Clinical Updates in Vestibular Disorders
March 30th 2015 at Holiday Inn Belgrade
Dear Colleagues,

The view on patients with vertigo differ between ENTs and neurologists. At the first glance it may seem simple to recognize if the vertigo is present because of peripheral or central vestibular disorder, but sometimes it can be difficult.

The aim of this seminar is to introduce doctors with new knowledge about vestibular system and its pathologies, to change the view on vestibular system as one unity and not just as peripheral/central, to introduce new diagnostic entities, and to incorporate new diagnostic tests in everyday practice the right way.

Two eminent neurologists with main scientific and clinical interests in vestibular field are coming to Belgrade to give a lecture about updates in central and peripheral vestibular disorders.

At the Contemporary Approach to Vertigo seminar held in 2011, we were talking mainly about the new therapeutic approach in vestibular pathologies. At last year’s New Diagnostics in Neurootology seminar, the main topics were new diagnostic tests and their clinical utility.

This seminar has the aim to introduce us with diseases which we often don’t recognize, such as: CANVAS, SSCD, perilymph fistula, atypical forms of BPPV, inferior vestibular neuritis, cerebellar infarcts with clinical picture of acute peripheral vestibular disorder, etc.

It is my honor to invite you to Clinical Updates in Vestibular Disorders.

Dušan Pavlović
president of Serbian Society of Otology and Audiology
Clinical Updates in Vestibular Disorders
March 30\textsuperscript{th} 2015 at Holiday Inn Belgrade

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Vascular Vertigo: Changing Concepts

Ji-Soo Kim, MD, PhD

Department of Neurology, Seoul National University
College of Medicine, Korea

Approximately, 20% of ischemic events occur in the territory of the posterior (vertebrobasilar) circulation, and dizziness/vertigo is one of the most common symptoms of vertebrobasilar diseases. It has been believed that isolated vertigo or dizziness is extremely rare in stroke. With the aids of recent development in neuroimaging, however, inferior cerebellar and small brainstem infarctions are increasingly recognized as a cause of isolated vertigo. Furthermore, transient isolated vertigo is the common manifestation of vertebrobasilar insufficiency. Approximately 11% of patients with isolated cerebellar infarction presented with isolated vertigo, nystagmus, and postural unsteadiness mimicking acute peripheral vestibular disorders. A head impulse test can differentiate acute isolated vertigo associated with cerebellar stroke (particularly within the territory of the posterior inferior cerebellar artery) from more benign disorders involving the inner ear. Acute audiovestibular loss with vertigo and hearing loss may herald impending infarction in the territory of anterior inferior cerebellar artery. Appropriate bedside evaluation is superior to MRIs for detecting central vascular vertigo syndromes.

Transient isolated vertigo typically occurs abruptly, and usually lasts several minutes. In patients with vertigo due to vertebrobasilar insufficiency, 62% had at least one isolated episode of vertigo, and 19% developed vertigo as the initial symptom. Patients with infarction in the territory of anterior inferior cerebellar artery (AICA) may had isolated recurrent vertigo, fluctuating hearing loss, and/or tinnitus (similar to Meniere’s disease) as the initial symptoms 1-10 days prior to the permanent infarction. A recent study found that the patients who visited the emergency department with dizziness/vertigo had 2-fold (95% CI, 1.35-2.96, p<0.001) higher risk of stroke or cardiovascular events than those without dizziness/vertigo during a follow-up of 3 years. The patients hospitalized with isolated vertigo have a 3.01-times (95% CI, 2.20-4.11; p<0.001) higher risk for stroke than the general population during the 4-year follow-up. Particularly, the vertigo patients with 3 or more risk factors have a 5.51-fold higher risk for stroke (95% CI, 3.10-
9.79; p<0.001) than those without risk factors. Another study having adopted the ABCD2 score, a clinical prediction tool to assess the risk of stroke after a transient ischemic attack, to predict cerebrovascular events in emergency department patients with dizziness found that only 1.0% of dizzy patients with a score of 3 or less had a cerebrovascular event compared to 8.1% of the patients with a score of 4 or more. Especially, 27% of the patients with a score of 6 or 7 suffered from cerebrovascular episodes. Thus, the ABCD2 score may predict cerebrovascular attacks in patients with transient vertigo.

Because the blood supply to the inner ear originates from the vertebrobasilar system, vertebrobasilar ischemic stroke can present with vertigo and hearing loss due to infarction of the inner ear (i.e., labyrinthine infarction). The internal auditory artery (IAA) is a branch of AICA. The IAA irrigates the cochlea and vestibular labyrinth, and occlusion of the IAA causes loss of auditory and vestibular function. Since the IAA is an end artery with minimal collaterals from the otic capsule, the labyrinth is especially vulnerable to ischemia. IAA infarction mostly occurs due to thrombotic narrowing of the AICA itself, or in the basilar artery at the orifice of the AICA. Because the inner ear is not well visualized on the routine MRI, a definite diagnosis of labyrinthine infarction is not possible unless a pathological study is done. The apical region of the cochlea is particularly vulnerable to vascular injury, and thus, low-frequency hearing loss is common with ischemia of the inner ear. When a labyrinthine infarction occurs, infarction of the brainstem and/or cerebellum in the territory of the AICA is usually associated. The labyrinthine infarction should be considered in older patients with acute onset of unilateral hearing loss and vertigo, particularly if there is a history of stroke or known vascular risk factors. Because current means of diagnosing labyrinthine infarction are not adequate (including MRI), clinicians should consider all the clinical evidences when attempting to determine the etiology of the acute audio-vestibular syndrome rather than emphasizing that MRI is the best way to distinguish viral from vascular etiology.

Mono-symptomatic attacks of vertigo and nystagmus without any other brainstem symptoms and signs would be unusual in brainstem ischemia. Selective damage to the vestibular nucleus and root entry zone of the eighth nerve in the pontomedullary junction can cause isolated vertigo. Because the root entry zone of the eighth cranial nerve has a rich network of anastomotic vessels arising from the neighbor arteries, the possibility of focal infarction in that area is extremely low in a clinical practice. Focal ischemia in the vestibular nucleus can cause isolated vertigo and nystagmus mimicking
acute vestibular neuritis. Vertigo in the lateral medullary infarction is usually associated with other neurological symptoms or signs, but tiny infarct in the lateral medulla can present with vertigo without other localizing symptoms. In this case, the HIT might be positive, if medial vestibular nucleus is involved.

It is important to differentiate isolated vertigo of a vascular cause from more benign disorders involving the inner ear since therapeutic strategy and prognosis differ in these two conditions. Early recognition of isolated vertigo of a vascular cause may allow specific management. Misdiagnosis of acute stroke may result in significant morbidity and mortality while overdiagnosis of vascular vertigo would lead to unnecessary costly work-ups and medication.
Cerebellar Infarction Mimicking Acute Peripheral Vestibulopathy

Ji-Soo Kim, MD, PhD

Department of Neurology, Seoul National University College of Medicine, Korea

Isolated vestibular symptoms have generally been ascribed to disorders of the peripheral vestibular labyrinth. However, diagnosis of isolated central vestibulopathy is increasing by virtue of recent developments in clinical neurotology and neuroimaging. Here, I present five distinct syndromes of isolated central vestibulopathy from lesions restricted to the flocculus, tonsil, nodulus, and inferior (ICP) and superior (SCP) cerebellar peduncles. A unilateral floccular lesion may show decreased response to high-velocity head impulse stimulation and increased response to low-frequency rotations. In contrast, unilateral cerebellar tonsilar lesion markedly impairs smooth pursuit while the vestibulo-ocular reflex is relatively preserved. Isolated nodular lesions may produce the symptoms and signs of pseudo-vestibular neuritis, but normal head impulse responses as well as perverted head shaking, central positional, and periodic alternating nystagmus. Unilateral lesions involving the ICP may show ipsilesional spontaneous nystagmus and contraversive ocular tilt reaction. Isolated unilateral SCP infarction presents with dysarthria and severe imbalance, and examination may reveal ipsiversive ocular torsion, severe ipsilesional limb ataxia, and truncal ipsipulsion. Decreased responses to head impulses do not exclude a central lesion as a cause of isolated vestibular syndrome. Brain imaging including diffusion-weighted MRIs may be falsely negative during the acute phase in patients with isolated vestibular syndrome due to a stroke. Central signs should be sought carefully in patients with isolated vertigo, even when the patients showed the features of peripheral vestibulopathy and negative MRIs. Recognition of these isolated cerebellar vestibular syndromes would aid in defining the lesions responsible for various vestibular manifestations in cerebellar lesions.
Central Vestibular Vertigo, Including Vestibular Migraine

Andreas Zwergal, MD, PhD

Department of Neurology and German Center for Vertigo and Balance Disorders, University of Munich, Germany

The traditional classification of vestibular disorders is based on the anatomical site of the lesion. Peripheral disorders cause vestibular syndromes that are commonly characterized by a combination of perceptual, ocular motor, postural, and vegetative manifestations: vertigo, nystagmus, ataxia, and nausea. Central lesions in the entrance zone of the vestibular nerve or in the vestibular nucleus may mimic peripheral lesions and can only be differentiated by an exact neuro-ophtalmological exam including testing for skew deviation, gaze-evoked nystagmus and head impulse pathology. However, patients with central disorders may also present with only single components like tilts of the perceived vertical or lateropulsion without vertigo and nystagmus. Lesions affecting the central vestibular pathways may cause disorders of postural control, such as thalamic astasia, or spatial orientation and memory, such as room tilt illusion or spatial hemineglect.

Vestibular migraine is the most common cause of central recurrent attacks of vertigo. Characteristic features include recurrent attacks of various combinations of vertigo, ataxia of stance and gait, visual disorders, and other brainstem symptoms accompanied or followed by occipitally located head pressure, pain, nausea, or vomiting. Treatment is the same as for migraine with aura, i.e., for prophylactic therapy the use of betablockers (metoprolol or propranol), valproic acid or topiramate for at least six months. A few treatment studies on vestibular migraine have been performed. Tricyclic antidepressants in combination with diet showed a good response in a trial on 81 patients. For zolmitriptane the response rate in acute attacks was 38% vs. 22% in a study on 19 patients. Another open trial on 10 patients demonstrated that lamotrigine (100 mg per day as a single dose) had a significant effect on the occurrence of headache and a more marked effect on vertigo. So far, only the standard treatment of migraine with aura can be recommended for vestibular migraine. There is an on-going a placebo-controlled multi-center trial (metoprolol 95 mg per day versus placebo; the PROVEMIG- trial).
Cerebellar Vertigo and Dizziness

Andreas Zwergal, MD, PhD

Department of Neurology and German Center for Vertigo and Balance Disorders, University of Munich, Germany

Cerebellar dysfunction can induce vertigo, dizziness and balance disorders. An acute cerebellar lesion may mimic a peripheral vestibulopathy. Chronic cerebellar degeneration may induce ocular motor disorders like downbeat nystagmus (DBN) and dysfunction of posture and gait.

DBN is generally caused by a bilaterally impaired function of the cerebellar floccular lobe due to neurodegenerative disorders. A randomized double-blind cross-over trial of 4-AP in DBN showed a reduction in slow phase velocity of DBN by half and an improvement of visual acuity at a dosage of 5mg 4-AP four times a day. The sustained-release form Fampyra™ is evidently also efficient. Finally, it was also demonstrated that 4-AP suppresses central positioning DBN which correlates with an increased glucose uptake in the ocular motor vermis and the flocculus. Chlorzoxazone, a non-selective activator of small conductance calcium-activated potassium channels, could be a potentially new therapeutic agent for the symptomatic treatment. In an observational proof-of-concept pilot study slow phase velocity of DBN, visual acuity and postural sway showed significant effects.

Treatment of motor symptoms of degenerative cerebellar ataxia remains difficult. There is consensus, that no medication has been proven effective. Aminopyridines and acetazolamide may be the only exception, which are beneficial in patients with episodic ataxia type 2. In a retrospective case series, patients with cerebellar ataxic gait due to different etiologies also benefitted from 4-AP. These observations are currently evaluated in placebo-controlled trial (the FACEG-trial). Recently it was shown in a case series that the modified amino-acid N-acetyl-DL-leucine (Tanganil™) which had been used in France since 1957 for the symptomatic treatment of vertigo significantly improves cerebellar ataxia, dysarthrophonia and limb ataxia in thus affected patients. A controlled prospective trial on treatment of cerebellar ataxia with N-acetyl-DL-leucine will start in summer 2015.
Inferior Vestibular Neuritis

Ji-Soo Kim, MD, PhD

Department of Neurology, Seoul National University
College of Medicine, Korea

Vestibular neuritis (VN) is usually defined by acute unilateral peripheral vestibulopathy that manifests with acute spontaneous vertigo, nausea/vomiting, and postural imbalance. VN preferentially affects the superior vestibular labyrinth which comprises the superior (SC) and horizontal (HC) semicircular canals, utricle, and their afferents constituting the superior division of the vestibular nerve. Patients with superior VN usually show mixed horizontal-torsional nystagmus beating away from the lesion side, along with positive head impulse test (HIT) for the involved SC and HC, ipsilesional caloric paresis, ipsiversive ocular torsion and ipsiversive tilt of the subjective visual vertical (SVV).

VN rarely involves the inferior division only (isolated inferior VN). However, diagnosis of isolated inferior VN is challenging since the usual signs of VN are absent in this disorder. As a result, isolated inferior VN may erroneously be ascribed to a central pathology if there is no scrutinized evaluation for the inferior vestibular function. Recent developments of HIT and cervical vestibular-evoked myogenic potential (VEMP) paved the way to evaluate the function of the posterior semicircular canal (PC) and saccule that constitute the inferior vestibular labyrinth.

In our previous study, of the 703 patients with a diagnosis of VN or labyrinthitis at Seoul National University Bundang Hospital from 2004 to 2010, 9 patients (6 women, age range: 15-75) had a diagnosis of isolated inferior VN based on torsional downbeating spontaneous nystagmus, abnormal head-impulse test (HIT) for posterior semicircular canal (PC), and abnormal cervical vestibular evoked myogenic potentials (VEMP) in the presence of normally functioning horizontal (HC) and anterior semicircular canals, as was determined by normal HIT and bithermal caloric tests. All patients with inferior VN presented with acute vertigo with nausea, vomiting and imbalance. Three patients also had tinnitus and hearing loss in the involved side. The rotation axis of torsional downbeating spontaneous nystagmus was best aligned with that of the involved PC. HIT was also positive only for the involved PC. Cervical VEMP was abnormal in 7 patients.
and ocular VEMP was normal in all 4 patients tested. Ocular torsion and subjective visual vertical were mostly within normal range.

Since isolated inferior VN lacks the typical findings of much more prevalent superior VN, it may be mistaken for a central vestibular disorder. Recognition of this rare disorder may help avoiding unnecessary work-ups in patients with acute vestibulopathy.
Combined Peripheral and Central Vestibulopathy

Ji-Soo Kim, MD, PhD

Department of Neurology, Seoul National University
College of Medicine, Korea

With recent progress in clinical neurotology, bedside diagnosis of peripheral and central vestibular disorders has been made easier with the head impulse test (HIT) and HINTS (negative head impulse test, direction-changing nystagmus, and skew deviation). These clinical tools assist the clinician in the differentiation of central from peripheral vestibular disorders. However, there are several disorders that may involve both peripheral and central vestibular structures, and diagnosis of these combined central and peripheral vestibular disorders remains a challenge because the peripheral vestibular signs may overshadow the central ones.

Combined peripheral and central vestibulopathy could be classified into four types according to the patterns of vestibular presentation. Infarctions in the territory of anterior inferior cerebellar artery are the most common cause of acute unilateral cases while cerebellopontine angle tumors are mostly found in chronic unilateral ones. Wernicke encephalopathy and degenerative disorders are common in acute and chronic bilateral disorders. HINTS may not detect central lesions in combined vestibulopathy. The dissociative patterns between caloric response and head impulse test may suggest combined peripheral and central vestibulopathy.

Since central vestibular signs may be overshadowed by the peripheral ones, and the prognosis usually depends on central involvements in combined vestibuloapathy, central signs should be sought carefully even in patients with obvious clinical or laboratory features of peripheral vestibulopathy. Comprehensive bedside neuro-otological evaluation may disclose central signs in combined peripheral and central vestibular disorders.
Peripheral vestibular disorders are the most common cause for vertigo and dizziness. Over the last ten years the insight into pathophysiology and treatment of the most frequent peripheral vestibular disorders has markedly increased. However, the diagnostic criteria are still not standardized and prospective treatment trials are still lacking.

Bilateral vestibulopathy can be reliably diagnosed by the head-impulse test, caloric irrigation, and vestibular-evoked myogenic potentials. A new frequent subtype has been described: cerebellar ataxia, neuropathy, and vestibular areflexia syndrome. Benign paroxysmal positioning vertigo (BPPV) can be easily diagnosed and effectively treated. Vitamin D deficiency may be a risk factor for recurrent BPPV. Vestibular neuritis is most likely caused by the reactivation of a herpes simplex type 1 infection; the inferior vestibular nerve subtype is now well established. More evidence is needed that the recovery can be improved by corticosteroids. Symptomatic treatment with antiemetic drugs in vestibular neuritis should be given on demand and for a short time. Endolymphatic hydrops in Menière's disease can be depicted by high-resolution MRI after transtympanic gadolinium injection; a high-dosage and long-term prophylactic treatment with betahistine is evidently effective. Its mechanism of action is most likely an increase in the inner-ear blood flow. Vestibular paroxysmia is now a well established entity; carbamazepine is the treatment of first choice. Superior canal dehiscence syndrome can be reliably diagnosed; the best current treatment option is canal plugging.

Although progress has been made in the diagnosis and treatment of most peripheral vestibular disorders, more state-of-the-art trials are needed on the treatment of bilateral vestibulopathy to prove the efficacy of balance training, of vestibular neuritis (in terms of recovery of peripheral vestibular function and central compensation), of vestibular paroxysmia to prove the effects of carbamazepine, and of Menière's disease to find the optimal dosage of betahistine.
Primary Autoimmune Cerebellar Ataxia

Slobodan Apostolski, MD, PhD¹, Dušan Pavlović, MD², Sladjana Knežević Apostolski, MD¹, Ivana Dejanović, MD¹

¹Outpatient Neurological Clinic ‘Apostolski’,
²Hearing and Balance Center, Belgrade, Serbia

The cerebellum may be affected by immune mediated mechanism triggered by infection, gluten ingestion or by cancer. In some cases there is no obvious trigger factor for the development of immune mediated damage. These cases have been recognized as an organ specific autoimmune disease with the proposed term of Primary Autoimmune Cerebellar Ataxia (PACA).

We have examined and followed ten patients with late onset sporadic cerebellar ataxia. Six women (mean age, 55 yrs) and four men (mean age, 65 yrs) presented with slow progressive cerebellar ataxia. Two patients had associated autoimmune thyroid disease. In addition to dysarthria, dysmetria, macrographia, tremor, and severe ataxic gait three patients had downbeat nystagmus. The negative finding of antineuronal and antigliadin antibodies as well as normal finding of thoracic and abdominal CT scans excluded a paraneoplastic and gluten induced ataxia. Genetic testing did not find any mutation of genes specific for SCA. IEF revealed oligoclonal IgG bands in the CSF in one patient and parallel oligoclonal IgG bands in the serum and CSF, indicating systemic immune activation. The conventional brain MRI showed atrophic changes of the cerebellar vermis in six patients. In only two patients the disease was associated with specific autoantibodies, one of them had antibodies to Purkinje cells and another one had high titer of anti-glutamic acid decarboxylase (GAD) antibodies. In three out of five patients treated with 4-aminopyridine an immediate positive response was obtained with improvement of gait and downbeat nystagms. All patients have been treated with immunosuppressive drugs (prednisone and azathioprine) and only four of them with long-term immunosuppression (mean, 18 months) significantly improved. In another six patients short-term immunosuppression prevented the progression of the disease.

We recommend use of 4-aminopyridine in patients with downbeat nystagmus as well as immunosuppression in patients with late onset sporadic cerebellar ataxia of unknown origin, particularly in those with ant-GAD antibodies.
Nystagmus in Posterior Fossa Stroke Patients

Ksenija Ribarić Jankes¹, MD, PhD,
Ljiljana Beslać Bumbaširević², MD, PhD

¹Euromedic hospital, Belgrade, ²Emergency department,
Emergency center of the Clinical center of Serbia
and Institute of Neurology of the Clinical center of Serbia,
Medical Faculty Belgrade

A retrospective study of 723 in-patients admitted to the Neurological Emergency Department of the Clinical center of Serbia during the year 2013 was performed. Only 22 patients were hospitalized because of sudden vertigo and sudden unsteadiness as the dominant symptom of illness. Thirteen of them were diagnosed as Neuronitis vestibularis, 9 as Cerebral stroke. They were between 25 and 75 years old (5 female, 4 male).

At the moment of admission, each patient was seen by a neurologist and a computerized tomography (CT scan) was performed. Patients with vertigo were also seen by an ENT specialist-neurootologist. In some of them a magnetic resonance imaging (MR) was performed. Four patients had cerebellar, two mesencephalic, two pontine and one had thalamic cerebral infarction. The following neurotological signs were present: spontaneous horizontal nystagmus, spontaneous torsional nystagmus, gaze-evoked nystagmus, internuclear ophthalmoplegia, skew deviation and head tilt, unilateral canal paresis (HIT and caloric test), failure of fixation suppression.

Seven out of 9 patients had positive additional neurological signs: involvement of long pathways, other cranial nerve lesions (except vestibular nerve and abducens nerve) hemihypesthesia, dismetria. In two patients the suspicion of posterior fossa stroke was raised and confirmed only because of the presence of central vestibular impairment.

In conclusion, in patients with sudden vertigo and sudden unsteadiness careful searching for additional neurological signs has to be performed. If they are not present, the presence of central vestibular impairment decides of the cerebral stroke diagnosis. In patients with stroke, it is important to admit proper therapy and explore risk factors in order of second stroke prevention.
Evidence suggests that brainstem involvement in multiple sclerosis (MS) is one of the major predictive factors for future disability. Recent work demonstrates that brainstem pathology is more frequent than can be depicted either clinically or with the use of MRI. Evoked potentials have been shown to reliably predict disability in MS patients. Although the severity of each evoked potential score (visual evoked potentials and somatosensory evoked potentials) significantly correlates with the disability of the corresponding functional system, this was not the case with the brainstem evoked potentials (BAEP). This finding suggests that BAEP is insufficient in neurophysiological evaluation of the brainstem in MS. Our group has recently shown that vestibular evoked myogenic potentials (VEMPs) are the optimal method to detect brainstem lesions in MS and that they detect them significantly better than clinical examination, AEP or MRI. Simultaneous ocular VEMP (oVEMP) and cervical VEMP (cVEMP) tests may be a convenient screening tool for assessing crossed vestibulo-ocular reflex and ipsilateral sacculo-collic reflex in every MS patient because this is noninvasive and short diagnostic procedure with very low cost. Moreover, we developed the VEMP score (consisting of VEMPs latencies, conduction block and amplitude asymmetry ratio) that correlates well with disability of MS patients and disease duration ($P = 0.011$ and $P = 0.032$, respectively). In conclusion, interpretation of the oVEMP and cVEMP results in the form of the VEMP score enables better evaluation of brainstem involvement than either of these evoked potentials alone and correlates well with disability.
Persistent Geotropic Nystagmus – a Kind of Cupula Pathology

*Tatjana Tomanovic MD, PhD*¹, *Johan Bergenius MD, PhD*²

¹Department of Hearing and Balance Disorders, Karolinska Hospital, Solna, Sweden
²Department of Clinical Science, Intervention and Technology, Karolinska Institute, Stockholm, Sweden

In patients with positional vertigo a persistent direction-changing nystagmus (PDCN) of apogeotropic direction (a-PDCN) in the supine yaw plane has been described. We have described earlier in 2006 a *geotropic* persistent direction changing nystagmus (g-PDCN) in patients during vestibular crisis. On the assumption that a position dependent nystagmus such as persistent a-PDCN is caused by a heavy cupula in one of the lateral semicircular canals (LSCC), thus it could be hypothesized that a g-PDCN can be caused by the cupula that is lighter than the surrounding endolympha. We have called this new diagnostic entity “light cupula”.

The aim of this study was to examine subjective symptoms and characteristics of nystagmus in patients with persistent geotropic nystagmus using vestibular tests, as well as possible correlations to migraine in this group. We enrolled 20 patients with a mean age of 53 years. The slow phase velocity (SPV) of the geotropic nystagmus and the nystagmus with the patient’s head in the supine (S) and prone (P) positions was recorded. All patients completed caloric tests, SVH and VEMP. All tests were repeated at follow-up (FU). SPV of the geotropic nystagmus directed to the left was 5.5°/s and 3.5°/s to the right. In 72% of patients, nystagmus in the P position was opposite to that in the S position. The vestibular tests were pathologic in about 60%. At FU geotropic nystagmus was found in 40%, but was significantly less intense. The vestibular test results remained at the same level at FU. Recurrent vertigo was reported in 78% of the patients. Forty percent of the patients suffered from migraine.

Conclusion: Persistent geotropic nystagmus indicates a condition of a light cupula, which is accompanied by vestibular disability and a high incidence of pathological findings in the vestibular tests. The prevalence of migraine is high.
Acute Vestibular Syndrome

Siniša Maslovara, MD
General County Hospital Vukovar, Croatia

Acute vestibular syndrome (AVS) is usually the result of acute vestibular neuritis, but in some, fortunately rare cases, it may be the result of "Central vestibular pseudoneuritis", the consequences of a stroke in the vertebrobasilar circulation area or posterior cranial fossa. Despite the great advances in the diagnosis of dizzy patients, diagnosis of acute vestibular neuritis even today is actually clinical! Unfortunately, misdiagnosis in cases of "Central vestibular pseudoneuritis", which in the clinical picture often mimics acute vestibular neuritis is still not uncommon in the Emergency units.

Kattah and colleagues conducted a study in 2009 which found that the common sensitivity of three clinical test which they called with acronym HINTS (Head Impulse, and Nystagmus Test of Skew), obtained by multivariate logistic regression, in the first 24 hours of disease is higher than the MRI, which often unjustly considered completely reliable, at a ratio of 100%: 72%. It has been shown that a combination of these clinical tests confirmed 78% of peripheral lesion, and at the same time excludes 96% of acute stroke. They proposed also acronym INFARCT for three dangerous oculomotor signs that can be obtained when performing the above tests: Impulse Normal, Fast-phase Alternating and Refixation on Cover Test, which indicate strong likelihood of central lesions.
CANVAS – Cerebellar Ataxia, Neuropathy, Vestibular Areflexia Syndrome

Dušan Pavlović, MD

Hearing and Balance Center, Belgrade

Association of cerebellar ataxia and bilateral vestibulopathy (CABV) was first recognized as distinct syndrome in 2004. The same group of authors in 2011 described 18 CABV patients and recognized that peripheral neuropathy is also constitutional part of the same syndrome and renamed it to CANVAS - Cerebellar Ataxia, Neuropathy, Vestibular Areflexia Syndrome.

The main clinical presentation of this syndrome is instability. Usually, it has late onset (in 6th decade of life) and is equally distributed between sex. Very characteristic clinical sign is positive VVOR (Visually enhanced Vestibulo Ocular Reflex) or doll’s eye test. It’s the result of three non-functioning compensatory eye movements: smooth pursuit, VOR and OKR.

As a result of cerebellar dysfunction, patients has gaze evoked Ny or downbeat Ny; saccadic smooth pursuit, gait ataxia, cerebellar dysarthria and appendicular ataxia. MRI shows reduction of anterior and dorsal vermis and hemisferic crus I.

Positive head-impulse test shows absence of VOR.

Neuropathy is predominantly sensory and deficit in one or more of light touch, pin prick, vibration or proprioception is present. Nerve conduction studies demonstrate lack of SNAPs in both upper and lower limb. Autonomic neuropathy presents as postural hypotension, hypohidrosis or persistent cough.

I’ll present three patients with this syndrome.
EVAS as a Cause of Hearing Loss After Head Trauma

Dušan Pavlović, MD, Aleksandra Stojiljković, MSc (Audiology)

Hearing and Balance Center, Belgrade

EVAS usually represents with hearing loss in early childhood. Head trauma can deteriorate hearing.

We present a 17yr boy with no hearing problems, who after head trauma presented with complete deaf ear and complete vestibular loss at same ear. Mild conductive hearing loss at the other, good ear, rise suspicion and after getting VEMPs, CT confirmed enlarged vestibular aqueduct at both ears.

What’s surprising, that four months later the hearing returned. Now, it’s moderate sensorineural hearing loss.

We still don’t know the exact mechanism of hearing loss in this syndrome, especially how the hearing deteriorate after head trauma.

EVA syndrome is easily diagnosed with VEMP and radiologically confirmed.
Presentation of the Case of Vestibular Migraine
One More Look at the Often Underestimated Phenomenon

Dragoslava Jovanović, MD

Clinical-Hospital Centre, Zemun, Belgrade, Serbia

Introduction: In this work we have presented the case of vestibular migraine, phenomenon whose importance is more and more recognized in the later years, but which is still neglected in clinical practice, thus often remaining undiagnosed. Goal: The goal is to remind ourselves once again of the importance of this pathological phenomenon not so rare in practice that can be easily overlooked in neurological clinic. We will give illustration of the case of vestibular migraine proven with clinical and diagnostic methods and we will summarize our knowledge about this phenomenon, touching upon epidemiology, clinical presentation, pathophysiology and differential diagnosis as well as available options for therapy.

Methods: In accordance with the recommendations of the diagnostic guide recently jointly published by the Barany Society and the International Headache Society (3rd Revised Edition), clinical picture meeting the criteria for diagnosis of vestibular migraine, confirmed through clinical diagnosis carried out by means of “elimination”, that is, negative conclusions from additional methods for examination of differential diagnostic possibilities.

Results: Clearly defined clinical picture supported by physical findings. Verified dysfunction of the vestibular system is clearly connected in time with the manifestation of migraine symptoms. Additional examination excluded other possible causes of vestibular symptomatology and headache, which allowed for vestibular migraine diagnosis. We would like to draw attention to the fact that there was also a migraine aura as a part of this complicated and complex migraine as some kind of independent phenomenon of vestibular migraine.

Conclusion: With estimated incidence of some 1% in general population, vestibular migraine is a significant phenomenon which doctors, not only neurologists, encounter in their daily practice, and which however often remains undetected, that is, misdiagnosed, during which time patients are receiving wrong therapy. In view of adequate diagnosis, correct differential diagnostic thinking is crucial as a necessary precondition for application of some of the therapy protocols.
What is the Cause?
Balance Problem With Many Possible Underlying Causes

Manja Hribar, MD, Špela Kordiš, MD, Nina Božanić Urbančič, MD, Saba Battelino, MD, PhD

University Clinical Centre of Ljubljana, Clinic of ENT and CFS
Ljubljana, dept. of Audiovestibulogy

Many times the diagnosis of vertigo is not straightforward as there are many possible underlying causes. This case report documents a 56-years old woman with a short history of balance problems, left sensorineural hearing loss, bilateral tinnitus, left ear pain and one episode of a severe headache. She described her problems as a feeling of imbalance and as she was falling or leaning to one side during walking. She denied having typical spinning vertigo. In clinical otoneurological examination no pathological findings were observed. Audiometry and the bithermal caloric vestibular test revealed mild left sided sensorineural hearing loss and less excitable left vestibular organ. The latter can be explained as paresis of the left vestibular organ or as hyperexcitability of the right vestibular organ. Magnetic resonance imaging of the head showed right-sided superior canal dehiscence (SCD), compression of the right vestibulocochlear nerve by a vessel, thinner right vestibular nerve and a small ischemic stroke in the left cerebellar peduncle. Regarding all the pathologies observed by the above mentioned investigations, there are several possible causes for her condition. She was treated with betahistine and vestibular rehabilitation exercises. As her balance problems gradually resolved within one year, the true underlying cause still remains unknown.
EMBalance Project: Computer Simulation of Hot Caloric Test and Fluid Motion in the Three Semicircular Canal

Nenad Filipović, Eng PhD, Igor Saveljić and Žarko Milošević

Bioengineering Research and Development Center Kragujevac, University of Kragujevac

The FP7 EMBalance project aims to extend existing but generic and currently uncoupled balance modelling activities leading to a multi-scale and patient-specific balance Hypermodel, which will be incorporated to a Decision Support System, towards the early diagnosis, prediction and the efficient treatment planning of balance disorders. Various data will feed the intelligent system increasing the dimensionality and personalization of the system. Human Computer Interaction techniques will be utilized in order to develop the required interfaces in a user-intuitive and efficient way, while interoperable web-services will enhance the accessibility and acceptance of the system. The vision extends to the experimental and clinical validation of the project outcomes with existing and newly acquired data (by conducting small scale clinical trials), and includes showcases in balance disorders diagnosis, prediction, treatment and follow-up in normal and micro-gravity environments. In this study we investigated the hot caloric test response in the three semicircular canals using coupled fluid flow, natural convection and fluid-structure interaction with the finite element method. We demonstrated that the temperature distribution of the horizontal canal duct is more dominant and a longer period of irrigation time is required in order to stimulate the two other vertical canals. Our results also show shear stress and force distribution from endolymph flow during natural convection. Future studies are necessary for validation of the presented computer model with clinical measurements.
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