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GUEST LECTURES:

MIGRAINE AND VERTIGO

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Migraine and vertigo are related in several ways. Quite commonly, the two are associated by chance as both conditions are highly prevalent in the general population. Beyond chance alone, there are several vertigo syndromes which are epidemiologically related to migraine including benign paroxysmal positional vertigo, Meniere's disease, motion sickness and anxiety disorders which may present with dizziness. The closest association, however, is migrainous vertigo (MV), which is vertigo directly caused by migraine. MV affects about 1% of the general population and about 10% of patients in specialized dizziness clinics.

Clinically, MV presents with attacks of spontaneous or positional vertigo lasting seconds to days. Severely affected patients may be confined to bed for several days. Since headache is often absent during acute attacks, other migrainous features such as photophobia or auras have to be specifically inquired about. Triggers include stress, sleep deprivation and hormonal changes. Cochlear symptoms may be associated but are mostly mild and non-progressive.

During acute attacks one may find central spontaneous or positional nystagmus and, less commonly, unilateral vestibular hypofunction. In the symptom-free interval, vestibular testing adds little to the diagnosis as findings are mostly minor and non-specific. Conversely, gross abnormalities, such as a complete canal paralysis, should raise the suspicion of an alternative diagnosis.

The pathogenesis of MV is still obscure, but migraine mechanisms may interfere with the vestibular system at various levels including labyrinth (e.g. sensitization by excitatory neurotransmitters), brainstem (e.g. crosstalk between trigeminal and vestibular nuclei) and cerebral cortex (e.g. spreading depression).

In the absence of controlled studies, treatment of MV is adopted from the migraine sphere comprising avoidance of triggers, stress management and exercise as well as pharmacotherapy for acute attacks and prophylaxis.

NEUROANATOMICAL CIRCUITS DRIVING VOLUNTARY AND VESTIBULAR EYE MOVEMENTS

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There are at least 5 different types of eye movements, and each type is controlled by a relatively independent neural circuit which converges onto the extraocular motoneurons. For example, the slow compensatory vestibular eye movements (VOR) are controlled through distinctive parts of the vestibular nuclei, including the magnocellular division. In contrast saccades (as well as fast phases of nystagmus) are driven by premotor neurons in the pontine and mesencephalic reticular formation, more specifically the paramedian pontine reticular formation and the rostral interstitial nucleus of the MLF (PPRF and RIMLF). At present it is generally believed that all extraocular motoneurons participate in all types of eye movements.

Eye muscles are different from skeletal muscles: they succumb to different diseases and they contain different types of muscle fibres. One type of muscle fibre that is found in the extraocular muscles of all mammals, but not found in skeletal muscles is the multiply-innervated non-twitch muscle fibre (MIF). It is innervated all along its length and responds to activation with a graded contraction, not a twitch like all other muscle fibres types. We have located the extraocular motoneurons for these multiply-innervated muscle fibres (MIFs), and investigated the central circuits that innervate them. We find that they are driven by regions of the brainstem that include some parts of the vestibular nuclei but do not include the magnocellular division, or the PPRF, or RIMLF. The function of multiply-innervated muscle fibres in eye muscles is still a matter of discussion.

ORAL PRESENTATIONS:

THE ROLE OF GENETICS IN MOTION SICKNESS SUSCEPTIBILITY

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BACKGROUND Individual differences in motion sickness susceptibility are large and appear to follow a continuum. However the underlying determinants remain unclear. The aim was to review the evidence for a genetic basis for motion sickness susceptibility.
METHODS Several approaches were used: qualitative / theoretical, computerised and paper literature searches. Recalculations were performed to provide a common standard of metrics for relevant quantitative data.
RESULTS From a theoretical perspective it is noteworthy that motion sickness is preserved across the evolutionary tree from fish to man. Circumstantial evidence includes: sex differences; racial differences; selective animal breeding. Medical genetics indicates: motion sickness susceptibility association with migraine e.g. CACNA1 gene; hereditary cochleo-vestibular dysfunction COCH gene; allelic variation of alpha2 receptor gene. Family & Twin Studies provide the best quantitative evidence for heritability of motion sickness susceptibility. Parent-child concordance (unweighted averages of 3 studies) showed risk of motion sickness is increased in offspring as a function of parental motion sickness susceptibility: neither parent susceptible 0.09; one parent 0.21; both parents 0.40. Twin casewise concordance (unweighted averages of 4 studies) was higher in MZ twins 0.83 than DZ twins 0.30. The largest and most recent twin study indicated an overall heritability for motion sickness susceptibility around 57 %. Heritability seems maximal in childhood around 70 % declining to 55 % by 30 years (perhaps due to habituation).
CONCLUSIONS Various lines of evidence suggest that genetics plays an important role in determining motion sickness susceptibility. Although females are more susceptible to motion sickness, there is no strong evidence from twin and family studies for sex linkage or differential heritability. Multiple predisposing genes for motion sickness susceptibility are likely.

INTRATYMPANIC DEXAMETHASONE PERFUSION VS. NATURAL HISTORY OF MENIERE'S DISEASE.

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OBJECTIVE: Comparison between five year results of intratympanic dexamethasone perfusion vs. natural history in Meniere's disease.
STUDY DESIGN: Prospective follow up for 5 years post intratympanic dexamethasone perfusion.
SETTING: Tertiary-care hearing and balance center.
PATIENTS: The study included 99 patients diagnosed with Meniere's disease.
INTERVENTION: Intratympanic injection of dexamethasone 24 mg/ml once weekly for a maximum of 3 treatments. Pre- and post-treatment neurotologic examination and tests of auditory and vestibular function carried out during follow every 3 months for the first year, then annually for 5 years.
MAIN OUTCOME MEASURES: Pre- and post-treatment hearing (pure-tone average and word-recognition score), vertigo frequency and functional levels, and subjective changes in tinnitus and aural fullness. Results were compared to the 5 year natural history of Meniere's disease as documented in neurotology literature. Correlated t test and 95% confidence interval were used for statistical analysis.
RESULTS: Significant gain of 30% speech discrimination was evident in 90% of patients. The five year average WRS gain was 80%. Vertigo frequency and functional levels were significantly improved in 90% of patients. Aural fullness and tinnitus subsided significantly in 90% and 60% of patients, respectively. No significant adverse reactions were reported by patients.

CONCLUSION: Dexamethasone 24 mg/ml intratympanic perfusion is an effective treatment for Meniere's disease. The treatment is associated with significant speech discrimination recovery and vertigo control by comparison to the natural history of the disease.

CYCLICAL VOMITING SYNDROME – UNDERLYING PATHOLOGY

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INTRODUCTION: Cyclical vomiting syndrome (CVS) is characterized by recurrent bouts of intense nausea and vomiting, at times in association with headaches or abdominal pain. Although the aetiology of CVS remains uncertain, the condition is thought to be related to migraine (Li BU, 1999). The nucleus tractus solitarius (NTS) in the dorsal brainstem coordinates retching and vomiting and itself receives inputs from the vestibular system, the area postrema and abdominal vagal afferents. It is necessary to exclude vestibular dysfunction as a trigger in patients with cyclical vomiting syndrome. (Lindley KJ, 2005)

This study examines historical features, neuro-otological examination and vestibular investigations in children with CVS.

METHODS: The clinical records of 29 patients with CVS who were referred to our tertiary level clinic were examined. The history of each individual was assessed, together with results of the neuro-otological examination and vestibular investigation results.

RESULTS: Records of 29 children between 4 to 15 years of age (13 males and 16 females) with CVS were examined. Periods of vomiting lasted between 6 hours to 5 days with symptom-free intervals of 3 weeks to 4 months. In association with periods of recurrent vomiting, 11 children complained of headaches, 6 had abdominal pain, 16 were dizzy and 5 were travel sick. There was a family history of migraine in first degree relatives in 13 children. A good response to anti-migraine prophylaxis was reported by 17 children (5 with Pizotifen and 12 with Propranolol), while 9 children were not treated and no mention of drug therapy was made in 3 of the records studied.

Neuro-otological examination was normal in all but one of the participants who had signs of left peripheral vestibular hypofunction. Caloric testing was possible in twenty children and revealed normal responses in all but one of them. A left canal paresis of 12% with a right directional preponderance of 16% was seen in this case. Electronystagmography or videonystagmography was carried out in 25 children. No abnormalities were found in 20 cases. A right directional preponderance was noted in 4 cases and a left directional preponderance in one on rotation testing.

DISCUSSION: Although the reasons for cyclical vomiting remains unknown, studies have suggested this condition to be a 'migraine equivalent' (Li BU, 1999; Dignan F, 2001). Increased incidence of migraine in first degree relatives, the response to anti migraine therapy and electrophysiological similarities have all been cited in support of this contention (Salmon MA, 1985; Jernigan SA, 1991). Investigations to exclude pathologies of the gastro-intestinal tract and the vestibular system are necessary as these can modulate the sensitivity of the Nucleus Tractus Solitarius to emetic stimuli and thereby contribute to recurrent vomiting.

Our data supports the contention that CVS is a migraine equivalent. A substantial majority of children studied had normal vestibular function.

VESTIBULAR EVOKED MYOGENIC POTENTIAL P13 LATENCIES ARE PROLONGED IN MIGRAINE-RELATED VERTIGO

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INTRODUCTION: The pathophysiology of migraine-related vertigo is not well understood, but central deficits on traditional vestibular testing are not uncommon. Vestibular evoked myogenic potential testing (VEMP) is a technique that assesses the integrity of the sacculo-collic reflex pathway. This pathway passes through the vestibular nuclei and via the medial longitudinal fasciculus. VEMP parameters, especially p13 latency measurements, have been shown to be useful in evaluating brainstem function. This study examines the hypothesis that patients with migraine-related vertigo (MV) exhibit abnormalities in VEMP latency parameters.

METHODS:10 sequential patients from our tertiary level clinic fulfilling strict criteria for migraine (IHS 2004) and migraine-related vertigo (Neuhauser 2001) were assessed using a full audiovestibular test battery including 500 Hz tone-burst VEMPs. Data were collected on VEMP thresholds, p13 and n23 latencies and normalised amplitudes. Subject data were compared with an age and sex-matched control group (n=10). In addition, data from both groups were compared with departmental norms based on a sample of 34 healthy volunteers aged 18 to 60.

RESULTS: The mean interaural p13 latency difference was longer (1.61; 95% CI 0.83 - 2.38) in the MV group when compared with the control group (0.76; 95% CI 0.41 – 1.1). This finding was supported by the observation that 3/10 patients in the MV group had prolonged p13 latencies when compared to departmental norms, whereas none of the control group displayed such an abnormality.

DISCUSSION: Dysfunction of sensory modulatory pathways is an important concept in migraine pathophysiology. This has been linked to findings within the brainstem, for example in PET scanning studies of acute migraine attacks. Such dysfunction within the central vestibular system may relate to abnormalities of VEMP latency, and has been demonstrated in patients with basilar migraine. Our data support similar abnormalities in patients with migraine-related vertigo, and may contribute to understanding of its pathophysiology.

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AGEOTROPIC LATERAL BPPV TREATMENT

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AIM OF STUDY
The aim of this study is to evaluate and to compare the efficacy of different liberatory manoeuvres described in the ageotropic lateral BPPV (ageo lBPPV). We will present movies for diagnosis and for some therapeutic manoeuvres.

MATERIALS AND METHODS
1) **Population:** 41 subjects were included. 2 Females for 1 Male;
2) **Protocol**: We considered that patient is cured when vertigo and positional nystagmus disappeared. First, we did simple manoeuvres: the Lempert manœuvre described for the geotropic form or the inverted Vannucchi manœuvre i.e. we asked subject to sleep in the

lesion side during 2 nights in order to transform ageo lBPPV to geotropic lBPPV. In case of failure, we did the other known manoeuvres: French manoeuvre so-called “Strasbourg manoeuvre” i.e. a very sudden and quick Lempert Manoeuvre; or a manoeuvre described by Magnusson et al. (head shaking) before Lempert or Vannucchi manoeuvres. In case of failure, we also tried Norré habituation exercises or survey only.

RESULTS

Cerebral MRI was carried out on 13 patients and no central pathology was detected.
We found a context which could explain aetiology of BPPV in 32 cases (78%):
-- History of repeated BPPV or associated with other type of BPPV: 25 cases
-- Head trauma in 5 cases, otospongiosis 1 case; Menière disease 1 case and labyrinthitis (sudden vestibular neuritis with sudden deafness) 1 case

a) In term of positional nystagmus: 39% were cured after first manoeuvre, increasing to 46% after trying another kind manoeuvre. 27% failed with any manoeuvre. 27% were lost to follow up. Success was obtained with the Lempert manoeuvre in 39% (11cases /28); Vannucchi manoeuvre: 15% (2/13); Magnusson: 2/7 (29%); Strasbourg: 43% (3/7); Norré 33% (1/3).

b) In term of symptoms, the outcome was always favourable in terms of positional vertigo after one or two manoeuvres, whether the positional nystagmus persisted or not. 5 patients remained unstable (4 with failure of manoeuvre and even one with a successful manoeuvre).

We noticed that we observed transformation from ageo lBPPV to geo lBPPV only once and only with the inverted Vannucchi manoeuvre.

Conclusion: In term of symptoms, the evolution is almost always favourable even if positional nystagmus persists. The results in terms of positional nystagmus are less favourable (49%) as results from pBPPV or geotropic lBPPV.

NORMATIVE DATA, VARIABILITY AND TEST-RETEST RELIABILITY OF THE SHAT, PRRT, AND VST.

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Rotational testing has been used in clinical practice to explore vestibular function. Frequently used stimulus algorithms include: sinusoidal harmonic acceleration test (SHAT), pseudorandom rotation test (PRRT), and velocity step test (VST). The aim of this study was to construct normative data as well as to evaluate the variability and test-retest reliability of those rotational paradigms. One hundred and fifty subjects without vestibular history participated in the normative study. The SHAT was presented at 5 frequencies (0.01, 0.02, 0.05, 0.1, 0.2 Hz) at 50 °/s, whereas for the PRRT those frequencies were summed. The VST consisted of a rotation to the right and left and was administered twice (2 °/s², 100 °/s, 200 °/s²). Thirty-two volunteers were retested to assess the test-retest reliability. Separate normative data was needed according to sex, stimulus type, and frequency for the SHAT and PRRT, and according to stimulus and direction for the VST. Correlation coefficients were highest for phase and time constant. PRRT gain demonstrated higher correlation coefficients than the SHAT gain. Absolute test-retest differences, as well as standard errors of measurement were calculated for all response parameters. Determination of the sensitivity and specificity of those rotational paradigms is essential to verify the above findings.

PRESENTATION OF DIZZINESS IN CERVICAL PAIN PATIENTS

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INTRODUCTION:

Dizziness affects 16% - 35% of population. It can accompany cervical spine dysfunction and physiotherapists often treat cervical patients with dizziness. Aetiological factors for

dizziness can be divided broadly into medical factors, vestibular dysfunction and cervicogenic dizziness. As dizziness can be a symptom of non-musculoskeletal dysfunction, advancing physiotherapists' ability to screen for and recognise different presentations is imperative. Psychological factors must be considered as they can affect clinical presentation.
Objective: This project aims to investigate the clinical and psychological presentation of cervical pain patients with dizziness compared to patients with cervical pain and no dizziness.

METHODOLOGY:
Twenty nine patients (22 females) with a diagnosis of cervical spine pain were recruited from physiotherapy waiting lists at two NHS Trusts.
The study consisted of one telephone interview using the following validated questionnaires; Vertigo Symptoms Scale (VSS with vertigo (VSS-V) and somatic anxiety (VSS-SA) subscales), Hospital Anxiety and Depression Scale, Numerical Rating Scale (NRS) for average cervical pain and Neck Disability Index (NDI). A locally developed questionnaire, the "Medical Factors Survey" was modified to aid investigation of general health and aetiological factors for dizziness.
A MANOVA test and *post hoc* Bonferroni tests were used with significance $p \leq 0.01$. Spearman's Correlation assessed the relationship between disability, pain and psychological symptoms ($p<0.05$).

RESULTS:
48% (n=14) of patients reported dizziness (9 females, aged 48.29 ± 14.98 years) and 52% (n=15) had none (13 females, aged 54.07 ± 19.57 years). There was a significant difference in %NDI ($p=0.01$), HAD-D ($p=0.00$), VSS-V ($p= 0.00$) and VSS-SA scores ($p=0.00$) between cervical pain patients with and without dizziness. There was no significant group difference in age, duration of cervical pain, HAD-A and NRS scores ($p>0.01$). There was a significant correlation between VSS-V and VSS-SA ($r=0.77$, $p=0.00$), %NDI ($r=0.54$, $p=0.04$) and HAD-A ($r=0.54$, $p<0.04$). No significant correlations were found between dizziness and other factors.

DISCUSSION:
This study demonstrated that patients with neck pain and dizziness have greater neck disability, psychological and vertigo symptoms than patients with pain only. Significant correlations were noted between dizziness, psychological symptoms, and disability, but it is not known whether this is a cause or effect. Further work is needed to differentiate the aetiology of dizziness in cervical pain.

AUDIOVESTIBULAR MANIFESTATIONS OF FACIAL NERVE SCHWANNOMAS

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Facial nerve schwannomas are uncommon tumours arising from the Schwann cell sheath which often present with fluctuating or progressive facial paresis of varying severity. However these tumours can present less commonly with neurotological manifestations even without any facial weakness. Here two cases are discussed with a brief review of literature. One patient presented with asymmetrical sensorineural hearing loss without any facial weakness and with complete canal paresis. There was an extensive facial nerve schwannoma with extension into anterior and posterior cranial fossae on the side with apparently better hearing. The second patient had facial palsy 5 years prior to the referral for tinnitus management. A facial nerve schwannoma was detected on the side with worse tinnitus even though the initial MRI was negative. Neither patient had surgical removal of the tumour due to differing reasons.

APOGEOTROPIC VARIANT OF HORIZONTAL CANAL BPPV.

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We present two rare cases of Horizontal Canal BPPV with apogeotropic nystagmus. The diagnosis was based on history of recurrent sudden crisis of vertigo associated with bursts of horizontal apogeotropic paroxysmal nystagmus provoked by turning the head from the supine to either lateral position. The patients were two women 60 and 64 years old respectively. We identified the affected ear in each case by the side on which the nystagmus was less intense.
Both patients were treated with positioning maneuvers addressed to shift the debris from the anterior into the posterior arm of the canal. We executed several times the barbecue rotation toward the healthy side and we also suggested the patients to maintain a forced prolonged bedrest on the affected side for up to 12 hours without any results. Then we executed the maneuver proposed by Appiani et al three times in one month period but the patients didn't show the transformation of the apogeotropic to geotropic variant of HC-BPPV.
On evaluation of both patients one month later the apogeotropic nystagmus still remained while there was a slight improvement of the symptoms.
Two months later the patients showed further improvement on symptoms and on examination there was no nystagmus on the turn of the head to either side while lying supine.

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CLINICAL AUDIT OF VESTIBULAR EVOKED MYOGENIC POTENTIALS (VEMP) ON THE STERNOCLEIDOMASTOID MUSCLE: DETERMINATION OF NORMAL LIMITS AND TEST-RETEST VARIABILITY FOR VEMP RESPONSE PARAMETERS

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BACKGROUND: Original VEMP reports have focused on the use of amplitude measures to assess asymmetrical function in the vestibulo-colic reflex pathways[1]. Amplitude measurements are quick to obtain, but have the disadvantage of high variablility across subjects. An alternative parameter is the VEMP threshold, which shows less variability between subjects[2], but is more time consuming and prone to subjective interpretation by the tester. VEMP latency is less commonly used, but has been shown to be useful in identifying retrolabyrinthine abnormalities[3].
OBJECTIVES: A service development project was undertaken to validate the efficacy of our vestibular myogenic potential (VEMP) test procedure, and to investigate the normal range, effects of age, and reliability of VEMP response parameters.
METHODS: Data were analysed from 40 normal volunteers (balanced across gender and age from 20-60). Details of the recording technique are described elsewhere[4]. Briefly,

VEMPs were recorded in response to 500 Hz tone bursts (8 ms duration) that were presented monaurally at a rate of 4.7/sec. Bio-feedback was used to control muscle tension at a constant level of 60-80 µV. The analysis involved the identification of response components P13 and N23. Normal limits were determined for threshold, normalised amplitude, latency, and inter-aural differences. Fifteen volunteers underwent additional testing within a 6 month period to assess "between session" reproducibility for each response parameter.
RESULTS: VEMPs were present in all normal volunteers. Thresholds ranged from 100-125 dB SPL in 95 % of the volunteers. Most volunteers exhibited inter-aural threshold differences of 0-5 dB, with a 10 dB difference defining the upper limit. Normalised amplitudes showed considerable variability across subjects, and when compared across test sessions. Furthermore, amplitude variability increased as the stimulus intensity was increased above threshold. VEMP latencies showed fairly good repeatability that was further improved when identified at supra-threshold levels. There was a weak correlation between age and both threshold and amplitude, with significant differences between the 3rd and 6th decades. There was no significant effect of age on VEMP latency.
CONCLUSIONS: Thresholds are superior to amplitudes in terms of decreased inter-subject variance, and repeatability when compared across test sessions. Thresholds and their inter-aural difference may therefore be the parameter of choice when investigating dysfunction of the saccule in neuro-otological patients. However, for patients unable to complete the threshold seeking process, inter-aural normalised amplitudes and mere presence/absence of the response can still provide some useful information. Latencies showed good repeatability, but where possible, should be interpreted at supra-threshold levels to enhance the accuracy of peak identification. Age may need to be considered when interpreting the results of patients over the age of 50.

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POSTER PRESENTATIONS:

Relative nauseogenicity of self and visual field motion during OVAR and relationships with general susceptibility.

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Abstract
Introduction Rotation about a tilted axis (OVAR) is highly provocative of motion sickness. In simulators the visual field motion equivalent to OVAR gives a sense of self motion and is also nauseogenic. This study attempted to parse the relative nauseogenicity of motion vs visual flow during OVAR.

Methods 12 subjects each undertook the conditions: A, OVAR in darkness at 0.2 Hz, 18^{o} tilt; B, identical OVAR with eyes open in the light; C seated Earth stationary watching a video of the visual motion experienced in B. The conditions were counterbalanced for

order and performed at the same time of the day with a minimum of five days separation between conditions. The motion challenge was stopped when a level of moderate nausea was attained or at a 20 minutes maximum cut off. Subjects' general motion sickness susceptibility was rated on a standardised questionnaire (MSSQ)

Results Time until moderate nausea was significantly shorter for real OVAR conditions (A: 7.1 $\pm$ 5.5; B: 7.7 $\pm$ 6.7 minutes) than for video (C: 15.7 $\pm$ 6.4). Subjects with relatively low susceptibilities to motion sickness developed nausea more slowly with vision (correlation with MSSQ scores($r=-0.7$, $p<0.05$). Headache emerged as an additional prominent symptom in response to the visual field motion in C.

Conclusions Self motion during OVAR is 50% more nauseogenic than the visual field motion. The prominent symptom of headache that developed during visual field motion suggests mechanisms in common with migraine. The context of 'visual field dependency' the 'dependent' subject makes poor use of visual cues. Therefore, our subjects who were equally susceptible in light and dark were field dependent whereas those subjects who fared better in the light used visual cues to help resolve sensory conflict; a form of 'field independency'. Hence it is not that the field dependent subject is more susceptible to motion sickness but that the field independent subject is better in the light.

A NEW MANOEUVRE FOR TREATMENT OF ANTERIOR CANAL BPPV

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Anterior canal (AC) BPPV is rare due the anatomical features of this canal. We recently had one patient in whom the diagnosis was thought to be AC BPPV who was successfully treated with a novel repositioning procedure. The patient was a 57 year old male GP who had suffered from positional vertigo for four months. During the Hallpike positional manoeuvre on the left side he experienced his typical symptoms and developed a predominantly downbeat nystagmus. We proceeded to treatment for left AC BPPV. Step 1: In the seated upright position, we turned his head in yaw approximately 45 deg to the left, and then we rapidly swung his body down through 90 deg to the left side - so that the rotation was in the plane of the left AC. Step 2: After a rest period of approximately 30s the patient was swung quickly through 180 deg to the opposite side, maintaining the original head-on-neck position, so that the acceleration again took place in the left AC plane. At this point, further nystagmus was observed. The nystagmus was torsional, with the top of the eye beating to the left shoulder, and had a downbeat component. Step 3: After a rest period the patient was sat upright again. On repeated telephone follow ups for three months, the patient reported to be fully or 80% free of symptoms. We modelled the accelerations present in this repositioning procedure, which confirmed that this motion sequence should be appropriate for freeing particles away the AC. The model also showed that outcomes could be improved by ending Step 1 and Step 2 with the head about 20 deg below the horizontal. In addition, as a counterpart to the Semont manoeuvre for posterior canal BPPV, the swing movement from one body side down to the opposite should be done as quickly as possible (e.g. < 2s) in order to guarantee intra-luminal particle progression.

THE IMPACT OF DIZZINESS ON PATIENTS' QUALITY OF LIFE

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OBJECTIVES: There are few surveys assessing the impact of dizziness on working and social life. We developed a survey consisting of 10 items in two specialised neuro-otology tertiary referral services in central and west London (UK) and Siena (Italy). The main aims of this survey were a) to identify the duration of symptoms and number of specialists seen and socio-demographic characteristics of the cohort studied, b) to identify if the dizziness has an effect on the employment pattern and self-perceived work efficiency and c) identify if the dizziness interfered with family, social life and ability to travel.

METHODS: The cohort studied included 400 outpatients (200 patients from each country) seen between May 2006 and May 2007 in the two tertiary referral centres. The 10 item questionnaire was administered to consecutive non acute outpatients. Statistical analyses included logistic regression and factor analysis.
RESULTS: the mean age of the patients was 54 (SD 16.4 range 17-88) years, with a female preponderance (62%). The work patterns were full time (40%), part time (9%) and not working (51%). The mean duration of dizziness was 43.3 months. 62.3% of patients attended the Neuro-Otology clinic for the first time, and 80% of patients had been seen by other specialist before attending the Neuro-Otology clinics (generally Neurologist, ENT or both). 27% of patients changed their job and 21% gave up work as a result of the dizziness. Over 50% of patients felt that their efficiency at work had dropped. Social life and travelling was disrupted in approximately 50% of patients and family difficulties attributed to the dizziness were experienced by 35%. The London sample showed a higher prevalence of women and more days off work than that in Siena. However factor analyses indicated a common theme across both samples in terms of the negative impact of dizziness on many aspects of life including work, travel, social and family difficulties.
CONCLUSIONS: Despite national differences, the data show an impressive impact of dizziness on the working and social life of patients. The social and economic cost of dizziness is higher than hitherto suspected, emphasising the need to diagnose and treat patients effectively.

Key words: working and social life, dizziness, survey

VISUO-VESTIBULAR INFLUENCES ON THE MOVING PLATFORM LOCOMOTOR AFTEREFFECT

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ABSTRACT

After walking onto a moving platform subjects experience a locomotor aftereffect (LAE), including a self-generated stumble, when walking again onto a stationary platform. Thus this LAE affords examination of the role of vestibular input during an internally generated postural challenge. The experiments involved, walking onto the stationary sled (BEFORE trials), walking onto the moving sled (MOVING) and a second set of stationary trials (AFTER). We investigated 9 bilateral labyrinthine defective subjects (LDS) and 13 age-matched normal controls (NC) with eyes-open. We repeated the experiment in 5 NC and 5 LDS but this time the AFTER trials were performed twice, first eyes-closed and then on eye reopening. During AFTER trials both groups experienced an aftereffect with eyes-open and closed, shown as higher approach gait velocity, a forward trunk overshoot and increased leg EMG. However, there were no significant group differences due to the fact that stopping the forwards trunk overshoot was accomplished by anticipatory EMG bursts. On eye reopening the aftereffect re-emerged, significantly larger in LDS than in NC. The results confirm the established role of the vestibular system during externally imposed postural perturbations, as in MOVING trials. The lack of group differences in AFTER trials suggests that when facing internally-generated postural perturbations, the CNS relies less on vestibular feedback and more on anticipatory mechanisms. Re-emergence of the aftereffect on eye reopening indicates the existence of a feedforward visuo-contextual mechanism for locomotor learning which is adaptively enhanced in the absence of vestibular function.

OLIVOCOCHLEAR EFFERENT FUNCTION IS AFFECTED IN MULTIPLE SCLEROSIS

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BACKGROUND AND OBJECTIVE. The brainstem is a site of predilection for multiple sclerosis (MS) plaques and the efferent medial olivocochlear (MOC) pathway may be affected at this level. However, there is a paucity of data on efferent function in MS. Therefore, this study evaluated efferent medial olivocochlear (MOC) function in patients with MS.
METHODS. The study included 30 MS patients with normal hearing, who were divided in two subgroups, according to MRI findings: those with an identifiable brainstem lesion (n=10) and those with MS lesions in other parts of the central nervous system, but without demonstrable MS plaques in the brainstem (n=20). Twenty two healthy subjects with normal hearing, matched for age and gender, served as a reference group for the auditory data. All subjects underwent standard auditory tests, including pure-tone audiometry and recording of auditory brainstem evoked responses (ABRs). In all subjects MOC function was evaluated by the olivocochlear suppression test, using transient evoked otoacoustic emissions.
RESULTS AND INTERPRETATION. The results showed that 66.6% of all patients had reduced MOC function, thus, this study provides the evidence for a deficit of efferent auditory function in the majority of patients with MS. Fifty five percent of patients had no identified lesions of the brainstem on MRI, implying the MOC suppression test is sufficiently sensitive to identify subtle brainstem lesions undetected by MRI
Taking into consideration the possible roles of the MOC system in processing of auditory information, abnormal MOC suppression in patients with MS may explain a variety of auditory presentations, which are currently largely overlooked. This study also highlights the diagnostic value of the MOC suppression test as a site-of-lesion diagnostic test and as a tool for an early diagnosis of MS.

MEASURING THE VESTIBULOOCULAR REFLEX WITH THE HEAD IMPULSE TEST IN THREE DIMENSIONS

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The Head Impulse Test (HIT) has become popularised as a simple clinical test to assess the VOR in the horizontal plane and is now widely used as a part of the normal examination of patients with balance disorders. It is easily recognised that the sensitivity and specificity of this clinical test are subject to large variation, with technique and observer error being potentially considerable confounding factors.
Many of the methods previously involved in this area of research are large cumbersome devices that are uncomfortable for the patient. The use of scleral coils is invasive and thus many of the devices are only used for research purposes.
We have developed a lightweight device, without the previously mentioned problems, that will test the VOR in the three planes of acceleration parallel with the semicircular canals. This is a presentation of a pilot study carried out to confirm the device's ability to detect the normal response.
The mean latencies for the horizontal, RALP and LARP test were 46.4ms, 53.3ms and 56.8ms respectively.
The device allows us to detect inadequate impulses and prediction of impulse by the patient, thereby acting as a training tool. It is hoped that it will a diagnostic tool for patients.

AUDITORY ABNORMALITIES IN FABRY DISEASE

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INTRODUCTION: Fabry disease is an X-linked lysosomal storage disorder due to a deficiency of alpha-galactosidase A. It results in an inability to catabolise

glycospingolipids. and thus there is an accumulation of the metabolite globotriaosylceramide (Gb3) in organs such as the heart, kidney, lung, G.I. tract, pancreas and the eyes. Audiovestibular abnormalities have been recognised in Fabry patients. Germain et al (2002) found a 54.5% incidence of hearing loss (both sudden and progressive) in 22 male patients compared to age related norms. Conti and Sergi (2003) found a 57.1% incidence of hearing loss in 14 patients (10 males, 4 females). They also noted vestibular abnormalities in 4 patients, bilateral hypofunction (2), bilateral failure (1), and a directional preponderance (1). Most of the studies of auditory pathology in Fabry patients have not considered the site of lesion, i.e. cochlear or retro-cochlear or even a higher, auditory processing disorder.

METHODS: The audiological data of 6 patients sent sequentially from the Metabolic Unit, were analysed with respect to age and gender for pure tone audiometry (PTA), middle ear reflexes (MER), speech audiometry (SpA), speech in babble (SIB), gaps in noise (GIN), otoacoustic emissions with contralateral suppression (CSOAE), ABR (performed with insert earphones and including rapid rate responses) and VNG calorics. The patients ranged in age from 19 years to 70 years (median, 47 years). There were 4 males and 2 females, of which 4 patients were on enzyme replacement therapy(ERT). Only auditory data will be presented.

RESULTS:

Standard audiometric testing (PTA & MER) identified a **sensori-neural hearing loss in**. 4 of 6 patients (7 ears). Of these, 2 patients had a relatively symmetrical, bilateral loss (1 mild and 1 severe), and 2 patients (3 ears) had a high frequency hearing loss at 8kHz of >45dBHL, despite normal pure tone averages (500Hz – 4kHz).

Central auditory processing tests (SpA, SiB, GiN, CSOAE and ABR) were used to identify retrocochlear pathology: **GIN and ABR were the most sensitive**, with abnormalities found consistently in a subset of 5 ears with an 8kHz threshold of >45dBHL but with normal (3 ears) or only mildly elevated i.e. 28 and 29dBHL (2 ears) pure tone averages. In the remaining patient (2 ears), the pure tone averages (62 and 65dB HL) were sufficiently raised to preclude central auditory testing. All 4 patients complained of hearing difficulties, specifically hearing speech in background noise.

CONCLUSION: Retrocochlear abnormalities may be a feature in some patients with Fabry disease who complain of hearing difficulties. Of the tests sensitive to central auditory processing dysfunction, abnormalities of GIN and ABR proved to be consistently related to a subset of patients with an 8kHz loss of >45dBHL, who otherwise appeared to have audiometrically normal hearing. These tests help to identify neural dys-synchrony and impaired temporal resolution, and abnormal results are consistent with our patients' symptoms and the neuropathology seen in Fabry disease.

Practice point: Where an 8kHz threshold of >45 dBHL is identified on an otherwise normal PTA, central auditory processing tests should be carried out to identify possible retrocochlear loss.

EVALUATION AND MANAGEMENT OF HC BPPV

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Horizontal canal BPPV is an uncommon cause of positional vertigo by comparison to posterior canal BPPV. The etiology is either idiopathic or post repositioning treatment of the posterior canal BPPV. The mechanism of HC BPPV is due to either canalithiasis (otolith particles floating within the canal) or cupulolithiasis (otoconia particles adherent to the cupula). In canalithiasis, the direction of nystagmus is geotropic (excitation of the down ear) and is treated with the Lempert procedure. In cupulolithiasis, the direction of nystagmus is ageotropic (inhibition of the down ear or excitation of the upper ear). Several procedures have been used to treat HC-cupulolithiasis including Semont and its modification by Gufoni and others. However, refractory cases have been seen which most likely are due to the difficulty determining the side (which ear) and site (which cupula surface). The gravity vector is, theoretically, stronger on the geotropic ear but clinically

both ears must be considered especially in cases that are refractory to treatment. Hamid introduced a new procedure using rapid head shaking in the prone position to liberate otoconia off the HC cupula.

MIGRAINE AND VERTIGO: A BIDIRECTIONAL CONNECTION?

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It is well-recognised that migraine is a cause of episodic vertigo. Additionally, it has been reported anecdotally that vertigo *per se* may trigger migraine symptoms (Seemungal *et al*; J Neurol 2006;253:1000). The caloric test is a routine clinical investigation of vestibular function, and normally causes transient vertigo during its execution. In this study we use the caloric test as a model for vertigo to explore the hypothesis that vertigo can trigger migraine symptoms. *Method*: Participants were recruited from new patients attending the Neuro-otology Clinic. They underwent a standardised protocol of caloric and rotation testing, and were contacted by telephone or email 24 to 72 hours afterwards to determine any migraine symptoms using a structured questionnaire. To control for the stressful effects of a hospital visit, these subjects were compared with new patients attending the clinic who did not have a caloric or rotational test during their assessment. *Results*: 20 subjects underwent vestibular testing, and the control group comprised 5 subjects. 9 participants in the caloric test group had a background medical history including migraine according to IHS (2004) criteria and 11 did not. Of the 9 migraineurs, 4 experienced headache within 24 hours of the caloric test. 2 of these strictly fulfilled criteria for migraine, and an additional subject reported what was subjectively a typical attack aborted with analgesics. Of those who did not have a background history of migraine, one subject with a benign intracanalicular 7th nerve tumour reported a typical migraine after testing despite denying having had such symptoms before. 2 non-migrainous subjects experienced headaches which had some migrainous features such as photophobia. Overall, 3/20 (15%; 95% CI 5 – 36%) of subjects in the caloric group experienced definite migraine, and 6/20 (30%, 95% CI 15 – 52%) had definite migraine or headache with migrainous features. The control group who did not have a vestibular test comprised 2 migraineurs and 3 non-migraineurs, none of whom experienced any headache or migrainous symptoms after their visit (0%; 95% CI 0 – 43%). *Discussion*: Our preliminary data are broadly supportive of the hypothesis that vertigo as modelled by the caloric test can act as a migraine trigger, and that therefore there is a bidirectional connection between migraine and vertigo.

THE SUBJECTIVE VISUAL VERTICAL AND HORIZONTAL: REPEATABILITY AND RELATIONSHIP WITH THE PRESET ANGLE

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INTRODUCTION: The subjective visual vertical [SVV] and horizontal [SVH] assess the function of the otoliths and semicircular canals. There is no standard procedure for doing

these tests with respect to the start position of the linear marker and studies of repeatability have not been reported.
AIMS: This study investigated the repeatability of SVV & SVH and its relationship with the direction of deviation of the linear marker [preset angle] in controls and patients with vestibular pathology.
SUBJECTS & METHODS: Twelve replicate readings of SVV and SVH were obtained in seventeen controls and nineteen patients with unilateral peripheral vestibular dysfunction -9 vestibular neuritis [uVN] and 10 Menière's disease [uMD]. Repeatability indicator 'R' was calculated for 3 conditions: baseline, after excluding first 3 readings and separately for clockwise and anticlockwise preset angles. SVV & SVH values were computed separately for clockwise and counterclockwise direction of the preset angle and compared using the statistical package STATA and SPSS.

RESULTS: Repeatability of SVV and SVH was better in healthy subjects than in the uVN and uMD groups, was better for SVH than for SVV and improved in all three subject groups if the preset angle orientation was constant at clockwise or anticlockwise. SVV depends on the direction of the preset angle in all subject groups, more so in the uPVD and uMD group as compared to controls [$p<0.001$]. The SVV is inclined towards the direction of the preset angle [chi square $P<0.001$ in all three groups]. A weaker relationship is seen between SVH and the preset angle.
CONCLUSION: This study indicates that SVV & SVH values are biased by the direction of the preset angle, and the preset angle should be considered when comparing SVV/H values between individuals indifferent test settings. Further research is needed to explore this effect with and without visual roll illusion.

THE EFFECT OF REPEATED EXPOSURE TO VISUAL MOTION STIMULI ON VISUAL DEPENDENCE IN NORMAL HEALTHY SUBJECTS

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Patients with vestibular dysfunction may experience visual vertigo (VV), in which symptoms are provoked or exacerbated by excessive or disorientating visual stimuli (e.g, supermarkets). Patients with VV are believed to be overly reliant on visual input for balance (i.e. visually dependent). VV can significantly improve when customised vestibular rehabilitation exercises are combined with exposure to optokinetic stimuli. However, the exact mechanisms, by which visual dependence can be modified, are unknown. This study aimed to further investigate this issue, by measuring visual dependency before and after repeated exposure to visual motion stimuli in normal subjects. Twenty-six normal healthy subjects (10 Males; mean age 29.8 years, range 21-42 years) without a history of vestibular or neurological disease were randomly allocated into either an intervention group which underwent graded exposure to visual motion stimuli for five consecutive days or a control group which did not receive any intervention. Objective assessment included completing the Rod and Frame and Rod and Disc tests which require subjects to set the subjective visual vertical in darkness, in front of a tilted luminous frame and in front of a rotating disc. Postural sway measures were obtained with eyes open and closed and in the presence of the rotating disc. Results showed a significant decrease (i.e. improvement) in subjective vertical tilt with the rotating disc only for the intervention group ($p = 0.002$); no significant changes were noted with the static frame tilt. Postural sway measures showed a significant decrease in the mean deviation induced by the rotating stimulus only for the intervention group ($p < 0.05$). The Kinetic Quotient, which is the ratio between sway path during disc rotation and eyes open and which assesses the destabilizing effect of the rotating disc showed a significant decrease in sway for the intervention group ($p = 0.07$).The Romberg Quotient, the ratio between sway path with eyes closed and eyes open, showed no change for either group. These findings suggest that visual dependency can be improved with short-term graded exposure to visual motion stimuli. The results of this study have important implications for the treatment of visual dependency in individuals with and without vestibular dysfunction.

ACUTE NOISE EXPOSURE AND VOLTAGE GATED SODIUM CHANNELS IN THE MAMMALIAN COCHLEAR NUCLEUS: A THERAPEUTIC TARGET FOR THE TREATMENT OF TINNITUS.

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INTRODUCTION: Tinnitus and hearing loss are thought to arise from pathological VGSC activity (1). There has also been empirical interest in the use of VGSC blockers as tinnitolytics, with the best known of these being intravenous lignocaine. There is surmounting evidence that the dorsal cochlear nucleus (DCN) may be an important site in the aetiology of tinnitus (2).

AIM: The aim of this study was first begin to characterise VGSCs in the mammalian central auditory pathway and changes it their expression after noise trauma.

METHOD: Auditory brain responses were measured in rats before and after acute noise exposure. After sacrifice the brainstems were removed, embedded, frozen and 20-micron cryosections were made through the brainstem. Immunocytochemistry was then carried out using antibodies that selectively bind to individual sodium channel α-subunits. Sections were then analysed and photographed using either an epifluorescence or a confocal microscope.

RESULTS AND CONCLUSIONS: Sodium channel type 1.1, 1.2, 1.6 and 1.7 were shown to be expressed in the Cochlear Nucleus. There was no change in expression after acute noise exposure. Further work is being carried out to assess the effect of longer term noise exposure. These findings may help us to target our therapy to treat certain types of tinnitus and hearing loss.

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GENOTYPE PHENOTYPE CORRELATION IN USHER SYNDROME

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Usher syndrome is an autosomal recessive condition characterised by sensorineural hearing loss, retinitis pigmentosa and variable vestibular function. It produces a severe dual sensory impairment with medical and social implications. Three clinical forms designated type I, II and III and eleven genetic subtypes have been described, with considerable phenotypic overlap between subtypes. This extreme heterogeneity makes it difficult to identify and interpret the condition clinically and genetic testing is currently not available to help in the diagnosis. To understand more about this condition and establish genotypic phenotypic correlation which can inform future diagnostic and genetic protocols we conducted a national recruitment of Usher families as part of the National Collaborative Usher study.

Materials and Methods – The NCUS was a collaboration between the Institute of Child Health, Moorfields Eye Hospital and Sense, a deafblind charity. We recruited 228

individuals from 182 families. All affected subjects underwent a complete audiovestibular and ophthalmological protocol and provided blood samples for genetic analysis.

Results – Complete audiovestibular assessment was completed on 96 males and 106 females (N=202) with an age range of 3 to 68 years. Genetic results are currently available on 114 individuals. USH2A was the largest group with
84 subjects. 31 individuals in this group had a frameshift mutation 2299delG which has been shown to have a high prevalence and phenotypic variability. Our cohort had normal vestibular function with no evidence of hypofunction or canal paresis. Grouping all other mutations in *USH2A* gene and comparison with the 2299delG mutation showed that significant canal paresis and/or directional preponderance was more common in the non-2299delG group.

14 subjects were found to have mutations in *MYO7A* gene (USH1B) forming the second largest group; while 13 had characteristic clinical picture with absence of peripheral vestibular function, one subject with a heterozygous mutation in the gene had good vestibular function on both rotation and caloric tests.

Usher type III is uncommon in our study population and only two families have been found to carry mutations in that gene. Intrafamilial variability (one sibling has bilateral hypofunction while his younger brother has normal vestibular responses) characterises this type in one affected family. Two siblings were diagnosed as Usher type III based on clinical characteristics but were subsequently found to be compound heterozygotes for mutations in the *USH1C* gene.

Conclusions – This study confirms the extreme heterogeneity of Usher syndrome. Comprehensive vestibular evaluation may prove invaluable in identifying 2299delG mutations of the *USH2A* genotype clinically. Correlating commonly occurring mutations within the *USH2A* and *MYO7A* genes with the rich pool of audiovestibular data available may provide clues for targeted genetic testing.

WHAT IS THE EFFECT OF SOUND ON BALANCE, A PILOT STUDY?

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AIMS: The aim of this experiment was to see if a fixed focal sound source could improve the standing balance function of subjects with normal audio/ vestibular function.
METHODS:10 subjects (mean age 31.6) were assessed using a dynamic posturography machine under four randomised sensory conditions: i. sound through a single speaker at 30° and 30 cm distance, ii. sound through a single speaker at 90° and 30 cm distance, iii. no sound and iv. sound through headphones. All sound trials were performed at 50 dB SL.
RESULTS: Results for combined mean equilibrium scores across the sensory conditions were (to 3 s.f.):

i) speaker at 30°: 75.3% (SD 6.73)
ii) speaker at 90°: 73.3% (SD 6.57)
iii) no sound: 71.3% (SD 9.98)
iv) headphones: 75.2% (SD 8.68).

The means of these four conditions were not found to be significantly different ($P > 0.05$) Nine out of ten subjects however did show an improvement in their equilibrium score when sound was presented at 30° compared to the no sound control condition.
CONCLUSIONS: To confirm this trend a repeat experiment needs to be carried out with a larger sample population (power analysis based upon this data indicates a sample size of 55 would be appropriate). Should the observed trend with the 30° condition prove repeatable or significant (confirming that a focal sound source can help to improve

postural stability) this may have implications for testing in a clinical setting and possibly patient management.

THE RELATIONSHIP BETWEEN POSITIONAL VERTIGO AND VISUAL DEPENDENCY

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It is not known if the increased visual dependence present in some patients with chronic vestibular symptoms is a life-long trait or whether it is secondary to the vestibular vertiginous symptoms. The underlying question is whether visual dependence is a neural plastic phenomenon that can be modified by vestibular excitation or dysfunction. In order to address this question we measured visual dependence, before and after Hallpike (and repositioning procedures if appropriate), in patients with BPPV and in two control groups. We studied 19 BPPV patients with a positive Hallpike plus repositioning treatment (+Hallpike group), 13 patients with symptoms suggestive of BPPV but in whom the Hallpike manoeuvre was negative (-Hallpike) and 11 age matched normal control subjects. The tests included the rod-and-frame test, the rod-and-disk-test (both seated) which measure the degree of tilt induced by a static frame tilt or a roll motion rotating disc, respectively, on a visual vertical line. In addition we measured the amount of body sway path induced by the roll motion disc (subjects standing). Test details can be found in Guerraz et al [Brain 24:1646 (2001)]. Two statistically significant findings were observed in the +Hallpike group: a) the frame-induced visual tilt was larger than normal, before and after the positional procedures, and b) the disc-induced body sway was also larger than normal but only before the positional manoeuvres. There appeared to be an experimental order effect in that the post-Hallpike stimulation with the rotating disc induced less sway than the pre-Hallpike disc stimulation; this effect seemed more pronounced in the +Hallpike group. Although this study is still ongoing, the current trend in the findings indicate that BPPV patients with a +Hallpike show visual frame and disc-induced abnormalities which might reflect underlying otolithic dysfunction. Regarding the original question that prompted this study we failed to induce significant increase in visual dependence by means of a BPPV attack. This suggest that, if increased visual dependence is vestibularly-induced, the brief periods of BPPV vertigo are not enough to induce it. Longer periods of vestibular stimulation may be required to modify visual dependence.

The –Hallpike group did not differ from normal values.

AUDIT ON ADULT NEURO-OTOLOGY REFERRALS TO THE DEPARTMENT OF AUDIOLOGICAL MEDICINE: TYPES OF REFERRALS, DIAGNOSIS, MANAGEMENT.

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BACKGROUND: Neuro-otology is a main aspect of work within the speciality of Audiological Medicine. Neuro-otology clinics are specialized clinics where patients with tinnitus, dizziness and balance problems are fully assessed and managed. The approach to the patient is holistic and the Audiological Physician is part of a multidisciplinary team. (1).The Neuro-otology clinics are very specialized although they are dealing with common problems. Tinnitus is present in 20% of population, 5% of the population describes this as an intrusive tinnitus and 1% has poor quality of life due to tinnitus. Each year 15/1000 patients consult their GP due to dizziness and balance problems. The prevalence of dizziness can be as high as 30% in patients older than 60 years of age. There is good evidence that if the underlying cause of these symptoms is diagnosed these patients can be managed satisfactorily.(British Association of Audiological Physicians' (BAAP) guidelines)

OBJECTIVES: To determine the underlying aetiological factors of tinnitus , dizziness and balance disorders of the patients who are referred to our department and to assess if the quality of our services regarding diagnosis ,investigations, management meet the standard national criteria (BAAP guidelines)
DESIGN OF AUDIT: Retrospective case review audit
METHODS AND MATERIAL: 161 consecutive new referred patients to the Neuro-otology clinic were identified by the electronic data base system between Jan.2005-Jan.2007.
Results: 137 case notes were reviewed (13 referred patients did not attend and 11 case notes could not be located). Information regarding age, sex, referring clinician, reason for referral, investigations, diagnosis, management, outcome were obtained.86 females and 51 males were seen at the department of Neuro-otology. The mean age was 52.86 (range 18-89). 78 patients were referred by the GP, 53 patients by the ENT and 6 by other specialists.36 /137 were referred with tinnitus as a single symptom. 30/36 patients had abnormal hearing.15 patients were given a hearing aid, 4 were referred to the hearing therapist for formal consultation , 7 had a metabolic disorder as cause of their tinnitus. 92/136 patients were referred with dizziness/vertigo. The three commonest causes of dizziness /vertigo were: BPPV (21/92), vestibular hypofunction (16/92),migrainous vertigo (14/92) .Most of the patients responded well to repositional manoeuvres and rehabilitation exercises.20/92 patients received medical treatment for their dizziness. Local GPs refer patients within 6 months of presentation , but ENT refer patients with chronic symtoms (1-10 years).These are more complicated cases and usually these are the vertiginous patients.
CONCLUSION: Although our patients are diagnosed and managed effectively and they need less clinical appointments the need of earlier referrals to the Audiological Physician/Neuro-otologist should be raised to other medical specialties as we see chronic and complicated cases which delay and affect the resolution of these symptoms.

MODELLING THE SEMI-CIRCULAR CANALS PAST AND PRESENT AND ITS RELATIONSHIP TO A SOLUTION FOR EPISODIC ATTACKS IN MENIERES DISEASE"

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SYNOPSIS.
An account of the tests carried out on off-centre rotation, leading to the study of a canal model of the past and the construction of a model in the present, resulting in a proposed engineering solution to the episodic vertigo experienced by patients with Menieres Disease.