test. 26 of 29 patients with rotational chair testing had findings suggestive for a bilateral high velocity vestibular loss (BHVVL). Of the 26 patients with BVFVL on rotational chair testing only 21 were found to have bilateral caloric loss. With magnetic scleral coil testing, 20 the patients had bilateral high velocity vestibular loss. Of these 20 patients, 17 were found to have bilateral caloric loss. Twenty of 33 patients were found to have abnormal cVEMP findings. Of 19 patients evaluated by all 3 studies (scleral coil, caloric and cVEMP testing), 19 presented high velocity vestibular loss, 16 were found to have a bilateral caloric loss and 5 demonstrated bilateral absent cVEMP responses. **Conclusion:** Our findings suggest that a hierarchy of vestibular injury exists in humans that parallel animal models. In our series lateral semicircular canal function appeared more sensitive to gentamicin toxicity than otolithic function. Our results suggest that high velocity testing is more appropriate for early diagnosis of vestibular injury from gentamicin toxicity than abnormalities in the caloric test or cVEMP testing.

Interpretation of Sonotubometric Data Based on Phase-Shift Detection – Y. Amoako-

Tuffour, P. Garland, M. Bance, Halifax, NS

Learning Objectives

By the end of this session, the otological clinician/researcher will:

1. Appreciate the variability of outcomes when Sound Pressure Levels (SPLs) are used exclusively in determining Eustachian Tube (ET) patency;
2. Consider the use of acoustic phase data in their interpretation of sonotubometric data as a more consistent probe of ET patency.

Objectives: Sonotubometry is a non-invasive means of assessing Eustachian tube (ET) function. Its interpretation remains a complex task with questionable results due to wide variation between trials. A study was conducted to ascertain whether the measurement of phase shift in sonotubometric signals would be a more reliable indicator of ET patency than fluctuating Sound Pressure Level (SPL). **Materials and Methods:** Eight healthy ears were probed with a 100 Hz signal. Five recordings of SPL were performed at the external auditory canal. Cross-correlation was performed among filtered SPL signals and among extracted phase

arrays. Peak coefficients were averaged to provide a measure of waveform similarity between trials. **Results:** Mean peak cross correlation coefficient for SPL signal measured 0.603 ± 0.057 (SEM) whilst that for Phase-Shift signal measured 0.884 ± 0.027 (SEM). **Conclusion:** Experimental data suggest that phase-shift detection is a more consistent means of interpreting sonotubometric data than SPL analysis.

Audiometric Findings in Tensor Tympani Contraction – B. Wickens, J. Belyea, D. Floyd, M. Bance, Halifax

Learning Objectives

1. To review the anatomy and physiology of the tensor tympani muscle.
2. To determine characteristic audiometric findings in the setting of tensor tympanic contraction.

Objectives: To characterize audiometric findings in individuals capable of voluntary tensor tympani contraction. **Methods:** 6 volunteers possessing the ability to voluntarily contract their tensor tympani muscles were identified and enrolled. Tensor tympani contraction was confirmed with characteristic tympanometry findings. Study subjects underwent conventional audiometry. Air conduction and bone conduction threshold testing was performed during tensor tympani muscle relaxation and contraction. **Results:** Audiometric results demonstrate a low frequency mixed hearing loss resulting from tensor tympani contraction. Specifically, at 250 Hz, air conduction thresholds increased by 22 dB and bone conduction thresholds increased by 9 dB. **Conclusion:** Previous research has demonstrated a low frequency conductive hearing loss in the setting of tensor tympanic contraction. This is the first study to demonstrate a low frequency mixed hearing loss associated with tensor tympani contraction. This additional information may aid in the diagnosis of disorders resulting from abnormal tensor tympani function.

A Steroid Eluting Implant for Inner Ear Disease: An Animal Study for Tolerance and Pharmacokinetics – P. Lavigne, I. Saliba, F. Lavigne, Montreal, QC

Learning Objectives

1. Review of middle and inner ear anatomy.
2. Review of inner ear diseases definitions and current therapy (Ménière's, ISSNHL, Noise induced hearing loss).
3. Review of systemic steroids potential adverse events.
4. Review of inner ear physiology and steroid effects.

Introduction: Intratympanic (IT) steroids were proven effective in the treatment of ISSNHL. Until now, repetitive injections of steroids are needed to achieve clinical benefits. This animal study assesses the pharmacokinetic properties and safety of a new middle ear steroid eluting device that would require a single installation intervention. **Method:** Under microscopic visualisation, myringotomies were performed and a Mometasone Furoate (MF) eluting polymer matrix was installed into ten Guinea-pigs' tympanic cavity. Two extra ears were used as controls. Fourteen days after installation, ears were examined and perilymphatic fluid (PF) was harvested for MF concentration measurements. H&E colorations were used to assess middle ear mucosal tolerance. **Results:** All Guinea-pigs tolerated the installation procedure and returned to usual activities. No ear infections were identified and all tympanic membranes had fully healed 14 days after the procedure. An average of 4 μ L of perilymph was harvested from the cochleae. MF was identified in 80% of the PF samples with an average concentration of 165 ng/mL. **Discussion:** These findings suggest that MF can diffuse to the inner ear just as

dexamethasone and methylprednisolone can. Furthermore, significant MF concentrations were found in the perilymph after 14 days, confirming the sustained delivery properties of the polymer. With prolonged inner ear exposure to steroids, the potential for successful therapy may be increased. **Conclusion:** Significant steroid concentrations were measured 14 days after device installation. Additionally, a single intervention would improve patient comfort and compliance to therapy when compared to repeated intratympanic injections.

Clinical and Quality of Life Outcomes in Adults with Semi-Implantable Active Bone Conduction Devices – E. Hwang, K. Williams, L. Smith, O. Hilly, J. Nedzelski, V. Lin, J. Chen, Toronto, ON

Learning Objectives

At the conclusion of this presentation, the participants should be able:

1. To discuss both clinical and quality of life outcomes in patients with a semi-implantable active bone conduction device in their first year of use.
2. To understand the measurable objective and subjective benefits of the recently available semi-implantable active bone conduction device.

Objectives: To determine audiological and qualitative outcomes for adults with conductive hearing loss (CHL), mixed hearing loss (MHL) and single-sided deafness (SSD) who received a semi-implantable active bone conduction device (ABCD), which is a recent alternative to bone-anchored or contralateral routing of signal hearing aids. **Study Design:** Prospective case series. **Methods:** All patients who were implanted with an ABCD (N=22) underwent pure tone audiometry and questionnaire assessments (Health Utilities Index Mark 3 [HUI3]; Speech, Spatial and Qualities of Hearing Scale [SSQ]; and Tinnitus Handicap Inventory [THI]) pre-operatively and at 1, 6, and 12 months post-activation. Patients with SSD also completed the adaptive Hearing in Noise Test paradigm. **Results:** 15 patients had CHL or MHL and 7 had SSD. Significant functional gain was demonstrated across all testing frequencies from 500 to 4,000 Hz in both CHL/MHL and SSD groups post-operatively (p-values<0.0001). For SSD patients, the mean signal-to-noise ratio also significantly improved post-operatively (by 3.56 dB at 6 months post-activation, p<0.0001). Additionally, following surgery, mean HUI3 scores significantly rose in all patients (p-values<0.0001) and significant progress was realized in all subsets of the SSQ in all patients (p-values<0.0001). The mean tinnitus handicap severity measured by the THI significantly declined in the 7 patients reporting pre-operative tinnitus (p=0.03). At this time, not all patients have reached their 6 or 12 months post-activation status and a more complete set of data will be presented. **Conclusions:** The semi-implantable ABCD is a new option for patients with CHL, MHL and SSD that provides both clinical and quality of life benefits.