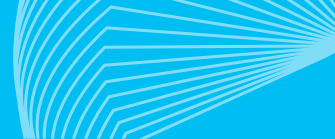


NEURO-OTOLOGY SOCIETY OF AUSTRALIA 2022 MEETING

JW Marriott Hotel I58 Ferny Ave, Surfers Paradise, Queensland
NOTSA Meeting: 2nd - 3rd September
Training Day: 4th September





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Welcome to the 2022 NOTSA meeting on the Gold Coast.

On behalf of the NOTSA organising committee, it is a tremendous pleasure to be able to welcome you to a face-to-face meeting. We haven't been able to hold a NOSTA meeting since the last meeting in Melbourne in 2019.

We have a tremendous line-up of presentations and are extremely fortunate to be joined in person by our invited guest speaker Professor Alex Tarnutzer who have travelled a very long way from Switzerland to be here. We are also most grateful Dr Diego Kaski from London, Dr Dan Gold from The John's Hopkins University School of Medicine in Baltimore & Dr Richard Ibitoye Consultant Neurologist (Gloucestershire Hospitals NHS Foundation Trust) who will be joining us via livestream and for sharing their considerable expertise.

A lot of work has gone into this meeting and I would like to thank everyone involved. We are greatly indebted to our Gold Sponsor (Interacoustics), our Silver sponsors (Southern XP, QLD Vestibular & Cochlear Implant) and to our Bronze sponsors (Biogen, Eisai, Seer Medical, Vesticam, Natus, Roche, Sonic Equipment & Teva) for their very generous support.

Thank you very much for joining us and for being a part of NOTSA once again. I hope you will find the meeting as educational and enjoyable as it has always been, and that you will find some time to enjoy your time on the Gold Coast.

Dr Ben Tsang MBBS, FRACP, B.Pharm (Hons)

NOTSA 2022 Convenor

GUEST SPEAKERS

Prof. Alexander A. Tarnutzer, MD.

Alexander Tarnutzer graduated from medical school at the University of Basel, Switzerland in 2003. In 2004 he took a position as a research fellow in the vestibulo-ocular motor laboratory of Prof. Dominik Straumann in Zurich, Switzerland, and at the same time started his neurology residency at the University Hospital Zurich. In 2009 he joined the Vestibular/Eye Movement Testing Laboratory (Prof. D.S. Zee) at the Johns Hopkins University School of Medicine in Baltimore, USA as a postdoctoral research fellow (supported by the Swiss National Science Foundation). After returning to Switzerland one year later, he became a board-certified neurologist in 2012 and continued to work both clinically as a senior physician at the Zurich University Hospital and as a research fellow in Prof. Straumann's laboratory. With a primary research focus on the physiology and pathophysiology of spatial orientation, navigation and perception of gravity, he performed a series of behavioral studies assessing adaptational mechanisms of spatial orientation and verticality perception in both healthy human subjects and in patients with peripheral and central vestibular disorders. This resulted in his habilitation in 2014, becoming a lecturer of Neurology at the University of Zurich. In 2018 he was awarded the Ellermann prize of the Swiss Neurological Society for his research on graviception. In the same year he took over a position as a senior leading physician and head of stroke unit at the Cantonal Hospital of Baden, Switzerland. Since then he is supervising a growing team of neurologists, providing a broad range of neurological services to both outpatients and in-house patients. Currently, a special focus of his clinical duties is dedicated to the specialized inter-disciplinary dizzy clinic he has established at the Cantonal Hospital of Baden, offering dedicated diagnostic assessments including quantitative vestibular testing and treatment for various vestibular disorders. In 2021 he became a titular professor in Neurology at the University of Zurich, awarding both his scientific career and his dedication to teaching neuro-otology to both medical students, medical professionals and the general audience.



His main research interests currently include both improving bedside diagnostic accuracy in acutely dizzy patients, pattern recognition in peripheral and central vestibular disorders, the diagnosis and management of vestibular deficits after traumatic brain injury and harmonizing ocular motor / vestibular testing in hereditary ataxia patients.

Dr Diego Kaski



Diego Kaski is an international leader in Vestibular Neuroscience, with major publications in high-impact journals, including Nature Genetics, BMJ, Lancet Neurology, and Annals of Internal Medicine. He set up and heads the Centre for Behavioural and Vestibular Neurosciences within the Department of Clinical and Motor Neurosciences at UCL and leads an active group of research exploring the neural mechanisms of spatial orientation and multisensory integration, with a strong translational element that aims to develop novel clinical biomarkers and therapies for vestibular disorders. He received the EAN Young Investigator award in 2015 and Barany Society Young instigator award in 2014. He has over 120 peer-reviewed research publications and 8 book chapters in English and Spanish languages. As a marker of the prestige surrounding his unit, he welcomes regular International visiting fellows, and receives frequent invitations to take part in International conferences, seminars, and masterclasses.

GUEST SPEAKERS

Dr Dan Gold

Dr. Gold is an Associate Professor of Neurology, Ophthalmology, Otolaryngology - Head & Neck Surgery, Neurosurgery, Emergency Medicine, and Medicine at The Johns Hopkins University School of Medicine. He is a neurologist with fellowship training in neuro-ophthalmology at the University of Pennsylvania and additional training in neuro-vestibular disorders at Johns Hopkins, and is the director of the Ocular Motor & Vestibular Oto-Neurology Fellowship within the Division of Neuro-Visual and Vestibular Disorders. Dr. Gold maintains an active clinical practice, seeing patients with vestibular and neuro-ophthalmic conditions. He is also heavily involved in the education of residents and fellows, giving frequent lectures on topics related to his subspecialty expertise in addition to leading neuro-ophthalmology/ocular motor bedside teaching rounds. He has received awards for neurology resident teaching and clinical excellence, and for outstanding educational contributions to the Neuro-Ophthalmology Virtual Education Library (through the North American Neuro-Ophthalmology Society) via an ocular motor/vestibular collection (<https://novel.utah.edu/Gold/>). He has also written a Neuro-Ophthalmology & Neuro-Otology case-based textbook, which was published in early 2022.



Dr. Richard Ibitoye

Dr. Richard Ibitoye MA MB BChir, PhD, MRCP (Neurology), Consultant Neurologist (Gloucestershire Royal Hospital), Honorary Senior Research Associate (University of Bristol).

Dr. Richard Ibitoye is a neurologist with expertise in vestibular medicine currently working at Gloucestershire Royal Hospital. He studied medicine at the University of Cambridge, intercalating in neuroscience. He is trained in neurology in Bristol (United Kingdom), and recently completed a research fellowship and PhD at Imperial

College London (supervised by Adolfo Bronstein, Diego Kaski and David Sharp). There he investigated the link between cerebral small vessel disease and dizziness in older people. He has been awarded funding to undertake a post-doctoral research fellowship at University College London to advance his interest in small vessel disease effects on balance control.



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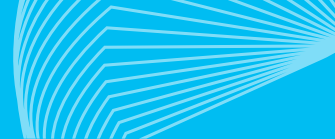


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TIME	SPEAKER	TITLE
08:00	Ben Tsang	Welcome
Session Sponsor: Interacoustics		
Session Chair	Leia Barnes	
08:10	Ian Curthoys	The origin of the video Head impulse test (vHIT) and some new insights vHIT is providing
08:25	Leigh McGarvie	vHIT re-fixation saccades and the many factors that affect them
08:40	Ian Curthoys	The vestibular labyrinth is more robust than previously thought - lessons from surgical removal of intracochlear schwannoma
08:55		
09:00	Dan Gold (virtual)	Skew deviation
09:30		5 min Q and A
09:35	Dan Gold (virtual)	Strabismus
10:05		5 min Q and A
10:10		Morning Tea
Session Sponsor: Southern XP		
Chair	Sally Rosengren	
10:30	Zeljka Calic	Video head impulse test characteristics in peripheral, central and neuromuscular disorders
10:45	Phil Cremer	A prospective study of the vestibular toxicity of gentamicin in a clinical setting
11:00	Rachael Taylor	Effects of middle ear pressure changes on cervical vestibular-evoked myogenic potentials
11:15	Luke Chen	Cervical and ocular vestibular evoked myogenic potentials in the diagnosis of SCD: single centre experience according to age groups
11:30	Alyssa Dyball	After the NI: late oVEMP peaks in healthy volunteers and patients with unilateral vestibular loss
11:45	Caroline Balke	Comparison of vHIT, rotatory chair, and calorics for the identification of peripheral vestibular dysfunction in an "average" audiology clinic.
12:00	Trung Thanh Ngo	Vestibulocortical stimulation with the caloric test: Shifting the balance from neurodiagnostic technique to chronic pain therapy & prevention?
12:15		Lunch



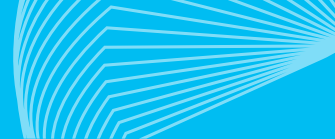
TIME	SPEAKER	TITLE
Chair	David Szmulewicz	
13:15	Alex Tarnutzer	Recent approaches to the acute vestibular syndrome
14:00		10 min Q and A
14:10	Ian Curthoys	Skull Vibration Induced Nystagmus (SVIN) - its neural basis
14:25	Ben Nham	Vestibular testing separates stroke and vestibular neuritis in the emergency vertigo setting
14:40	Afternoon tea	
Chair	John Waterston	
15:00	Sandeep Rajagopal	Cortical hypersensitivity explains visual induced dizziness better than the maladaptation model.
15:15	Sandeep Rajagopal	Incidence of photosensitivity in vestibular migraine
15:30	John Waterston	Persistent Postural-Perceptual Dizziness: precipitating conditions, co-morbidities, and treatment with CBT.
15:45	Diego Kaski (virtual)	PPPD
16:15	Diego Kaski (virtual)	Functional Eye movements
16:45		Q and A
17:00	Close	
17:05	AGM	
18:30 - 21.00	Welcome reception	Sake Sisters, Level 4/21a Elkhorn Ave Surfers Paradise



TIME	SPEAKER	TITLE
Session Sponsor: QLD Vestibular & Cochlear Clinic		
Session Chair	Miriam Welgampola	
08:00	Julia Dlugaiczyk	Prevalence of endolymphatic hydrops in cochlear implant candidates with idiopathic profound sensorineural hearing loss
08:20	Miriam Welgampola	Vestibular event monitoring in the emergency room and community
08:35	Imelda Hannigan	Caloric nystagmus slow phase velocity versus subjective vertigo sensation in Meniere's disease and vestibular migraine
08:50	Belinda Kwok	Ictal Nystagmus characteristics of post-cochlear implant vertigo
09:05	Kim Hawkins	Vestibular function and vestibulo-visual sensory integration in people with mild-moderate severity Parkinson's disease: a comparison with age-matched controls
09:20	Ann Rahmann	Many older adults in sub-acute rehabilitation have vestibular dysfunction on clinical assessment but few report dizziness when moving.
09:35	Neil Todd	Collic evoked potentials, myogenic potentials (CEMPs) and postural responses produced by brief 100Hz vibration of the sternocleidomastoid muscle.
09:50	Neil Todd	Non-invasive recording from the human cerebellum during a classical conditioning paradigm using the otolith-evoked blink reflex
10:05	Sally Rosengren	Subjective cognitive dysfunction in neuro-otology outpatients.
10:20	Sally Bradshaw	Emergency department management of BPPV: is best evidence being used in practice?
10:35	Break	



TIME	SPEAKER	TITLE
Chair	Phil Cremer	
10:55	Renee De Maria	Clinical audit of clinical data obtained from assessment of patients undergoing vestibular schwannoma Resection and microvascular decompression pre and post-operative. A guide to further research.
11:10	Chao Wang	Using machine learning for differential diagnosis in episodic spontaneous vertigo
Chair	Phil Cremer	Case studies
11:25	Chao Wang	A challenging case of episodic oscillopsia, ophthalmoplegia and ataxia.
11:35	Dan Truong	Seizures make my head spin - a case of epileptic vertigo
11:45	Andrew Charmley	Novel ophthalmoplegia in STN/PSA deep brain stimulation
11:55	Luke Chen	A not-to-miss cause of vertigo and hearing loss.
12:05	Serge Geara	Chordae tympani ear drop neurotoxicity
12:15	Tom Wellings	A little dizzy.
12:25	Caroline Balke	Paediatric vestibular dysfunction - literature review and case studies
12:35-12:40		
12:40		Lunch
Chair	Michael Halmagyi	
13:40	Alex Tarnutzer	Novel devices and technologies in neuro-otology
14:25	Alex Tarunutzer	10 min Q and A
14:35	David Szmulewicz	CANVAS update
15:00	Gülden Akdal	Clinical Differences between Meniere's disease with migraine, Meniere's disease without migraine and Vestibular Migraine
15:15		Break
Chair	Ben Tsang	
15:35	Richard Ibitoye (virtual)	Dizziness, unsteadiness, and small vessel disease
16:20	Richard Ibitoye (virtual)	5 mins Q and A
16:25	Ben Tsang	The State of Origin Great Debate: Introduction
16:30	Phil Cremer	Affirmative/Pro/Blues
16:40	Shane Anderson	Negative/Con/Reds
16:50	Rebuttals	
17:00	Closing remarks	
17:10	Close of meeting	



08:10

The origin of the Head Impulse Test and the video Head Impulse Test (vHIT) and some new insights vHIT is providing

Presenter:

Ian Curthoys

Author:

Ian Curthoys. Emeritus Professor, University of Sydney,
Honorary Professor, Macquarie University, Sydney NSW, Australia

on behalf of the whole team:

Michael Halmagyi , Ian Curthoys, Hamish MacDougall, Leigh McGarvie, Konrad Weber

I describe how Halmagyi and Curthoys found the head impulse test (in 1983) and the irony that the “clinical sign of canal paresis” (the corrective saccade in the head impulse test) is an indirect measure of semicircular canal function.

The direct measure is the compensatory slow phase eye velocity in response to brief, abrupt, unpredictable, head angular acceleration.

The saccade is indirect because it is a correction for inadequate semicircular canal function. In order to get direct measures of semicircular canal function – the slow phase eye velocity - required the design, development and validation of the video head impulse test (vHIT) which Hamish MacDougall accomplished over about 10 years with the help of the whole team.

I briefly describe the origin and development of the hardware and software for the original video system by Hamish and its validation.

vHIT shows both slow phase eye velocity and saccades but evidence shows these two very different responses are governed by two different neural circuits in the brainstem and it is important to realize saccades are indirect, secondary indicators of peripheral vestibular function. Many healthy subjects make saccades during vHIT testing.

Finally I show unexpected examples of the value of vHIT testing.

08:25

vHIT re-fixation saccades and the many factors that affect them

Presenter:

Leigh McGarvie

During the last decade, the vHIT has increasingly become a standard clinical tool for assessing balance dysfunction and, as a consequence, interest in the re-fixation saccades has been increasing. With even very small position errors of the eye with respect to the target leading to highly obvious re-fixation saccades when the data is presented in the standard velocity profile report, it is easy to see why this is so. However, in order for these re-fixation saccades to contribute any meaningful complementary data to the position gain measurement, it is very important to consider the factors that may generate and contribute to such re-fixation saccades. This presentation will consider the major contributing factors including ipsilateral and contralateral gains, the head velocity profile during the impulse and the latency of any such saccades. Examples of such situations will be presented, and further examined by varying the parameters of a simple video head impulse model developed by Dr Hamish McDougall.

08:40

The vestibular labyrinth is more robust than previously thought—Lessons from surgical removal of intracochlear schwannoma

Presenter:

Ian Curthoys

Authors:

Stefan K. Plontke¹, Torsten Rahne¹, Ian S. Curthoys², Bo Håkansson³, Laura Fröhlich¹

Institutions:

¹ Department of Otorhinolaryngology, Head & Neck Surgery, Martin Luther University Halle-Wittenberg, University Medicine Halle, Halle (Saale), Germany

² Vestibular Research Laboratory, School of Psychology, The University of Sydney, Sydney, Australia

³ Electrical Engineering, Chalmers University of Technology, Gothenburg, Sweden

The receptors for hearing and balance are housed together in the labyrinth of the inner ear and share the same fluids. It was widely believed that surgical damage to either receptor system causes certain permanent loss of the receptor function of the other. However, anecdotal reports in individual patients of at least partial preservation of cochlear function after major surgical damage to the vestibular division and vice versa have called that principle into question. Recently, we showed in a large case series (27 patients) that after major trauma to the cochlea for surgical removal of intracochlear schwannoma, the vestibular receptors continue to function normally. This was demonstrated by specific, objective function tests (vHIT and VEMPs) for each of the peripheral vestibular sense organs before and after surgery. We suggest that the vestibular labyrinth may continue to function normally because the schwannoma surgery probably sealed the ductus reuniens which is the endolymphatic communication channel between the cochlea and vestibular labyrinth. It seems the dark cells of the vestibular labyrinth or the endolymphatic sac may generate enough endolymph to allow continuing vestibular function.

Plontke S, Rahne T, Curthoys IS, Hakansson B, Frohlich L (2021) A Case series shows the independent vestibular labyrinthine function after major surgical trauma to the human cochlea. *Communications Medicine* 1:37 | <https://doi.org/10.1038/s43856-021-00036-w> | www.nature.com/commsmed free article

10:30

Video-head impulse test characteristics in peripheral, central and neuromuscular disorders

Presenter:

Miriam S Welgampola

Authors:

Zeljka Calica^b, Stojan Peric^c, Milorad Vujnic^d, Bogdan Bjelica^c, Ivo Bozovic^c, Vidosava Rakocevic-Stojanovic^c, Andrew Bradshaw^e, James G Colebatch^f, Nese Ozalp^a, Miriam S Welgampola^f

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^c Neurology Clinic, Clinical Centre of Serbia, Faculty of Medicine, University of Belgrade, Belgrade, Serbia

^d Department of Pathophysiology, Faculty of Medicine, University of Banja Luka, Institute of Physical Medicine and Rehabilitation "Dr Miroslav Zotovic", Banja Luka, Republic of Srpska, Bosnia and Herzegovina

^e Institute of Clinical Neurosciences, Royal Prince Alfred Hospital, Central Clinical School, University of Sydney, Sydney, NSW, Australia

^f Institute of Neurological Sciences, Prince of Wales Clinical School, University of New South Wales, Randwick, Sydney 2031, Australia

Background: The video-head impulse test (v-HIT) enables non-invasive interrogation of the human vestibulo-ocular reflex (VOR) pathway.

Aim: To characterize VOR performance as measured by the v-HIT at multiple sites along the neuraxis. We studied patients with genetically confirmed myotonic dystrophy type 1 (DM1), Charcot Marie Tooth Disease Type 1A (CMT1A), vestibular neuritis (VN), bilateral vestibular loss (BVL), and posterior circulation (PCS). We calculated an asymmetry ratio between the two halves of the eye velocity response.

Methods: VOR gain and first-saccade amplitude, onset latency, peak velocity and duration were examined and compared against age-matched normal-controls (NC). We calculated an asymmetry ratio between the two halves of the eye velocity response.

Results: Mean HC VOR-gain was 0.40 ± 0.2 , 0.65 ± 0.2 , 0.85 ± 0.3 , 0.89 ± 0.2 , 1.02 ± 0.10 and 0.98 ± 0.1 in VN, BVL, PCS, DM1, CMT1A and NC, respectively. VOR-gain was reduced ($<$ mean -2 SD of NC) in all patients with VN and BVL, 32% of patients with PCS, 50% of patients with DM1 and 41% of patients with CMT1A. In the HC plane the first saccade amplitude was larger, onset latency was shorter, peak velocity was faster and saccade duration was longer in DM1, PCS, BVL and VN compared to NC ($p < 0.05$). In CMT1A the first saccade amplitude was larger, peak velocity was faster, onset latency and duration were longer in CMT1A compared to NC ($p < 0.05$). Asymmetry ratio between the two halves of the eye velocity response were significantly larger and negative in DM1 compared with VN, VBL, PCS and NC with comparable low VOR-gains ($p < 0.05$).

Conclusion: VOR impairment is observed in diverse neurological disorders affecting the VOR at distinct points along the neuraxis. Refixation saccade amplitude and latency, VOR profile are additional new tools that complement gain measures.



10:45

A prospective study of the vestibular toxicity of gentamicin in a clinical setting

Presenter:

Phillip Cremer

Authors:

Sophie CHATTERTON, Chao WANG, Hans SATYAN, George KOTSIUO, Christopher J TODD, Americo A MIGLIACCIO, Phillip D CREMER

Objective: Gentamicin is a widely used aminoglycoside with ototoxicity as a known adverse effect. Due to difficulty in clinical recognition, the prevalence of gentamicin ototoxicity in practice is thought to be higher than reported. This study aimed to prospectively assess the effect of gentamicin on vestibular function and whether ototoxicity is underrecognised.

Study Design: Single-centre, prospective, non-blinded trial.

Setting: Inpatient tertiary hospital setting followed by vestibular outpatient clinic review.

Patients: 48 patients undergoing a urological procedure were recruited, with 24 and 17 patients having 1 or 2 follow-up tests respectively, after initial gentamicin administration.

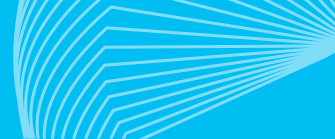
Intervention(s): Single dose of gentamicin during a urological procedure.

Main Outcome Measure(s): Gains for the vestibulo-ocular reflex (VOR) were measured using the video head impulse test prior to receiving gentamicin and at two other time-points following gentamicin. The gains in VOR were then compared to prior testing sessions to determine if there was a deterioration following gentamicin use.

Results: Prior to receiving gentamicin, the gains for horizontal VOR were measured for 48 patients.

The gains were measured a second time for 24 patients at varying durations post-gentamicin (1-56 days,) and a third time for 17 patients (14-152 days) post gentamicin. The mean VOR gain for time-points 1, 2 and 3 were 0.72 ± 0.13 , 0.75 ± 0.16 and 0.79 ± 0.18 respectively. Linear-Mixed-Model with repeated-measure analysis revealed no significant difference in VOR gain between time-points 1 and 2 ($p=0.19$).

Conclusions: There was no significant effect observed on mean VOR gain decrement following a single dose of gentamicin.



11:00

Comparison of vHIT, Rotary Chair and Calorics for the identification of peripheral vestibular dysfunction in an “average” Audiology Clinic.

Presenter:

Caroline Balke

Author:

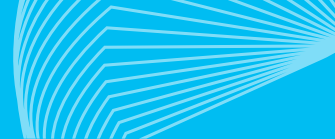
Caroline Balke (Audiologist).

Data was collected on all eligible patients over a 12 month period at the Mater Audiology Department. The Mater Audiology Department could be considered to represent an “average” diagnostic Audiology clinic as there are multiple staff with various levels of training and experience with vestibular function testing, using a range of equipment from different suppliers. Outcomes of vHIT, Rotary Chair and Caloric tests were compared to determine clinical effectiveness for identifying peripheral vestibular impairment in a patient population with primarily chronic symptoms.

Consumer surveys were also conducted to determine which tests were preferred/best tolerated by patients.

Outcomes indicated that:

- vHIT had the lowest false positive rate and lowest rate of incomplete testing, but may fail to identify peripheral vestibular dysfunction in up to 22.7% of chronic cases.
- Rotary Chair had the highest rate of incomplete testing; but was also the most preferred test overall (by patients).
- The Caloric test had the highest false positive rate, but also the lowest false negative rate. It was the least preferred test by patients, but was still able to be obtained in 92% of cases.



11:15

Effects of middle ear pressure changes on cervical vestibular-evoked myogenic potentials

Presenter:

Rachael Taylor

Authors:

Maja Brumm¹, Irene Cheung¹, Peter Thorne^{1,2}, Mehrdad Aghamohammadi³, Rachael Taylor²

Institutions:

¹Department of Audiology, University of Auckland, New Zealand

²Department of Physiology, University of Auckland, New Zealand

³Department of Engineering, University of Auckland, New Zealand

Background: Cervical vestibular-evoked myogenic potentials (cVEMPs) are commonly recorded using air conducted (AC) sound but can be absent in people with middle ear pathology. However, the effects of changes in middle ear pressure (MEP), which can occur without significant loss of hearing, have not been systematically studied.

Methods: Using a novel approach, the MEP of 11 participants was systematically manipulated with continuous positive airway pressure. Amplitudes and rates of cVEMP detection were recorded at four MEP levels (baseline \pm 49, +50-99, +100-149 and >150 daPa) in response to air- and bone-conducted stimulation at 500, 1000 and 2000 Hz. Puretone audiometry was undertaken to evaluate effects on hearing.

Results: AC cVEMP amplitudes decreased steadily with increasing MEP ($p < 0.001$). The effect was greatest for the 500 Hz stimulus, revealing a 52.2% decline in amplitudes by the highest MEP (>150 daPa). The MEP also affected 500 Hz AC hearing thresholds, but only at the highest level, and none of the participants with abnormal 500 Hz AC cVEMPs had significant air-bone gaps on audiometry. BC cVEMP amplitudes were unaffected by MEP until >150 daPa where 500 Hz amplitudes increased slightly.

Conclusions: To avoid errors in VEMP interpretation, we recommend undertaking tympanometry when using an AC stimulus.



11:30

Cervical and ocular vestibular evoked myogenic potentials in the diagnosis of SCD: single centre experience according to age groups.

Presenter:

Luke Chen

Authors:

Luke Chen, Jamila Gencarelli and John Waterston

Institution:

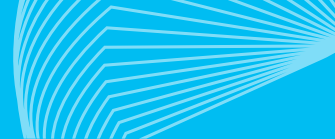
Department of Neurology, Alfred Hospital, Melbourne

Background and Objective: Air conducted ocular vestibular evoked myogenic potentials (oVEMP) is regarded as sensitive and specific in the diagnosis of superior canal dehiscence (SCD), but there are relatively few studies examining its diagnostic utility in older patients (especially >70s and 80s)

Method: Single centre retrospective study from 2018 to 2020. 33 patients (age 26-85, mean 51)) were identified as being referred for diagnostic testing for possible SCD. All ears with SCDs (39 ears) were confirmed radiologically by examination of high resolution CT temporal bones. Non-dehiscent ears (27 ears) were used as controls. All patients underwent standardised vestibular function tests, including audiogram, air conducted (clicks) oVEMP amplitude and cVEMP thresholds.

Results: In those below the age of 60, oVEMP amplitude of ~10 uV provides complete separation between dehiscent and non-dehiscent ears, whereas in those above the age of 60 oVEMP amplitude in dehiscent ears was as small as 1-2uV. cVEMP thresholds below 70 to 80dB nHL consistently identifies SCD in all age groups, except those older than 80. All age groups considered, oVEMP amplitude of 6.7 uV yields sensitivity of 80% and specificity of ~70%, whereas cVEMP thresholds of 83 dB has a sensitivity and specificity of ~90%. When only age<80 were considered, oVEMP amplitude of 8.7uV has a sensitivity of ~95% and specificity of ~90%.

Conclusion: In our institution click cVEMP threshold provides better diagnostic separation than oVEMP amplitude across all age groups, whereas oVEMP amplitude yields excellent diagnostic utility in those younger than 80, but is inferior to cVEMP thresholds when all groups are considered. In younger patients oVEMP amplitude is robust for the diagnosis of SCD, however, in older patients, cVEMP thresholds are more reliable.



11:45

After the N1: Late oVEMP peaks in healthy volunteers and patients with unilateral vestibular loss

Presenter:

Alyssa Dyball

Authors:

Alyssa C. Dyball¹, Xiao Ping Wu², Belinda Y. C Kwok¹, Chao Wang^{1,3}, Benjamin Nham^{1,3}, Jacob, M. Pogson^{1,4}, Jonathan H. K. Kong^{5,6,7}, Rachael, L. Taylor⁸, Miriam S. Welgampola^{1,3}, Sally M. Rosengren^{1,3}

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⁴ Otolaryngology, Head, Neck and Skull Base Surgery Department, St Vincent's Hospital

⁵ Department of Otolaryngology, Royal Prince Alfred Hospital

⁶ Discipline of Surgery, Sydney Medical School

⁷ Department of Otolaryngology, Head and Neck Surgery, Macquarie University, North Ryde

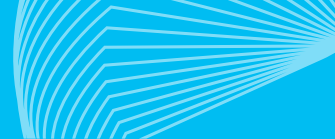
⁸ Department of Physiology and Centre for Brain Research, The University of Auckland, Auckland, New Zealand

The ocular vestibular evoked myogenic potential (oVEMP) is a measure of otolith function. The first negative-going peak, the n10, represents a contralateral pathway from ipsilateral utricle to contralateral inferior oblique muscle. However, the oVEMP response continues after the n10 with a series of positive- and negative-going peaks. We measured these late peaks in healthy volunteers and patients with unilateral (uVL) and bilateral vestibular loss (bVL).

Method: oVEMPs were elicited with bone-conducted (BC) square wave pulses using a Mini-shaker placed medially (near the hairline), in 20 healthy volunteers, 16 patients with uVL (total neuritis), 10 uVL (schwannoma excision), and 3 patients with bVL.

Results: In healthy volunteers, up to four peaks and troughs were elicited. Of these, the initial three peaks were large and symmetric but became smaller as latency increased. In uVL, the contra-lesional n10 was largely absent, but late peaks were often present, and became larger as latency increased. The contra-lesional n1 and n2 peaks were later and smaller compared to healthy ears, while the n3 peak was more equal in amplitude and latency across both groups. All peaks were abolished in bVL.

Conclusion: Unlike the n10, later peaks appear to represent bilateral projections to the extra-ocular muscles.



12:00

Vestibulocortical stimulation with the caloric test: Shifting the balance from neurodiagnostic technique to chronic pain therapy & prevention?

Presenter:

Trung Thanh Ngo PhD

Authors:

Michael H. Kaplan MD¹, Jesse Lazarovic MD², Jessica Ross MD³, Trung Thanh Ngo PhD⁴

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² Long Island Jewish Medical Center, Northwell Health, New York NY, USA.

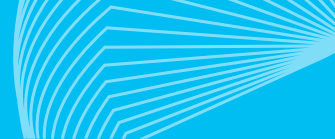
³ Meuhedet, Israel.

⁴ RECOVER Injury Research Centre; University of Queensland and Surgical, Treatment & Rehabilitation Service (STARS), Brisbane QLD, Australia.

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Centralised pain syndromes (CPS) are common and notoriously challenging to manage. As such, there remains an urgent need for safe & effective therapeutic innovations. Vestibulocortical stimulation (VCS) is a relatively simple, inexpensive & widely utilised neurodiagnostic technique (i.e., the caloric test) that has also demonstrated therapeutic effects in adults with CPS as well as other neurological disorders. Here we present the first known case of rapid & sustained pain relief following VCS in a child. An 8-year-old girl presented with a sore throat & headache that evolved into severe widespread body pains with hypersensitivity and pronounced disability. Refractory to multiple trials of medical therapy (e.g., analgesics, antimicrobials, pulse dose glucocorticoids), her syndrome rapidly improved after 15 seconds of left-ear cold-water irrigation. Full recovery was achieved after a second (bilateral) VCS administration that was adjuvant to regular physical & psychological therapy. Ten years later she remains in remission from her widespread pain & associated symptoms. This intriguing paediatric precedent suggests further investigation into the potential preventative clinical utility of VCS for CPS and associated conditions (e.g., across neuroimmunology, emergency & rehabilitation medicine, oncology & palliative care), including a focus on the majority of undertreated populations across rural/regional areas and developing countries.



14:25

Vestibular testing separates stroke and vestibular neuritis in the emergency vertigo setting

Presenter:

Ben Nham

Authors:

Benjamin Nham^{1,2}, Chao Wang^{2,3}, Nicole Reid³, Zeljka Calic⁴, Belinda Kwok^{2,3}, Andrew Bradshaw^{2,3}, G Michael Halmagyi^{2,3}, Miriam S Welgampola^{2,3}

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⁴ Department of Neurology, Liverpool Hospital, Sydney, Australia

Aims: To separate posterior-circulation stroke and vestibular-neuritis using quantitative vestibular tests

Methods: Patients with posterior circulation stroke (PCS) and acute vestibular neuritis (VN) patients were prospectively recruited from the emergency room within 72 hours of presentation. We conducted video-nystagmography (VNG), three-dimensional video head-impulse testing (vHIT), vestibular-evoked myogenic potentials (VEMPs) and subjective visual horizontal (SVH) tests.

Results: There were 128 stroke and 134 VN patients. Common stroke territories were: posterior-inferior-cerebellar-artery (41.4%), basilar-perforators (21.1%), multi-territory (14.1%) and anterior-inferior-cerebellar-artery (7.8%). VN subtypes included superior-neuritis (53.3%), inferior-neuritis (4.2%) and pan-neuritis (41.5%). Most VN (96.6%) and stroke (61.7%) patients presented as acute vestibular syndrome.

We recorded horizontal (98.5%) or vertical/torsional spontaneous-nystagmus (1.5%) in VN and absent nystagmus (53.9%), horizontal (32%) or vertical or torsional (14.1%) nystagmus in PCS. The mean slow-phase velocity of horizontal-nystagmus was faster in VN ($11.8 \pm 7.2^\circ/s$) than PCS ($5.2 \pm 3.0^\circ/s$) ($p < 0.01$).

Ipsilesional horizontal-canal (HC) vHIT gain was lower in VN than in stroke (values, $p < 0.01$). Ipsilesional catch-up saccades occurred earlier and their amplitude, prevalence, velocity were greater in VN than PCS ($p < 0.01$). Ipsilesional SVH deviation $> 2.5^\circ$ occurred more often in VN (97.6%) than in stroke (24.3%) ($p < 0.01$). Abnormal bone-conducted ocular- VEMP asymmetry ratio was more common in VN (50%) than stroke (14.4%) ($p < 0.01$)

We used ten vestibular-test metrics and ascribed scores of 1 or 0 to abnormalities indicative of VN or PCS; a cumulative test score of ≥ 5 separated VN from PCS with sensitivity 92.9% and specificity 89.8%. Quantitative tests enhanced clinical HINTS specificity for detecting PCS from 63.4% to 80.6%, with comparable sensitivity.

Conclusion: Quantitative vestibular testing using vHIT, VNG and SVH enables accurate separation of stroke and vestibular neuritis.



15:00

Cortical Hypersensitivity explains Visually Induced Dizziness better than the Maladaptation model

Presenter:

Sandeep Rajagopal

Authors:

Sandeep Rajagopal^{1,5}, Teresa Neeman¹; Tom Wellings²; John Waterston³; Christian Lueck^{1,4}

Institutions:

¹ Australian National University, Australia.

² John Hunter Hospital, New Castle, Australia.

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⁵ Canberra Dizziness Clinic, Canberra, Australia.

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Abstract:

Background: We propose the Cortical Hypersensitivity Model (CHM) to explain various characteristics of Visually induced Dizziness (VID), as an alternative to the present model of the Maladaptation/Visual Dependence. The 3 hypersensitivities (Pattern, Photo, and Vection sensitivity) can explain VID, which can coexist with other hypersensitivities seen in migraineurs.

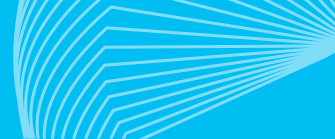
Method: Patients were divided into Vestibular Migraine groups (Definite -134, Probable - 69) and Controls (all other diagnoses excluding patients with migraine- 150) in a retrospective analysis of patients from Canberra Dizziness Clinic. VID was measured with the modified Visual Vertigo Analogue Scale (VVAS) score (0-140). Patients gave yes/no responses to questions for 6 hypersensitivities: photo, pattern, vection, sound, smell, and motion.

3 hypotheses were tested:

1. The probability of exhibiting hypersensitivity will increase with VID;
2. The probability of exhibiting a larger number of different types of hypersensitivity will increase with VID;
3. Vestibular migraine patients will have higher VVAS scores than controls.

Findings: There were significant associations between the presence and number of hypersensitivities with VID and there was a significant increase in VID in migraine groups compared to controls.

Conclusion: These findings were consistent with the CHM and not with the maladaptation/visual dependence model, as the explanation for VID.



15:15

Incidence of Photosensitivity in Vestibular Migraine.

Presenter:

Sandeep Rajagopal

Authors:

Sandeep Rajagopal^{1,5}, Teresa Neeman¹; Tom Wellings²; John Waterston³; Christian Lueck^{1,4}

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¹ Australian National University, Australia.

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⁵ Canberra Dizziness Clinic, Canberra, Australia.

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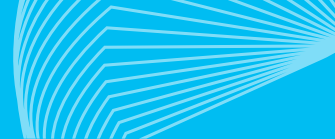
Sandeep.Rajagopal@anu.edu.au

Background: Clinical observation was that patients with vestibular migraine had a high incidence of interictal photosensitivity.

Method: A retrospective analysis was done on patients who came to the Canberra Dizziness Clinic with vestibular symptoms. These patients were divided into definite vestibular migraine (n-134), and probable vestibular migraine (n- 69) according to Barany criteria. The rest of the patients who had other diagnoses were used as controls (n-150) but patients with a history of migraine were excluded. These patients had filled in modified VVAS scores (0-140) and answered questions (yes/no response) about the presence of different sensitivities interictally including photosensitivity.

Findings: Analysis observed that interictal photosensitivity was present in 75% of patients with definite vestibular migraine and 62% of patients with probable vestibular migraine, while it was only present in 14% of patients in controls. This was significantly different. (Pearson's chi-square test-p<0.001). Other hypersensitivities were also observed in a significantly high proportion in vestibular migraine groups.

Conclusion: Interictal photosensitivity is seen in a significantly high proportion in patients with vestibular migraine and may represent generalized hypersensitivity of the brain in migraine patients.



15:30

Persistent Postural-Perceptual Dizziness: Precipitating Conditions, Co-morbidities and Treatment With Cognitive Behavioral Therapy

Presenter:

John Waterston

Authors:

John Waterston^{1,2}, Luke Chen^{1,2}, Kate Mahony³, Jamila Gencarelli² and Geoff Stuart^{4,5}

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Persistent postural perceptual dizziness (PPPD) is a common chronic vestibular disorder characterized by persistent vestibular symptoms, including postural instability and non-spinning vertigo, which is aggravated by motion, upright posture and moving or complex visual stimuli. In our review of 198 cases seen over a 5 year period, we have confirmed a number of common precipitating conditions for PPPD, including anxiety disorders and vestibular migraine. Vestibular abnormalities, including a unilateral loss of vestibular hypofunction and isolated otolith abnormalities, were found on investigation in just under half the cases. The use of cognitive behavioural therapy (CBT) as a treatment for PPPD resulted in impressive reductions in anxiety and measures of dizziness over follow up periods of up to 6 months.



08:00

Prevalence of Endolymphatic Hydrops in Cochlear Implant Candidates with Idiopathic Profound Sensorineural Hearing Loss

Presenter:

Julia Długaiczek

Authors:

Eva Mosimann¹⁺, David Bächinger¹⁺, Andreas Eckhard¹, Philipp Reddiess¹, Dorothe Veraguth¹, Christof Röösl¹, Alexander Huber¹, Anthony De Vere-Tyndall², Sebastian Winklhofer², Julia Długaiczek¹, Adrian Dalbert^{1#}

Institutions:

¹ Department of Otorhinolaryngology, Head & Neck Surgery, University Hospital Zurich, University of Zurich, Switzerland

² Department of Neuroradiology, Clinical Neuroscience Center, University Hospital Zurich, University of Zurich, Switzerland

+ Both authors contributed equally.

Current address: Department of Otolaryngology, University of Melbourne, Melbourne, VIC, Australia

Objective: To determine the prevalence of endolymphatic hydrops (EH) in cochlear implant (CI) candidates with idiopathic profound sensorineural hearing loss (SNHL) and its influence on preservation of audio-vestibular function after cochlear implantation.

Study Design: Prospective case series.

Patients: CI candidates with idiopathic progressive SNHL, but without classic EH-associated symptoms.

Interventions: Delayed intravenous gadolinium-enhanced inner ear fluid-attenuated inversion recovery magnetic resonance imaging, pure-tone audiograms, video head impulse tests (vHITs), and vestibular evoked myogenic potentials (VEMPs) before and 4 weeks after cochlear implantation.

Results: EH was detected in nine out of 32 ears (28%) from 16 CI candidates. Pre-operative saccular function was reduced in hydroptic vs. non-hydroptic ears. Of the 10 subjects who received a unilateral

CI, 3 (30%) showed EH on the implanted side. There was no difference in postoperative hearing loss between the two groups, but the results point towards a higher vulnerability of hydroptic ears with respect to loss of otolith function after cochlear implantation.

Conclusions: This is the first study indicating that EH is present in about one third of CI candidates with idiopathic profound SNHL. Preliminary results suggest that EH could be a risk factor for loss of otolith function after cochlear implantation.



08:20

Vestibular Event Monitoring in the Emergency Room and Community

Presenter:

Miriam Welgampola

Authors:

Allison S Young^{1,2}, Ben Nham^{1,2}, Belinda Y C Kwok^{1,2}, Nicole Reid^{1,2}, Hamish Macdougall³, Jonathon H K Kong^{4,5,6}, Gulden Akdal^{7,8}, G Michael Halmagyi^{1,2}, Miriam S Welgampola^{1,2}

Institutions:

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³ Vestibular Research Laboratory, School of Psychology, The University of Sydney, Sydney, NSW, Australia.

⁴ Department of Otolaryngology, Royal Prince Alfred Hospital

⁵ Discipline of Surgery, Sydney Medical School.

⁶ Department of Otolaryngology, Head and Neck Surgery, Macquarie University, North Ryde.

⁷ Faculty of Medicine, Department of Neurology, Dokuz Eylül University, İzmir, Turkey

⁸ Department of Neuroscience, Institute of Health Sciences, Dokuz Eylül University, İzmir, Turkey

Background: Vertigo is characterized by ictal nystagmus that points to the underlying vestibular disorder. We report our observations on vestibular event-monitoring undertaken in >750 patients over the past 5 years

Methods: 320 patients undertook event monitoring in their own homes using standalone video Frenzel glasses. 439 patients were studied in the Emergency Room using video glasses attached to computers on wheels. Patients were classified clinically based on history, examination and audiovestibular tests

Results: Patients with a diagnosis of Ménière's Disease demonstrated ictal horizontal-nystagmus ($42.8 \pm 31.1^\circ/\text{s}$; range 5.3 – 160.1 $^\circ/\text{s}$) which changed direction in 57% of instances. In vestibular migraine, nystagmus was horizontal, vertical or torsional, SPV was lower ($5.3 \pm 9.0^\circ/\text{s}$; range 0 – 57.4 $^\circ/\text{s}$) and direction change was rare. Vestibular Neuritis always demonstrated ictal spontaneous-nystagmus ($12.3 \pm 7.2^\circ/\text{s}$; range 2.1-42.9 $^\circ/\text{s}$) that was nearly always horizontal whereas posterior-circulation strokes demonstrated ictal spontaneous nystagmus in only 57% subjects; nystagmus was diverse in direction but predominantly horizontal and of low velocity ($3.0 \pm 4.6^\circ/\text{s}$; range 1.3 - 26.5 $^\circ/\text{s}$). Vestibular paroxysmia demonstrated ipsiversive horizontal nystagmus lasting seconds, provoked by hyperventilation.

Conclusion: Ictal nystagmus velocity and direction could assist in the differential diagnosis of both acute and episodic vestibular syndromes.



08:35

Caloric Nystagmus Slow Phase Velocity Vs Subjective Vertigo Sensation in Meniere's Disease and Vestibular Migraine.

Presenter:

Imelda Hannigan

Authors:

Hannigan IP^{1,4}, Rosengren SM^{1,2}, Welgampola MS^{1,2}, Watson SRD^{3,4}

Institutions:

¹ Central Clinical School, Faculty of Medicine and Health, University of Sydney, Camperdown, NSW, Australia.

² Institute of Clinical Neurosciences, Royal Prince Alfred Hospital, Camperdown, NSW, Australia.

³ Prince of Wales Clinical School, University of New South Wales, Randwick 2013, NSW, Australia.

⁴ Blacktown Neurology Clinic, Blacktown, NSW 2148, Australia.

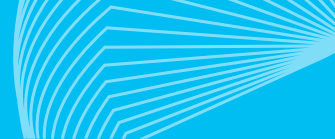
Background: Patients undergoing the caloric-test report sensations of vertigo and nausea which are considered unwanted side-effects rather than a source of diagnostic information.

Aim: We recorded both caloric-evoked nystagmus slow-phase velocity (SPV) and vertigo-intensity in 1373 balance-clinic patients and examined the relationship between these measures.

Methods: During the recording phase of each caloric irrigation, patients scored their sensations (0-4), 4 being their worst ever symptoms. Following diagnosis, patients were classified into three groups: vestibular migraine (VM), Meniere's disease (MD) and non-vestibular dizziness NVD. Their objective and subjective data were assessed.

Results: The mean caloric SPV was 26.4 ± 11.33 , 26.3 ± 13.8 and 25.3 ± 12.75 °/sec, for VM, MD (unaffected-ears) and NVD. The mean subjective vertigo scores (SVS) were 2.3 ± 1.19 , 1.3 ± 1.26 and 1.3 ± 1.31 . On ANOVA, there were significant differences in SVS between groups ($p < 0.001$) but not the SPV ($p = 0.15$). We found 34.4% of VM and 3.3% of MD patients were unable to complete the caloric test. Correlation between caloric SPV and SVS was stronger in the MD group than in the VM patients ($r = 0.47$ vs $r = 0.31$).

Outcome: Caloric vertigo by verbal rating is a valid and meaningful measure. Significant differences between MD and VM draws attention to the utility of this measure when seeking to separate these two diagnoses.



08:50

Ictal Nystagmus Characteristics of Post Cochlear Implant Vertigo

Presenter:

Belinda Kwok

Authors:

Belinda Y C Kwok, Allison S Young, Sally M Rosengren, Jonathan H K Kong, Simon L Greenberg, Sean Flanagan, Catherine S Birman, Stephen Rodrigues, William P Gibson, G Michael Halmagyi, Miriam S Welgampola

Objective: To explore history, ictal nystagmus and vestibular-test characteristics of post-cochlear implantation (CI) episodic-vertigo.

Methods: Twenty-five patients referred to our clinic with reports of post-CI vertigo were loaned home video oculography (VOG) goggles to self-record ictal nystagmus at home. History, post-CI video head impulse (vHIT) and vestibular evoked myogenic potentials (VEMP) tests were undertaken.

Results: Twelve patients were diagnosed with post-CI delayed endolymphatic hydrops (DEH), 4 with probable vestibular migraine (VM), 1 with VM and post CI DEH; 4 with exacerbation of pre-existing Meniere's Disease in the implanted (n=2) or contralateral ear; 4 remain undiagnosed. Post-CI delayed endolymphatic hydrops was characterised by episodic spontaneous vertigo/disequilibrium lasting minutes to hours. Average nystagmus slow-phase velocity was 49.4°/sec (range 6.4- 172.9°/sec). Seven displayed nystagmus direction-reversal and 2 showed ictal lateral semicircular- canal dysfunction on vHIT. Patients diagnosed with VM reported vertigo/disequilibrium lasting seconds to days and demonstrated low velocity ictal horizontal or vertical nystagmus (range 0-21.7 °/sec).

Conclusions: Ictal VOG and vHIT could assist differential diagnosis of post CI vertigo.



09:05

Vestibular function and vestibulo-visual sensory integration in people with mild-moderate severity Parkinson's disease: a comparison with age-matched controls

Presenter:

Kim Hawkins

Authors:

Kim E Hawkins¹, Serene S Paul², Elodie Chiarovano³, Ian S Curthoys¹

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²Discipline of Physiotherapy, Sydney School of Health Sciences, Faculty of Medicine and Health, University of Sydney, Sydney, Australia

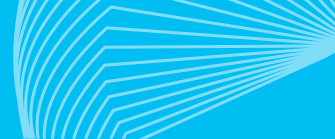
³Sydney Human Factors Research, School of Psychology, Faculty of Science, University of Sydney, Sydney, Australia

Background: Vestibular dysfunction may be a consequence of the common neurodegenerative disorder, PD. Modern tests, the HIMP, SHIMP and BCV oVEMPs and cVEMPs have scarcely been reported in PD. Virtual reality (VR) assessment tools, adjuncts to vestibular test batteries, have not been applied to PD.

Methods: This study compared vestibular function in 40 people with PD to 40 controls (HC). The study analysed: i) SCC VOR function and saccades with HIMP and SHIMP; ii) otolith mediated VOR with oVEMPs, and iii) otolith mediated VCR with cVEMPs. VEMPs were induced by both clicks and Fz taps. Verticality perception was assessed via SVV. Vestibulo-visual integration was determined through a VR standing balance protocol.

Results: In mild to moderate PD, VOR gains with HIMP and SHIMP were not significantly different from HC. However, in PD, SHIMP peak saccade velocity was reduced and latency prolonged. Tap oVEMPs were more robust than clicks in both groups, PD had smaller tap oVEMP p-p amplitudes than HC. PD had more absent cVEMP responses to both clicks and taps and more abnormal SVV responses with greater variability. PD failed at significantly lower levels of VR visual perturbation on both firm and foam surfaces than HC.

Conclusion: In people with mild to moderate PD, the impulsive VOR remains largely unaffected. However, saccadic dysfunction is evident with SHIMP. The dynamic VCR, verticality perception and vestibulo-visual integration are affected by PD.



09:20

Many older adults in sub-acute rehabilitation have vestibular dysfunction on clinical assessment but few report dizziness when moving

Presenter:

Ann Rahmann

Authors:

Dr Ann Rahmann (PhD)^{1,2} and Professor Nancy Low Choy (PhD)²

Institutions:

¹ Brighton Rehabilitation Unit, Community and Oral Health, MNHHS

² School of Allied Health, McCauley at Banyo Campus, Australian Catholic University

Aim: To determine the prevalence of vestibular dysfunction on clinical assessment in older adults admitted to a sub-acute rehabilitation facility

Method: Clinical vestibular assessments were undertaken over a twelve-month period in patients over the age of sixty years who had been admitted following a fall, who were deconditioned after an extended acute admission or those who reported dizziness on moving.

Outcome measures: The Vestibular Screening tool (VST) was used to record subjective dizziness and a clinical oculomotor and vestibular assessment was completed. Clinical findings were collated, and individuals classified into one of twelve common diagnostic categories.

Results: Sixty patients (80.0yrs \pm 8.7yrs) were screened. More than 70% of screened patients had a VST score $<4/8$, indicating little self-reported dizziness on movement. Only one patient had a VST score of 0/8 and a normal clinical oculomotor and vestibular screen. The three most common diagnostic categories were: age-related deconditioning (30 patients, 50%); Central oculomotor / vestibular dysfunction (8 patients, 13%) and mixed central and peripheral vestibular dysfunction (8 patients, 13%). Individualised vestibular rehabilitation strategies were then incorporated into each patient's physiotherapy program.

Conclusion: Vestibular dysfunction is common in older adults in sub-acute rehabilitation but is under-recognised because few report dizziness when moving.

Trial registration:

ANZCTR 12619000052134

**09:35**

Collic evoked potentials, myogenic potentials (CEMPs) and postural responses produced by brief 100 Hz vibration of the sternocleidomastoid muscle

Presenter:

Neil Todd

Authors:

Neil PM Todd^{a,b}, Sendhil Govender^{b,c}, and James G Colebatch^{b,c}

Institutions:

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^b School of Clinical Medicine, Randwick Campus, UNSW, Sydney, NSW 2052, Australia.

^c Neuroscience Research Australia, UNSW, Sydney, NSW 2052, Australia

We present an initial report using 5 subjects, of short and long latency collic evoked responses following a half cycle of 100 Hz vibration (5 ms) applied to the sternocleidomastoid (SCM) tendon. These were detected in EEG and extraocular and leg muscles and compared with vestibular-dependent responses from direct mastoid stimulation. The responses from the extraocular recording site are likely to be evoked myogenic potentials, thus “collic evoked myogenic potentials” (CEMPs). An n19/p24 presumed ocular CEMP (oCEMP) was followed by a P22/N28 response over the posterior fossa, referred to as a collic cerebellar evoked potential (CoCEP), with responses in leg muscles starting around 55 ms. In contrast to their vestibular analogues, the oCEMP and CoCEP were predominantly ipsilateral to the side of stimulation, consistent with a double-crossed projection. In addition, their thresholds were just above the threshold of vibrotactile sensation, implying a low threshold, oligo-synaptic projection of SCM afferents to both extraocular and cerebellar targets. Following these short latency responses, SCM tendon stimulation evoked prolonged EMG responses in postural muscles of the legs, consistent with a role in the afferent limb of a short latency, spino-bulbar-spinal postural response to sternal perturbations. These collic evoked responses are likely to be of value in understanding the functions of cervical muscle afferents and have clinical value, for example in monitoring compensation after vestibular loss.

References:

NPM Todd, S Govender, JG Colebatch (2021). Collic evoked potentials, myogenic potentials (CEMPs) and postural responses produced by brief 100 Hz vibration of the sternocleidomastoid muscle. *Neuroscience Letters* **781**, 136677

**09:50**

Non-invasive recording from the human cerebellum during a classical conditioning paradigm using the otolith-evoked blink reflex

Presenter:

Neil Todd

Authors:

Neil PM Todd^{a,b}, Sendhil Govender^{b,c}, James G Colebatch^{b,c}

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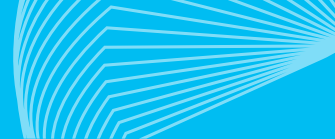
^b School of Clinical Medicine, Randwick Campus, UNSW, Sydney, NSW 2052, Australia.

^c Neuroscience Research Australia, UNSW, Sydney, NSW 2052, Australia.

We studied nine normal volunteers with a classical conditioning paradigm using a mastoid tap, believed to activate otolith receptors, as an unconditional stimulus (US) and the consequent blink as the unconditioned response (UR). Both visual (alternation of stripes) and an auditory tone were used as conditional stimuli (CS). Recordings were made below the eyes at IO1 and IO2, from over the frontal eye fields (C3' and C4') and over the posterior fossa, the latter at sites we have previously reported that we were able to record an evoked climbing fibre response (CFR) at short latency. Behavioural analysis confirmed that weak conditioning did occur early, which subsequently showed extinction on repeated CS alone trials. The EMG associated with the eyeblink for the UR occurred at a similar time to the expected post-CFR pause in the spontaneous cerebellar activity, or electrocerebellogram (ECeG), while hypothesised conditioned pausing in the ECeG was also observed in CS alone trials. We suggest that these recorded events fit with the proposed role of the CFR in Purkinje neurons in classical conditioning, gating the excitability of the cerebellar nuclei, and thereby neurons in the reticular formation mediating the otolith blink reflex. This effect appears to apply to polysynaptic reflexes only as there was no evidence of changes to the oVEMP.

References:

NPM Todd, S Govender, JG Colebatch (2021). Non-invasive recording from the human cerebellum during a classical conditioning paradigm using the otolith-evoked blink reflex. *Neuroscience Letters* **765**, 136270



10:05

Subjective cognitive dysfunction in neuro-otology outpatients.

Presenter:

Sally Rosengren

Authors: Jack Tame¹, Danica Xie², Haydan Bonnacorsi², Rengen Parlane², Miriam S. Welgampola^{2,3}, Sally M. Rosengren^{2,3}.

Institutions:

¹Psychology Department, Macquarie University, Sydney, Australia

²Central Clinical School, University of Sydney, Sydney, Australia

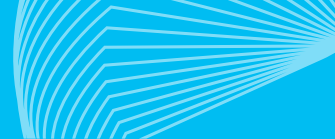
³Neurology Department, Royal Prince Alfred Hospital, Camperdown, Australia

We recently reported higher levels of subjective cognitive dysfunction in neuro-otology outpatients compared to controls, which persisted after accounting for demographic variables and psychological distress. We now report the results of a larger group of patients, who also underwent vestibular function testing.

Neuro-otology outpatients (N=287) and control subjects (N=115) completed two questionnaires: the Neuropsychological Vertigo Inventory and Depression, Anxiety and Stress Scales (DASS). A subset of patients also completed the Wayfinding Questionnaire (N=148) and the Metacognition Index of the Behaviour Rating Inventory of Executive Functioning - Adult Version (N=146). Patient and control scores were compared using age, gender and DASS score as covariates.

Although patients reported more dysfunction than controls on nearly all questionnaires, DASS scores were also significantly greater in patients. Comparison of patient and control scores, adjusted for DASS scores, showed no significant differences between groups. In patients with at least one vestibular test abnormality (N=63), there were no significant differences from controls after accounting for DASS scores.

In contrast to our previous study, we used a larger sample size and better characterization of psychological distress. Patients reported higher levels of subjective cognitive dysfunction than controls, but these differences disappeared when psychological distress was taken into account.



10:20

Emergency department management of benign paroxysmal positional vertigo: Is best evidence being used in practice?

Presenter:

Sally Bradshaw

Authors:

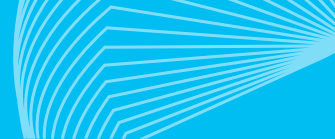
Sally Bradshaw, Marnie Graco, Anne Holland

Introduction: Benign paroxysmal positional vertigo (BPPV) is a peripheral vestibular condition that can cause vertigo, nausea, vomiting and unsteadiness, and may result in presentation to the emergency department (ED). Evidence demonstrates low adherence to BPPV recommended practice in ED however little is known about the underlying reasons. We investigated adherence to guideline recommended care and explored the factors influencing the delivery of guideline recommended care of BPPV in an emergency department with a vestibular physiotherapy service.

Methods: A retrospective clinical audit of six months of vertigo, dizziness, imbalance, or unsteadiness presentations investigated adherence to guideline recommended care. Semi-structured interviews based on the Theoretical Domains Framework were conducted with emergency physicians and physiotherapists to identify the barriers and facilitators to evidence-based practice.

Results: Adherence to guideline recommended practice was low. Only 26.4% of patients with symptoms of BPPV received the recommended diagnostic practice. In presentations diagnosed with BPPV 50.9% received the recommended treatment practice. Presentations seen by a physiotherapist were more likely to receive guideline recommended care than those seen by medical staff alone. Analysis of interview data identified several themes including perceptions of role, reduced learning opportunities for medical staff due to the physiotherapy service, and the emotional responses to BPPV as contributing factors.

Conclusion: These findings demonstrate that the influences on practice extend beyond the knowledge of guideline and treatment techniques and workload pressures, to perceptions of role and responsibility. These factors present targets for a future intervention to improve the management of patients presenting to ED with BPPV.



10.55

Clinical Audit of clinical data obtained from assessment of patients undergoing Vestibular Schwannoma Resection and Microvascular Decompression pre and post-operatively. A guide to further research

Presenter:

Renee De Maria

Authors:

Jarred Janetzki¹; Renee De Maria¹; Joanne Bullock-Saxton¹; Anthea Goslin¹

Institution:

¹Active Rehabilitation Physiotherapy, South Brisbane

Participants: Individuals presenting to physiotherapy pre and post-operatively and listed for neurosurgical procedures of either Vestibular Schwannoma(VS) or Microvascular Decompression(MVD).

Method: Standard clinical assessment measures derived from questionnaires assessing self-reported dizziness, imbalance and tinnitus as well as standard objective measures for: VOR function, balance, gait and facial nerve function were audited. Retrospective records collected from October 2020 to July 2022 were compiled.

Results: 30 patients presented to the clinic during the time frame evaluated. 13 attended both pre and post-operative assessments; (VS) 8 and (MVD) 5.

This paper will present frequency tables for each group. Self-reported dizziness and imbalance increased post-operatively while, subjective tinnitus improved. Interestingly and unexpectedly, the common Romberg and 4-item DGI (Dynamic gait index) tests indicated minimal imbalance deficits and these were in opposition to self-reported measures.

Patients reported that attending pre-operative appointments was highly valuable.

Conclusions:

This pilot study provides justification to develop a robust clinical research study. Evaluation has confirmed the objective tests that are of value and assists in the streamlining of data collection. We believe that future research would be valuable and should include information relating to tumour size to evaluate surgical outcomes. Optimal post-operative outcomes and reduction of anxiety associated with these surgeries would be of great benefit.



11.10

Using Machine Learning for Differential Diagnosis in Episodic Spontaneous Vertigo

Authors:

Chao Wang^{1,2}, Allison Young², Chahat Raj³, Andrew Bradshaw¹, Sally Rosengren^{1,2}, Zeljka Calic^{4,5}, Gnana Bharathy^{3,6}, Mukesh Prasad³, Miriam Welgampola^{1,2}

Institutions:

¹Institute of Clinical Neurosciences, Royal Prince Alfred Hospital, NSW, Australia

²Sydney Medical School, Faculty of Medicine and Health, University of Sydney, NSW, Australia

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Background: The two main causes of episodic spontaneous vertigo (ESV) are Ménière's Disease (MD) and Vestibular Migraine (VM). Differentiating between them can be difficult. In this study, machine learning methods were applied to develop a classification model to assist in the differential diagnosis of MD and VM.

Methods: 114 MD and 160 VM patients were recruited. Data was collected across 100 variables from case history, ictal video-oculography, VHIT, VEMPs, audiogram and calorics. Ten machine learning algorithms were applied to develop classification models. Three dataset combinations were used to mimic different clinical settings: all variables (the neuro-otologist), history variables only (the GP) and history, audiogram and calorics only (the non-expert specialist). Model performance was validated using 10-fold stratified cross validation.

Results: When all variables were used, models developed using XGBoost and AdaBoost performed best with 97.45% accuracy. When only variables from history were used, the model using random forest performed best with 94.16% accuracy. When only variables from history, audiogram and caloric were used, models using XGBoost and passive-aggressive classifier performed best with 94.89% accuracy.

Conclusion: A model developed using machine learning techniques can provide accurate and efficient data analysis for differentiating MD and VM as causes of ESV.



11:25

A Challenging Case of Episodic Oscillopsia, Ophthalmoplegia and Ataxia

Presenter:

Chao Wang

Authors:

Chao Wang^{1,2}, David Brown^{2,3}, John Parratt^{2,4}, Kishore Kumar^{5,6}, Miriam Welgampola^{1,2}

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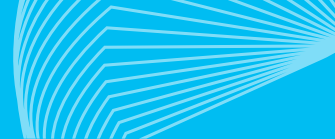
³ New South Wales Health Pathology, Institute of Clinical Pathology and Medical Research, and Westmead Institute for Medical Research, Westmead Hospital, NSW, Australia

⁴ Department of Neurology, Royal North Shore Hospital, NSW, Australia

⁵ Molecular Medicine Laboratory and Department of Neurology, Concord Repatriation General Hospital, Faculty of Medicine and Health, University of Sydney, NSW, Australia.

⁶ Kinghorn Centre for Clinical Genomics, Garvan Institute of Medical Research, NSW, Australia.

We present a challenging case of a 38-year-old lady. Since 2015, she has experienced recurrent episodes of oscillopsia with primary position upbeating nystagmus. From 2020 her condition escalated with episodes also demonstrating severe bilateral esotropia, gaze-evoked nystagmus, right-beating positional nystagmus and gait ataxia. The spontaneous upbeating nystagmus abates when prone. Attacks are accompanied by pre- and post-dromal autonomic symptoms. Her episodes have continued to become more frequent, with incomplete resolution of symptoms and signs between episodes. We review her investigations and management to date.



11:35

Seizures make my head spin- a case of epileptic vertigo

Presenter:

Dan Truong

Authors:

Dan Truong, Lisa Gillinder

Institution:

Mater Centre for Neurosciences, Brisbane, Queensland

Seizures are a rare but important cause of vertigo.

A sixteen-year-old, right-handed male presented with recurrent seizures comprising of a hallucination of his “brain rotating” in his head, “feeling off balance” and blurred vision, followed by a sensation of falling and needing to steady himself. This would be followed by chills, tingling, nausea and loss of awareness. Some seizures would involve auditory hallucinations of voices swearing or the noise of “wind through a scary forest”. More recently, seizures would arise from sleep and involve aphasia.

Interictal electroencephalography (EEG) showed epileptiform discharges in the left frontotemporal region and ictal EEG showed late evolution in the same region. His MRI revealed a bottom-of-sulcus-dysplasia in the left superior temporal sulcus, with concordant hypometabolism on PET imaging and hyperperfusion on SPECT/SISCOM imaging. Stereo EEG captured habitual seizures arising from the lesional area. The patient was managed with two anti-seizure medications and remained seizure-free at two years.

Illusions of rotation and translation can be generated over the temporo-perisylvian vestibular cortex and less frequently by the posterior insula. Yaw-plane rotation is mainly associated with the temporal neocortex and pitch-plane rotation with the parietal operculum.^{1,2} When localising vestibular symptoms, cortical causes such as seizures should be considered.

References:

¹ Kahane, P., D. Hoffmann, et al. (2003). “Reappraisal of the human vestibular cortex by cortical electrical stimulation study.” *Ann Neurol* 54(5): 615-24.

² Xue, L. Y. and A. L. Ritaccio (2006). “Reflex seizures and reflex epilepsy.” *Am J Electroneurodiagnostic Technol* 46(1): 39-48.



11:45

Novel ophthalmoplegia in STN/PSA deep brain stimulation

Presenter:

Andrew Charmley

Authors: Dr Andrew Charmley, Neurologist, Townsville University Hospital, Dr Alex Lehn, Neurologist, Princess Alexandra Hospital, Ms Anna Nolan, Movement Disorders Nurse, Princess Alexandra Hospital

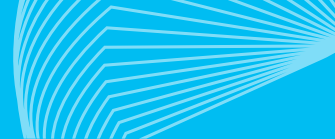
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We describe a case of position dependent skew deviation in a man with bilateral deep brain stimulation (DBS) electrodes in the right subthalamic nucleus (STN) and left posterior subthalamic area (PSA). Eye movement abnormalities developed after 6 months after DBS insertion, in the context of increasing stimulation parameters. Gaze was normal in the primary position with hypertropia of the left eye with right gaze and restricted depression of the left eye with left gaze. Ophthalmoplegia is well documented in STN DBS. Forced contraversive gaze is related to spread of current to the medial corona radiata tracts from the frontal eye fields and vertical ophthalmoplegia is described with current spread medially to the oculomotor tracts. This case demonstrates a novel ophthalmoplegia in DBS, possibly resultant from ipsilateral PSA stimulation which has not been previously described. Possible causes of this novel ophthalmoplegia include; unbalanced stimulation inherent in the mixed STN/PSA targets, or medial spread from the more medial white matter PSA BDS target. It is difficult to conclusively assess the cause of this novel ophthalmoplegia as the patient did not tolerate long periods without stimulation due to the severity of his tremor, and no neuro-imaging was undertaken.



11:55

A not-to-miss cause of vertigo and hearing loss.

Presenters:

Luke Chen

Authors:

Siriratnam, P., Chen, L.

Objectives: Acute vestibular syndrome with hearing loss is frequently attributed to ischaemia and an immune mediated mechanism. We present a case with a less commonly encountered aetiology.

Methods/results: A 52-year-old construction worker presented with sudden onset vertigo, right sided hearing loss and tinnitus. His past medical history includes chronic obstructive pulmonary disease and pneumothorax. Examination revealed a left beating nystagmus on left lateral gaze with a positive head impulse to the right, right sided otitis media on otoscopy, and subsequent audiometry revealed an anacoustic right ear. Computed Tomography of brain and carotid angiography showed opacification of the right mastoid air cells. Magnetic resonance imaging of the inner ear showed right sided labyrinthitis affecting the seventh and eighth cranial nerves as well as signal change in the petrous region. The final diagnosis is acute otitis media complicated by labyrinthitis, although no organism was cultured. He had ear toileting and was managed with oral ciprofloxacin 500mg twice daily for 5 days, intra-aural ciprofloxacin 5 drops twice daily and prednisolone 50mg daily for 5 days. He underwent right myringotomy and grommets insertion. A month since his presentation, his symptoms remain unchanged.

Conclusions: Otitis media is a common condition but not necessarily frequently encountered by neurologists. It is an important mimic of acute vestibular syndrome. Prompt recognition and institution of treatment is essential in minimising audiovestibular sequelae.

**12.05**

Chordae tympani ear drop neurotoxicity

Presenter:

Serge Geara

Authors:

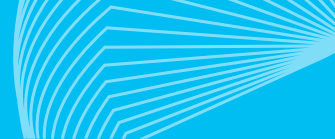
Serge Geara, John Phamnguyen

This is the first described case of ageusia (loss of taste) occurring secondary to an isolated chordae tympani injury from swimmer's ear drops used on a perforated ear drum. A 25-year-old male presented with reported ageusia on the right side of the tongue. This is on a background of recurrent surgeries for a perforated eardrum complicated by ear discomfort. On the advice of the local chemist, the patient was recommended an ear drop for swimmer's ear (called Aquaeear) containing glacial acetic acid and isopropyl alcohol mixture. The patient reported an immediate loss of taste following the use of these ear drops with clinical examination confirming ageusia of the anterior two-thirds of the right tongue. The rest of the examination was unremarkable. Investigation with MRI brain was unremarkable, and audiometry demonstrated right-sided conductive loss secondary to the perforated ear drum. Auditory brainstem responses excluded any vestibulocochlear nerve injury. No improvement was seen following a trial of corticosteroids.

This case highlights the anatomy of the chordae tympani nerve, a branch of the facial nerve. The chordae tympani nerve originates from the taste buds from the anterior two-thirds of the tongue before running through the middle ear across the tympanic membrane^{1,2}. The neurotoxic effects of isopropyl alcohol have been described in animal studies^{3,4} and likely resulted in direct neurotoxicity to the chordae tympani nerve due to the perforated eardrum. Glacial acetic acid neurotoxicity has not been reported.

References:

- ¹ McManus, L. J., Dawes, P. J., & Stringer, M. D. (2011). Clinical anatomy of the chorda tympani: a systematic review. *The Journal of laryngology and otology*, 125(11), 1101–1108. <https://doi.org/10.1017/S0022215111001873>
- ² Seneviratne, S. O., & Patel, B. C. (2021). *Facial Nerve Anatomy and Clinical Applications*. In StatPearls. StatPearls Publishing.
- ³ Gill, M. W., Burleigh-Flayer, H. D., Strother, D. E., Masten, L. W., McKee, R. H., Tyler, T. R., & Gardiner, T. H. (1995). Isopropanol: acute vapor inhalation neurotoxicity study in rats. *Journal of applied toxicology: JAT*, 15(2), 77–84. <https://doi.org/10.1002/jat.2550150204>
- ⁴ Spencer, P. S., Schaumburg, H. H., Sabri, M. I., & Veronesi, B. (1980). The enlarging view of hexacarbon neurotoxicity. *Critical reviews in toxicology*, 7(4), 279–356. <https://doi.org/10.3109/10408448009037489>



12:15

A Little Dizzy

Presenter:
Tom Wellings

Authors:
Wellings TP¹, Smith R²

Institutions:
¹ John Hunter Hospital
² Kaleidoscope Children's Hospital at John Hunter

An 11 year old child presents for assessment of a lifelong history of postural symptoms and “flicky eyes”. As a baby, her parents were unable to lie her down to change her as she would become distressed and develop downbeat nystagmus. She had recurrent bouts of unprecipitated childhood vomiting. As an infant, trials of cyproheptadine failed to provide any benefit. Her development was otherwise normal with ability to run, jump and climb. At age 4 she started developing migraine headaches on a background of a strong family history of this. Serial MRIs demonstrated a dilated central spinal canal but otherwise normal brain and cerebellar morphology.

At age 11, on clinical assessment she demonstrated downbeat nystagmus, worse with removal of fixation. She also had horizontal gaze-evoked nystagmus bilaterally, rebound nystagmus and marked exacerbation in the Hallpike positions. With fixation removed, a periodic alternating nystagmus of a few beats was seen, with a period of approximately 10-12seconds. Video head impulse tests were normal. There was no appendicular ataxia or other neurological abnormality. A mutation in CACNA1A was suspected.

Whole exome sequencing confirmed a novel de novo frameshift mutation in Exome 3 of the CACNA1A gene (CANCA1A:c458_459dup), previously undescribed in the literature. Treatment trials with 4-aminopyridine and acetazolamide are underway.

12:25

Paediatric Vestibular Dysfunction – literature review and case study.

Presenter:
Caroline Balke

Authors:
Christine Jessop (Physiotherapist) & Caroline Balke (Audiologist).

Rates of vestibular impairment increase with increasing age. However, children can suffer from vestibular dysfunction (congenital or acquired), which may often be overlooked. Our presentation aims to raise awareness of paediatric vestibular dysfunction - we will review the literature around causes / risk factors for vestibular dysfunction in children, assessment options / limitations and rehabilitation. A few short case studies will be provided for demonstrative purposes, including a data collected from small sample of children tested post-cochlear implant (at the Mater CI Clinic).



15:00

Clinical Differences between Menière's disease with migraine, Menière's disease without migraine and Vestibular Migraine

Presenter:

Gülden Akdal

Authors:

Gülden Akdal^{1,2}, Tural Tanriverdizade², Koray Koçoğlu², Pınar Özçelik^{2,3}, Alpin Güneri⁴ Günay Kırkım⁵

Institutions:

¹ Dokuz Eylül University, Faculty of Medicine, Department of Neurology, Izmir, Turkey

² Dokuz Eylül University, Institute of Health Sciences, Department of Neuroscience, Izmir, Turkey

³ Biruni University, Faculty of Medicine, Department of Neurology, Istanbul, Turkey

⁴ Dokuz Eylül University, Faculty of Medicine, Department of Otolaryngology, Izmir, Turkey.

⁵ Dokuz Eylül University, Faculty of Medicine, Department of Otolaryngology, Unit of Speech, Hearing & Balance, Izmir, Turkey

Background: Vestibular migraine (VM) and Meniere's Disease (MD) are the causes of recurrent episodic vertigo and there is an overlap between two disorders especially in the early stages.

Aims/Objective: To compare and contrast the clinical features of 3 patient groups: 17 MD patients who also had migraine (MDM); 11 MD patients who did not have migraine (MDO) and 28 patients with VM.

Materials and methods: All patients were asked about their vertigo characteristics, motion sickness susceptibility and migraine family history. MDM and VM patients were also asked about their headache characteristics using the Migraine ID Test. Posture, gait, motion sickness susceptibility, anxiety and handicap were evaluated by a series of 9 different questionnaires and clinical tests.

Results: In MD vertigo attacks were shorter but stronger than in VM. In MDM headaches were shorter than in VM. MDM and VM patients were both more off-balance than MDO patients. VM patients were more motion sick, more apprehensive and had more family history of migraine and of motion sickness than MDO patients. MDM patients had more fear of falling than VM patients.

Conclusion: MD and VM patients have some distinctive clinical characteristics. Balance is worse in both MDM and VM patients than in MDO patients



TIME	SPEAKER	TITLE
Chair		
8:00	Ian Curthoys	Vestibular anatomy and physiology
8:45	Leigh McGarvie	vHIT techniques and pitfalls and misinterpretation
9:15	Michael Halmagyi	Neuro-otology Pearls from an experienced neurologist
9:45	Mark Paine	Neuro-ophthalmology for the neuro-otology audience
10:15	Tea Break	
Chair		
10:45	Tristan Allsopp	Otology pearls part I
11:15	Ross Harrington	The Efficient Dizzy Interview
11:45	Andrew Chang	Cochlear implantation for the neuro-otology audience
12:15	Kristy Fraser-Kirk	Otological surgery for endolymphatic hydrops
12:45	Lunch	
Chair		
1:30	Natalie Rando	Assessment and treatment of BPPV
2:00	Ben Nham	AVS assessment and stroke
2:30	Caroline Balke	PTA, VEMPs, caloric, rotatory chair
3:00	Kate Mahony (virtual)	PPPD
3:30	Close of training Day	