

### Basic Tutorials (English)

#### T1

#### **TECHNICAL BASICS: IMAGING AND DOPPLER ULTRASOUND**

*R. Brucher (Germany)*

Experience during almost four decades and more has shown that diagnostic ultrasound has no serious side-effects. However, for correctly applying ultrasound with the lowest risk ultrasound physics, transducer technology and the most important features used for insonation should be known especially for long-term monitoring. The power output can be very different using modes of insonation like as A-Scan, B-scan which can possibly increase the risk/benefit ratio. E.g. TIC-index (tissue heating by power output) should be as low as possible using small sample volumes, low PRF, low burst amplitude etc. Today for 2D-imaging of vascular diseases different ultrasound techniques are used. B-Mode imaging shows tissue structure in a brightness greyscale in real-time as cross-sectional pictures. For flow information colour-coded mean velocity is added to the B-mode images to eliminate aliasing effects during high flow situations. Combining these techniques with Power Doppler, spectral Doppler or with newer technology such as B-flow will increasingly provide more reliable diagnoses. For detailed flow information during monitoring spectral Doppler instrumentation is now established. Recently extended Doppler techniques such as M-Mode, power Doppler and neuronal networks have increased the reliability especially in monitoring embolic events. Extended applications applying more than one transmitting frequency may also allow differentiating between solid and gaseous emboli. For long-term monitoring of the cerebral circulation also fixations of the US-transducer at the temporal bone which are already on the market have to be optimized. Here manual fixation has several weaknesses but robotic technology should lead to improvements in the near future to establish automatic long-term monitoring in the clinical routine e.g. stroke units.

#### T2

#### **CAROTID ARTERIES: CLASSIFICATION OF STENOSIS**

*J. Klingelhöfer (Germany)*

The classification of internal carotid artery stenosis is of great impact. The degree of stenosis is the main criterion for the decision between an invasive or non-invasive treatment of extracranial internal carotid artery stenoses. By now the NASCET criteria have been internationally approved for radiological grading. Accordingly to NASCET the stenosed lumen is compared with the lumen of the distal internal carotid artery. All ultrasound criteria do have limitations and can therefore cause pitfalls in determining the degree of stenosis using one criterion exclusively. Therefore a multi-parametric grading of stenoses should be favored. The multi-parametric "DEGUM ultrasound criteria" have been revised and a novel differentiation between main (primary) and additional (secondary) criteria has been proposed (Ultraschall in Med 2010; 31:251-257). The differentiation between main and additional criteria is caused by their different reliability. Main criteria include the following: Imaging of the stenosis in B-mode sonography; visualization of the stenosis by color-coded imaging of flow; measurement of the maximum systolic flow velocity in the area of greatest narrowing of the lumen; systolic flow velocity measurement in the poststenotic segment; assessment of the collateral supply. Additional criteria include the following: Indirect findings of an internal carotid artery stenosis in the common carotid artery; evidence of flow disturbances; end-diastolic flow velocity in the area of greatest narrowing of the lumen; the so-called confetti-sign; the carotid ratio. The main advantage of a multi-parametric grading of internal carotid artery stenoses is the synergetic effect of the different single criterion. Combining these ultrasound criteria, neurosonography allows reliable grading of carotid stenoses as a basis for decision making.

#### T3

#### **SONOGRAPHY OF THE VERTEBRAL ARTERIES**

*G. Baltgaile (Latvia)*

Basic knowledge in the field of sonography of the vertebral arteries will be presented, specific pitfalls and recent proceedings will be discussed in detail.

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**T4  
TRANSCRANIAL DUPLEX SONOGRAPHY**

*R. Dittrich (Germany)*

The tutorial „Transcranial colour-coded Duplex Sonography“ (TCCD) is an introduction into the field of transcranial neurovascular ultrasound. The course will start with the anatomy of the basal intracranial arteries and the circle of Willis. Therefore, the first step is the correct identification of the basal intracerebral arteries and their different segments. The second step is the measurement of the normal flow velocities. Afterwards there will be an introduction into the pathological key findings of arterial stenosis, arterial occlusion and vasospasm. In particular, the significance of TCCD in acute stroke and collateral flow patterns will be discussed. Furthermore, the recent proceedings in the emerging field of sonothrombolysis will be presented.

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**T5  
MUSCULOSKELETAL ULTRASOUND**

*S. A. Gilani (Pakistan)*

1. Upper Limb Ultrasound
  - Shoulder Ultrasound; Rotator cuff and Non-Rotator cuff, anatomy, techniques and pathologies are discussed.
  - Elbow Ultrasound; Extensor and flexor compartments and their normal appearance and pathologies are discussed.
  - Wrist Ultrasound; Wrist tendons and median and ulnar nerves with their pathologies are discussed.
  - Hand Ultrasound; Muscles and tendons of hand are discussed in detail with some pathological cases.
2. Lower Limb Ultrasound
  - Hip Ultrasound; Normal appearance of bursae, tendons and joint effusion is discussed.
  - Knee Ultrasound; Normal and pathologies of Muscles, tendons, bursae are discussed.
  - Ankle Ultrasound; Tendons of all compartments of ankle and some pathologies of ligaments are discussed.
  - Foot Ultrasound; Foot pathologies and plantar fasciitis is discussed.
3. Advantages of Musculoskeletal Ultrasound:
  - Non-invasive
  - Dynamic Study (stress can be applied)
  - inexpensive (vs MRI)
  - quick examination time
  - Bilateral comparison
  - patient acceptance
  - serial examinations can be preformed to monitor changes over time (e.g..with or without therapy).
4. Limitations of Musculoskeletal Ultrasound:
  - Very operator dependent
  - long learning curve: depends greatly on the experience and expertise of the operator
  - Competition with an established modality

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**Basic Tutorials (German)**

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**T6  
TECHNISCHE GRUNDLAGEN / TECHNICAL BASICS**

*M. Siebler (Germany)*

Ultrasonography has been proven to be an important clinical tool providing highly useful clinical information with excellent reliability. Basic knowledge about technical and physical background of Doppler- and Duplex-sonography is mandatory for tapping the full potential of the method and avoiding misinterpretation. Particularly generation, dispersion and general properties of ultrasonic waves will be illustrated.

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**T7  
A. CAROTIS: UNTERSUCHUNGSTECHNIK, IMT UND FALLSTRICKE / CAROTID ARTERY: EXAMINATION TECHNIQUE, INTIMA-MEDIA THICKNESS, PITFALLS**

*D. Sander (Germany)*

The tutorial that will be held in German is subdivided into 3 parts: The first part focussed on the examination technique to investigate the carotid system using high resolution duplex ultrasonography. The second part gives an overview of the techniques to optimize IMT measurements including the discussion of automatic IMT detection systems. Additionally, a critical overview concerning the usefulness of IMT measurements as a surrogate parameter for clinical endpoints and as a possible tool for cardiovascular risk stratification will be given. In this framework, recent study data concerning IMT were presented. The third part of the tutorial discussed possible pitfalls for the examination of the carotid system including IMT measurements that will be presented with several clinical examples. Participants of the tutorial should have basic experience in the investigation of the carotid system using duplex ultrasonography.

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**T8  
VERTEBRALARTERIEN: UNTERSUCHUNG UND FALLSTRICKE / VERTEBRAL ARTERIES: EXAMINATION AND PITFALLS**

*M. A. Ritter (Germany)*

The examination of the vertebro-basilar circulation is nowadays mainly a duplex-sonography based method. For special indications however, the Doppler sonography remains an important supplemental method. The basic examination includes the investigation of the V1- and V2-segments in the interforaminal segments including the measurement of angle corrected flow velocities and the display of the flow spectrum. The determination of the vessel diameter is mandatory. Intracranially, the V4 and V5 (distal to the branching of the PICA) and the vertebro -basilar junction must be investigated. The basilar artery must be followed to the most distal parts that can be insonated. Here, the Doppler sonography frequently allows detection of sufficient flow spectra in greater depths than

the color-coded mode. The V0-Segment also remains a black spot for many cases. A sector probe may help overcome this problem. Especially for the transnuchal approach, echo contrast agents may be of help to establish a diagnosis. A frequent pitfall is hypoplasia of one vertebral artery, which can lead to a large spectrum of seemingly pathological flow spectra. Stenosis of the subclavian artery may cause an incomplete or complete "subclavian steal" effect with quite uncertain clinical significance in most cases. Proximal occlusions may be present without pathological flow spectra in the V2-segment due to collaterals from the neck arteries. A very dorsal location of the V0-segment and frequent elongations of the V1-segment further complicate the investigation of the proximal part of the vertebral artery.

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#### **T9**

#### **A. CAROTIS: STENOSEKLASSIFIKATION / CLASSIFICATION AND GRADING OF CAROTID STENOSIS**

*G.-M. von Reutern (Germany)*

With 3 positive carotid surgery trials precise measurement became essential. The aim of this presentation is to discuss the most important variables. Morphology and method of anatomical measurement: The hemodynamic effect of a stenosis is linked to the area reduction. Most methods however measure diameter reduction: The reference for giving % reduction of diameter or area is either the original local diameter (ECST) or the diameter distal to the stenosis (NASCET). Velocity in a stenosis is the most accepted criterion. Many variables influencing velocities have to be considered. 1. The stenotic jet represents often only a small portion of the registered velocities within the spectrum making it difficult to detect the highest frequencies. 2. Angle correction: Doppler shifted frequencies can be converted into velocities taking in account the incident angle of insonation. This can be inaccurate due to irregularly diverging streamlines resulting in overestimation of degree of stenosis. 3. Vessel geometry: The velocity profile is skewed in case of vessel curvature or kinking. 4. Hemodynamic considerations: Velocities increase with increasing narrowing (Venturi effect). In nearly occluded arteries on the other side highly variable velocities can be seen. This creates ambiguity. The role of collaterals: Flow volume through a stenosis and velocities are depending on the pressure gradient. The pressure gradient is dependent on the collateral supply. Poststenotic pressure drop is high with insufficient collateral flow. Patients exist with insufficient collateral supply resulting in higher velocities at the site of stenosis and vice versa. This is the main factor for a wide range of velocities to be found in severe stenoses of equal morphologic appearance. The following criteria should be combined: Extra- and intracranial collateral flow. Prestenotic reduction of flow velocity (side to side comparison CCA). Intrastenotic flow velocity (peak systolic velocity (maximum frequency)). Poststenotic flow velocity and vessel diameter reduction. Vessel diameter and plaque morphology as visualized by B-Mode imaging. In a recent publication (Arning et al: *Ultraschall in Med* 2010, 251 ff) these criteria have been adapted to modern Duplex-sonography and categorized in a hierarchical order. This will be discussed in detail.

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#### **T10**

#### **TRANSKRANIELLE DUPLEXSONOGRAPHIE: TECHNIK UND PATHOLOGISCHE BEFUNDE / TRANSCRANIAL DUPLEXSONOGRAPHIE: TECHNIQUE AND PATHOLOGICAL FINDINGS**

*F. Schlachetzki (Germany)*

Transcranial color-coded duplex sonography (TCCS) is a noninvasive and flexible method for vascular and parenchymal imaging of the adult brain, and adds important complementary to cCT and MRI including their angiographic modes. The low frequency phased array transducer can be optimized for B-Mode and color Doppler imaging according to the basic ultrasound physics and the specific properties of the temporal bone window. Defined transcranial image planes are important for the identification of the major intracranial arteries including their variations. TCCS may rapidly identify occlusions and stenosis of major cerebral arteries and directly or indirectly assess the sufficiency of collateral flow. While transcranial B-mode sonography appears superfluous when focusing on vascular diagnosis basic knowledge can help to avoid pitfalls in vessel identification. Ultrasound contrast agents have had a tremendous impact on TCCS application and are used in cases of unfavorable acoustic bone windows resulting in superior signal-to-noise and result in high and fast diagnostic confidence. This basic tutorial is aimed to guide the unexperienced sonographer to valid and important findings in intracranial cerebrovascular disease.

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### **Basic Tutorials: Technicians**

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#### **T11**

#### **THE TECHNICIANS' VIEW – ROUND TABLE DISCUSSION**

*B. Eckenweber, C. Leege, T. Rhiel (Germany)*

Around table, to discuss the specific situation of technicians in Europe. Topics include the field of responsibility, hierarchic organization, documentation of diagnostic findings and financial and legal issues in different European countries.

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#### **T12**

#### **UNTERSUCHUNG DES KAROTISSTROMGEBIETS / EXAMINATION OF CAROTID ARTERIES**

*M. Jauss (Germany)*

Incidence of cerebrovascular events and efficacy of surgical treatment of carotid artery depends on severity of stenosis. Clinical trials were performed with patient selection using digital subtraction angiography, however, current evaluation of patients with carotid artery disease relies nearly exclusively on non invasive techniques such as CT / MRI angiography, color coded duplex and doppler sonography. There were recent attempts to correlate neurosonological parameters with angiographically defined values for classification of carotid stenosis. The multi-parametric "DEGUM ultrasound criteria"

(Arning 2010) consisting of combined doppler and duplex criteria have consequently been revised and transferred to the NASCET definition. In addition, a novel differentiation between main (primary) and additional (secondary) criteria will be presented and discussed with extensive presentation of patient cases supported with examples of ultrasound examination with respect to technical details for optimized examination technique.

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### T13

#### **UNTERSUCHUNG DER VERTEBRALARTERIEN / THE VERTEBROVASCULAR CIRCULATION: PATHOLOGICAL FINDINGS AND THEIR CLINICAL IMPACT ON PATIENT MANAGEMENT**

*K. Gröschel (Germany)*

Vertebrobasilar strokes occur in up to 20 % among all ischemic strokes (1), and might even be often underdiagnosed due to unspecific clinical symptoms such as dizziness or vertigo. The etiology of vertebrobasilar strokes differs from that within the anterior circulation, since especially an atherosclerotic burden has been found to occur more frequently in the former. Moreover, it could be shown that a stenosis in the posterior circulation bears a higher risk for subsequent strokes as compared to a stenosis in the anterior circulation (2). Therefore, vertebrobasilar strokes necessitate a thorough diagnostic workup to identify a potential stenosis within the posterior circulation. Due to the non-invasive nature of duplex sonography, this diagnostic tool is of particular interest because the complete vertebrobasilar circulation may be assessed. Over the past years, especially the treatment of extra- and intracranial vertebrobasilar stenoses has undergone further developments therefore yielding a possible therapeutic option in case of pathological findings. In order to avoid redundant diagnostic procedures which might even be of a potential risk for the patient (e.g. conventional angiography), a high quality of duplex sonography has a major impact especially in the serial longterm follow-up of patients with vertebrobasilar pathological findings.

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### T14

#### **TRANSKRANIELLE DUPLEXSONOGRAPHIE / TRANSCRANIAL DUPLEXSONOGRAPHY**

*E. Stolz (Germany)*

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## **Advanced Tutorials: Theory**

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### T15

#### **PFO**

*S. Horner (Austria)*

Patients with cryptogenic stroke should be screened for possible paradoxical cerebral embolism via a cardiac or pulmonary right-to-left shunt (RLS). Diagnostic studies that can identify a PFO or an atrial septal aneurysm may be considered for prognostic purposes. Contrast-enhanced transcranial Doppler sonography (cTCD) has a sensitivity that is comparable to contrast echocardiography for detection of a PFO with RLS. Its diagnostic sensitivity ranges from 70% to 100% and the specificity is more than 95%. However, there are many parameters influencing the sensitivity of the method: setting of the ultrasound instrumentation, the choice and mode of application of the contrast agent, the size of the cardiac shunt, shunting via extracardial shunts and performance of the valsalva manoeuvre. Uncertainties exist regarding optimal treatment. Although international guidelines recommend antiplatelet therapy as first line strategy for treating stroke patients with PFO, transcatheter closure has become common practice and is one of the most frequent interventional procedures performed in adult congenital heart disease. The main purpose of this tutorial is to present recommendations on a standardized examination protocol for RLS detection using cTCD and to discuss the treatment strategies.

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### T16

#### **THE INTRA- AND EXTRACRANIAL VENOUS SYSTEM ASSESSED BY COLOR-CODED DUPLEX SONOGRAPHY**

*J. Valdueza (Germany)*

Venous vessels are involved in primarily venous disorders like cerebral sinus and venous thrombosis but also in a variety of primarily non venous pathologies, e.g. arterio-venous malformations, dural fistulas and transient global amnesia. Recently a chronic impaired venous outflow from the central nervous system has claimed to be associated with multiple sclerosis pathology. A concept of a "chronic cerebrospinal venous insufficiency" (CCSVI) has been elaborated which is based on five extra- and transcranial duplex sonography criteria proposed by Zamboni and coworkers. The prevalence of  $\geq 2$  of these criteria should perfectly match with the diagnosis of MS with 100% sensitivity, specificity, positive and negative predictive value. For different reasons the selection seems very subjective and problematic but even when using this five criteria their data could not be reproduced by other investigators. **Aim of the lecture** is 1) to give an overview about the ultrasound examination of the intra- and extracranial venous circulation using color-coded duplex sonography, and, 2) to focus on its usefulness in cerebral sinus and venous thrombosis, transient global amnesia and multiple sclerosis.

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**T17****CEREBRAL PARENCHYMA***U. Walter (Germany)*

Transcranial B-mode sonography (TCS) is a non-invasive, low-cost, short-duration neuroimaging method that allows high-resolution imaging of deep brain structures in patients with movement disorders. With contemporary high-end ultrasound systems, image resolution of echogenic deep brain structures can even be higher on TCS than on MRI. On TCS, about 90% of patients with idiopathic Parkinson's disease (PD) exhibit abnormal hyperechogenicity of the substantia nigra (SN). This finding is already present in presymptomatic disease stages, suggesting TCS as a screening tool for populations at risk of later developing PD. Meanwhile, a number of independent TCS studies have shown that SN hyperechogenicity well discriminates PD from other Parkinsonian disorders such as multiple-system atrophy, vascular Parkinsonism and welding-related Parkinsonism. In turn, normal SN echogenicity in combination with lenticular nucleus hyperechogenicity indicates an atypical Parkinsonian syndrome rather than PD with a specificity and positive predictive value of more than 95%. TCS detects characteristic basal ganglia changes also in other movement disorders such as lenticular nucleus hyperechogenicity in idiopathic dystonia and Wilson's disease and caudate nucleus hyperechogenicity in Huntington's disease. The TCS finding of reduced echogenicity of midbrain raphe is frequent in depressive disorders and was found to correlate with responsiveness to serotonin reuptake inhibitors. Emerging applications of TCS are the intra- and postoperative localization of deep brain stimulation electrodes in patients with movement disorders, the detection of changes of deep brain structures in multiple sclerosis patients that may have a predictive value for further disease progression, as well as the characterisation of basal ganglia alterations in children with neurobehavioral disorders.'

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**T18****VASOMOTOR REACTIVITY***B. Zvan (Slovenia)*

Advanced knowledge in the field of vasomotoric reactivity will be presented, specific pitfalls and recent proceedings will be discussed in detail.

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**Advanced Tutorials:  
Practical Demonstrations**

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**T19****CEREBRAL PERFUSION***G. Seidel (Germany)*

This presentation will give an overview of state-of-the-art contrast-specific imaging techniques for perfusion imaging of the brain. The general indication for the use of ultrasound contrast agents in neurosonology is an insufficient signal-to-noise ratio when investigating the cerebral macro- and microcirculation. Ultrasound contrast imaging also allows assessment of the cerebral microcirculation. There are a number of techniques available for performing perfusion studies of the brain, which are clinically useful in acute ischemic stroke. These generally utilize high mechanical index imaging, since until recently lower acoustic outputs were unable to detect microbubbles in the brain. New-generation microbubbles in combination with very sensitive contrast-specific ultrasound techniques now enable real-time visualization of cerebral microcirculation. Moreover, destruction sequences with assessment of microbubble replenishment using real-time, low mechanical index imaging are now available. These new technique allow ultrasound contrast agent specific evaluation of cerebral microcirculation (microvascular imaging) with low investigation time and analysis of perfusion in multiple imaging planes with one contrast bolus injection.

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**T20****PLAQUE PERFUSION***K. Stock (Germany)*

Plaque imaging using contrast enhanced ultrasound should only be provided after a careful, conventional Doppler ultrasound study of the carotid arteries. Plaque perfusion in the carotid arteries can be visualized with commercial microbubble contrast solution administered by an experienced ultrasound operator imaging with premium ultrasound equipment. We recommend that the patient sign informed consent before the exam. The (clinically) successful administration of intravenous contrast agents requires some training. The examination is optimally effected by a team with one member performing the ultrasound examination and another (doctor or nurse) assisting by assuming responsibility for the microbubble injection. The ultrasound data should be electronically stored (video clip) for later re-evaluation. Complications after ultrasound contrast media injection are rare; nevertheless the examination team should be prepared, and an emergency drug kit should be available throughout for the doctor whose training in resuscitation should be up to date.

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**T21**  
**PERIPHERAL NERVES**

*H. Kele (Germany)*

With improvements in ultrasound (US) imaging equipment and refinements in scanning technique, an increasing number of peripheral nerves and related pathologic conditions can be identified. Modern US imaging supports the clinical examination and electrophysiologic testing in setting the diagnosis, and enhances this functional information by illuminating the morphological aspects and etiology of peripheral nerve pathology. US can readily be used for detection of nerve abnormalities caused by trauma, tumors, inflammation and a variety of nonneoplastic conditions, including compressive neuropathies. Well recognized advantages of this technique in this field are: the possibility of realizing a dynamic examination and assessing long nerves segments in a short time; it is bedside-available, non-invasive and low cost. The potential of US nerve imaging in specific clinical settings is presented by a series of US images and videos of diverse pathologic processes involving peripheral nerves.

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**T22**  
**TRANSCRANIAL DUPLEX SONOGRAPHY,  
PATHOLOGICAL CASES**

*M. Jauss (Germany)*

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**TEVA Pre-Conference Lunch-Symposium**

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**HOW TO FIND A PARKINSON PATIENT?  
UPDATE ON DIAGNOSTIC OPTIONS****LS 1**

*U. Walter (Germany)*

The very early application of a pharmaceutical that has been proven to change the developmental course of Parkinson's disease (PD) after 72 weeks' treatment promises an improved quality of life of patients affected by PD. Furthermore, pathogenesis-targeted neuroprotective therapies are being developed for future use in at-risk populations, even before clinical onset of disease. That is why there is an urgent need for diagnostic strategies allowing the identification of preclinical stages of PD. Beside the advances in clinical recognition of early symptoms and signs, the development of new neuroimaging probes and technologies, the identification of genes associated with predisposition of PD, and the results of epidemiologic studies progressively improve our ability to detect subjects at increased risk of developing PD. In this concert, transcranial B-mode sonography (TCS) is an interesting non-invasive imaging tool for the early detection of deep brain changes associated with an increased risk of PD. On TCS, about 90% of patients with idiopathic PD exhibit abnormal hyperechogenicity of the substantia nigra. This finding is already present in presymptomatic disease stages, suggesting TCS

as a screening tool for populations at risk of later developing PD. The TCS finding of substantia nigra hyperechogenicity also well discriminates PD from other Parkinsonian disorders such as multiple-system atrophy, vascular Parkinsonism and welding-related Parkinsonism. Preliminary results of ongoing studies suggest that the combined presence of substantia nigra hyperechogenicity with other preclinical signs, such as subtle motor asymmetry and hyposmia, and/or a positive family history of PD indicate a high risk of subsequent manifestation of PD.

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**LS 2**

*J. Winkler (Germany)*

The understanding on early neurodegenerative processes in Parkinson's disease (PD) has increased significantly. Early pre-motor symptoms, also called non-motor symptoms, precede the onset of the motor symptoms in PD. These non-motor symptoms consist of hyposmia, sleep disturbances, depressive symptoms, behavioural or emotional dysfunction, constipation, urinary dysfunction, orthostatic hypotension, and chronic joint as well as muscle pain. The majority of pre-motor symptoms may be related to structural changes of lower brainstem nuclei and the peripheral nervous system including the autonomic and enteric ganglia. Based on this concept, motor symptoms predominantly related to the substantia nigra may reflect rather an intermediate stage of a disease process. In contrast, the clinical diagnosis of PD relies still exclusively on motor symptoms such as bradykinesia, rigor, resting tremor, and postural instability. Thus, the focus on diagnostic work up needs to be shifted from the category of motor impairment in PD towards the subtle underlying continuum of the pre-motor stage in PD. To identify patients having the risk to develop later in life PD, it will be crucial to develop a PD risk score. This is the first means not only to define individuals who are most likely to develop the motor symptoms at a later stage, but more importantly will be the first to benefit from disease modifying approaches. It will be important to develop a consensus with regard of sensitivity and specificity of different screening batteries. Based on this conceptual frame work different approaches to move closer to a pre-motor diagnosis will be presented including a stepwise diagnostic work up consisting of standardized questionnaires, non-invasive investigations, functional and structural assessments, including imaging studies. The combined sequence of standardized clinical, neurophysiological, and neuroimaging examinations will enable us to identify individuals at the earliest stages of PD.

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## Session I: Heart & Brain

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### S1

#### CONTRIBUTION OF MICROEMBOLIC SIGNAL DETECTION IN CARDIOEMBOLIC STROKE

M. A. Ritter

UKM Münster, Department of Neurology, Münster, Germany

Microembolic signals (MES) are less frequent after cardioembolic stroke than after stroke due to carotid stenosis with frequencies reported between 15 and 38%. In contrast to MES from carotid stenosis, MES in cardioembolic stroke are usually detectable in both hemispheres.

Potential cardiac sources of embolism have been investigated to various extents in conjunction with MES to define the risk of future stroke and to guide therapeutic decisions.

MES from prosthetic heart valves and during cardiothoracic surgery have been most extensively studied. In cases of prosthetic heart valves the frequency of MES depends largely on the valve type. MES are mainly gaseous and the risk of stroke is not correlated to the presence and number of MES.

During cardiac surgery the number of MES is high, and the number of MES is correlated with post-operative cognitive impairment. In patients with atrial fibrillation (AF), the frequency of MES is correlated with the number of additional risk factors and is reduced by effective anticoagulation. No study has yet determined whether MES in AF are predictive of future stroke. MES occurred in 17% of patients with acute myocardial infarction in one study and were predictive of future stroke. In patients with intracardiac thrombi or left ventricular aneurysm, MES prevalence was 26% and 34%, respectively.

In summary, MES document an increased risk of clinical overt stroke in patients with cardiac sources of embolism. Whether MES in cardiac sources of embolism should influence clinical management remains to be determined.

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### S2

#### ATRIAL FIBRILLATION: NEW DRUGS FOR STROKE PREVENTION

D. Russell

Oslo University Hospital - Rikshospitalet, Department of Neurology, Oslo, Norway

Atrial fibrillation (AF) affects more than 6 million European Union Citizens. The most catastrophic complication of AF is an embolic stroke and AF is the cause of 15% of all ischemic strokes. Marevan plays a central role in the prevention of stroke in AF. However, it has several limitations including a slow onset and offset of antithrombotic effect, a narrow therapeutic index, many pharmacokinetic and pharmacodynamic interactions, and a variable and unpredictable antithrombotic effect, all of which necessitate regular monitoring and dose adjustments. Novel anticoagulants that selectively block specific pathways of the coagulation cascade have demonstrated efficacy and safety. In the RE-LY study, dabigatran 110 mg b.i.d. was noninferior to Marevan for the prevention of stroke and systemic embolism with lower rates of major bleeding, whilst dabigatran 150 mg

b.i.d. was associated with lower rates of stroke and systemic embolism with similar rates of major hemorrhage, compared with Marevan. In the ROCKET AF trial, rivaroxaban 20 mg once daily was shown noninferior to Marevan in reducing all-cause stroke and non-central nervous system embolism in AF patients, with a similar rate of major bleeding. These new oral anticoagulants have important advantages over Marevan which may lead to improved adherence with anticoagulant regimens in AF.

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### O1

#### ATRIAL FIBRILLATION: ENHANCED DETECTION RATES BY PROLONGED HOLTER MONITORING IN STROKE PATIENTS

B. Görlicke<sup>1</sup>; R. Stahrenberg<sup>2</sup>; M. Weber-Krüger<sup>2</sup>; J. Seegers<sup>2</sup>; F. Edelmann<sup>2</sup>; R. Lahno<sup>2</sup>; B. Haase<sup>2</sup>; M. Mende<sup>3</sup>; J. Wohlfahrt<sup>4</sup>; P. Kermer<sup>1</sup>; D. Vollmann<sup>2</sup>; G. Hasenfuß<sup>2</sup>; R. Wachter<sup>2</sup>; K. Gröschel<sup>1</sup>

<sup>1</sup>Universitätsmedizin Göttingen, Neurologie, Göttingen, Germany; <sup>2</sup>Universitätsmedizin Göttingen, Kardiologie und Pneumologie, Göttingen, Germany; <sup>3</sup>Universität Leipzig, Coordination Center for Clinical Trials, Leipzig, Germany; <sup>4</sup>Universitätsmedizin Göttingen, Neurologie, Göttingen, Germany

**Background:** Atrial fibrillation is an established risk factor for cerebral ischemia and is, if detected, an important reason to treat those patients with oral anticoagulation. Standard care of patients with ischemic stroke free from atrial fibrillation on admission includes a 24-hour Holter monitoring. However, paroxysmal atrial fibrillation may not occur during this interval. The aim of this study was to compare the diagnostic yield of an early initiated and prolonged continuous Holter monitoring with that of the standard procedure of 24-h Holter monitoring.

**Methods:** In this single-center prospective observational trial (Find-AF trial), consecutive patients presenting with symptoms of cerebral ischemia were included. Patients free from atrial fibrillation on admission received a prolonged and early initiated 7-day Holter monitoring. **Results:** Of 281 patients included, 44 (15,7%) showed atrial fibrillation on admission. The remaining patients received Holter monitors. Prolonged Holter monitoring significantly increased the detection rate of atrial fibrillation from 4,8% (mean of seven 24-hour intervals) and 6,4% (mean of six 48-hour intervals) up to 12,5% (7 days, P=0,015 and P=0,023). Of those 28 patients with new atrial fibrillation on Holter monitoring, 15 (6.7% of all) had been discharged without therapeutic anticoagulation after routine clinical care. Diagnostic yield appeared to be only slightly and not significantly increased during the first 3 days after the index event. **Conclusions:** Detection of atrial fibrillation in those patients plays a pivotal role in therapeutic decisions concerning oral anticoagulation. Prolonged Holter monitoring significantly improves the detection rate of atrial fibrillation in patients with ischemic stroke leading to a change of therapy in a substantial number of patients. Thus, prolonged Holter monitoring seems to be recommendable for all patients with unexplained ischemic stroke.

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## O2

### EMBOLE DETECTION DURING BALLOON ATRIAL SEPTOSTOMY IN NEONATES WITH COMPLEX CONGENITAL HEART DISEASE

S. Wallace<sup>1</sup>; G. Døhlen<sup>2</sup>; C. Lund<sup>1</sup>; R. Brucher<sup>3</sup>; D. Russell<sup>1</sup>

<sup>1</sup>Oslo University Hospital - Rikshospitalet, Dept of Neurology, Oslo, Norway; <sup>2</sup>Oslo University Hospital - Rikshospitalet, Dept of Pediatric Cardiology, Oslo, Norway; <sup>3</sup>Ulm University of Applied Sciences, Dept of Medical Engineering, Ulm, Germany

**Background:** Brain injury before corrective cardiac surgery is an increasingly recognized phenomenon in babies born with complex congenital heart disease. In newborn patients with Transposition of the Great Arteries (TGA) recent reports associate radiological evidence of embolic brain injury with balloon atrial septostomy (BAS), a procedure in which a balloon catheter is used to enlarge the foramen ovale, prior to definitive surgery, improving systemic oxygen saturation. The aim of this on-going study is to use transcranial Doppler (TCD) to directly monitor for evidence of emboli during BAS, in addition to MRI.

**Methods:** To date 10 newborn infants have taken part in this prospective study. All infants were cannulated via the umbilical vein. Unilateral, multifrequency, multigate TCD monitoring of the middle cerebral artery was used to detect emboli during BAS on the first day of life. Infants were then studied with MRI (DWI and T2 imaging) before surgery. **Results:** TCD monitoring has not detected embolic signals directly under BAS. Evidence of embolic injury on MR-DWI has been detected in only one patient: 1 lesion in the posterior circulation territory. No other pathological findings are reported. **Conclusions:** In patients with TGA, the right ventricle communicates directly with the aorta. These patients are therefore at increased risk of cerebral embolus. Emboli could potentially arise from a number of sources, including intravenous access administration of medications and interventional catheterization. To date, we have found no direct relationship between BAS and preoperative embolic brain injury.

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## O3

### EMBOLE MECHANISM IN PATHOGENESIS OF TRANSIENT ISCHEMIC ATTACKS OF BRAIN-ULTRASOUND STUDY.

Z. Jovanovic<sup>1</sup>; A. Pavlovic<sup>1</sup>; B. Vujisic Tescic<sup>2</sup>; M. Kostic Boricic<sup>2</sup>; E. Cvitan<sup>1</sup>; M. Mijajlovic<sup>1</sup>; A. Sundic<sup>1</sup>; N. Sternic Covickovic<sup>1</sup>

<sup>1</sup>Clinic of Neurology Clinical Center of Serbia, Cerebrovascular diseases, Belgrade, Serbia; <sup>2</sup>Institute of Cardiology Clinical Center of Serbia, Echocardiology, Belgrade, Serbia

**Background:** Testing embolic mechanism of transient ischemic attacks (TIAs) is facilitated by applying of ultrasound methods. It is clinically important to examine source of emboli: artery to artery, cardiogenic and paradoxical embolism. Aim was to examine frequency of embolic types in pathogenesis of TIAs, using ultrasonic methods for cerebrovascular system

and heart. **Methods:** 110 TIA patients were examined by color Doppler flow imaging of carotid arteries, detection of microembolic signals-MES, detection of right to left (R-L) cardio-pulmonary shunt with air contrast (bubble test), transthoracic (TTE) in all patients, and transesophageal echocardiography (TEE) in patients with positive bubble-test. **Results:** It was found that 14.5% patients had artery to artery embolism from exulcerated carotid artery plaques. There were 3.6% patients with unstable plaques or postoperative intimal flap on aortic arch. Cardiogenic embolism was present in 5.5% patients (left atrial thrombus in 1 patient, atrial septal aneurysm in 4). TIAs, caused by paradoxical embolism, were present in 5.5% patients (PFO with cardiac R-L shunt in 4.5% patients, pulmonary R-L shunt in 0.99%); source of embolism from peripheral veins was confirmed. Numerous microshunts were detected (I, II and III degree), but they didn't correlated with TIAs. We detected MES in 71.8% of patients with embolic TIAs. **Conclusion:** We established embolic mechanism of TIAs in 29.1% patients: from exulcerated carotid plaques in 14.5%, from aortic arch in 3.6%, cardiogenic embolism in 5.5% and the paradoxical embolism in 5.5% patients.

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## O4

### ITALIAN PATENT FORAMEN OVALE SURVEY (I.P.O.S.): EARLY RESULTS

L. Caputi<sup>1</sup>; E. Parati<sup>1</sup>; G. Sangiorgi<sup>2</sup>; E. Onorato<sup>3</sup>; G. P. Anzola<sup>4</sup>; M. Chessa<sup>5</sup>; M. Carminati<sup>5</sup>; G. Butera<sup>5</sup>

<sup>1</sup>Neurological Institute C. Besta, Milan, Italy, Cerebrovascular Diseases, Via Celoria 11, 20133, Milan, Italy; <sup>2</sup>Modena University, Modena, Italy, Cardiology, Modena, Italy;

<sup>3</sup>Ospedale S. Orsola, Brescia, Italy, Cardiology, Brescia, Italy;

<sup>4</sup>Ospedale S. Orsola, Brescia, Italy, Neurology, Brescia, Italy;

<sup>5</sup>Policlinico San Donato, San Donato Milanese, Italy, Pediatric Cardiology, San Donato Milanese, Italy

**Background:** PFO percutaneous closure is gaining wide acceptance. Aims of the study were: 1) to analyse clinical practice regarding PFO closure in Italy, 2) to study indications, devices used, results of percutaneous PFO closure, 3) to study follow-up of large series of patients treated by percutaneous closure. **Methods:** IPOS is a prospective, observational, multi-centric survey that uses a web-based database. The survey lasted 12 months, between November 2007 and October 2008. 50 centres participated. Ongoing follow-up will continue up to 36 months. 1035 patients (mean age 46 years, 59% females) were included in the registry. 60% of patients had either only a previous TIA or an ischemic stroke. PFO diagnosis and right-to-left shunt (RLS) were assessed by contrast-enhanced transesophageal and/or transthoracic echocardiography and/or transcranial doppler. An aneurysm of the interatrial septum was associated in 41% of patients. **Results:** Early complications occurred in 24/1035 patients (2.3%): 12/24 (50%) of them had cardiac arrhythmias, 1 subject had a TIA. The overall rate of neurological events and cardiac complications were around 2% and 3% up to the 24-month follow-up, respectively. A recurrent TIA/ stroke event occurred in 5/1035 (5%) patients. Imaging regarding residual RLS was assessed in 384, 195 and in 16 subjects at the 6-12- and 24-month follow-up, respectively. A

large residual RLS was observed in about 1% of patients and no RLS in > 80% of them at the 1-year follow-up. **Conclusions:** Our data confirm that percutaneous PFO closure is a safe procedure. Early complications and during follow-up are mostly related to arrhythmias. Longer follow-up is under way.

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## Session II: Stroke, Genetics and Ultrasound

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### S3 GENETICS & CEREBROVASCULAR DISEASES – THINK ABOUT IT!

*M. Dichgans*

Institute for Stroke and Dementia Research, Klinikum der Universität München, Munich, Germany

M. Dichgans will give an overview on the role of genetics in stroke medicine and report on new insights in specific disease patterns.

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### S4 IMT FROM RISK ASSESSMENT AND CLINICAL USE TO GENETIC DISCOVERIES

*T. Rundek*

Department of Neurology, University of Miami, USA

Carotid intima-media thickness (cIMT) is an ultrasound imaging measures of carotid atherosclerosis and strong predictors of future stroke, myocardial infarction and vascular death. The use of ultrasound measures of cIMT as a screening tool in clinical practice however have been extremely limited by a lack of recognition of its value by medical communities, health care policy makers and a lack of reimbursement by third-party payers engaged in the delivery of vascular imaging services. This presentation will address the role of cIMT in vascular disease risk prediction. Recent data from large population based studies on reclassification of the vascular risk using carotid ultrasound imaging markers will be presented. In addition, the common clinical scenarios for the appropriate use of cIMT in clinical setting will be reviewed according to the recent study conducted by the Society of the Atherosclerosis Imaging and Prevention in collaboration with the International Atherosclerosis Society. This presentation is intended to provide a practical guide for use of cIMT to clinicians to promote optimal clinical use of cIMT and to researchers to direct cIMT research towards investigating environmental and genetic factors of a complex disorder - subclinical atherosclerosis - leading to future genetic discoveries and new anti-atherosclerotic therapies.

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### O5 ALTERED INTIMA-MEDIA THICKNESS IS REVERSIBLE IN HYPERTENSIVE PATIENTS

*K.R. Kovacs<sup>1</sup>; Z. Bajko<sup>2</sup>; C.C. Szekeres<sup>2</sup>; K. Csapo<sup>1</sup>; S. Molnar<sup>1</sup>; L. Olah<sup>1</sup>; M.T. Magyar<sup>1</sup>; L. Kardos<sup>3</sup>; P. Soltesz<sup>4</sup>; L. Csiba<sup>1</sup>*

<sup>1</sup>University of Debrecen Medical and Health Science Center, Department of Neurology, Debrecen, Hungary;

<sup>2</sup>Mures County Clinical Emergency Hospital, Department of Neurology, Targu-Mures, Romania; <sup>3</sup>Kenezy Gyula Hospital, Contract Medical Statistician, Debrecen, Hungary; <sup>4</sup>University of Debrecen Medical and Health Science Center, 3rd Department of Internal Medicine, Debrecen, Hungary

**Background:** Hypertension is one of the most important modifiable risk factors of stroke. It can cause alterations already in the early stage of the disease, when target organ damages are not yet present. Previously we have found significant differences between newly diagnosed hypertensive patients and healthy controls in their intima-media thickness (IMT), neuropsychological performance and different hemodynamic parameters. In the present study we aimed to investigate whether these changes are reversible. Especially, IMT and its correlation with other parameters were evaluated. **Methods:** Fifty-eight newly diagnosed hypertensive patients with a mean age of 44.5±10.5 years (male/female: 1.2) were recruited in the study. Beside IMT measurement, laboratory tests, head-up tilt table testing (HUTT) and neuropsychological tests were also performed at baseline evaluation and after 1 year of antihypertensive therapy. **Results:** Evaluation of all patient data is under process. According to the preliminary results - based on data of 51 patients – after 1 year, IMT values decreased (0.64±0.11 mm vs. 0.61±0.11 mm, p=0.0516). Improvement was also observed in neuropsychological performance, as memory (Digit Span Test: forward recall p=0.0408, backward recall: p=0.0247), attention (Pieron Test: p= 0.0291) and general processing speed (Digit Symbol Test: p<0.0001). Scores of trait and state anxiety showed also significant reduction (p=0.0012, p=0.0004). Correlations of IMT with the other studied parameters are under evaluation. **Conclusions:** Changes in the morphological and functional characteristics of the arterial wall seems to be reversible in patients with hypertension. Therefore, appropriate treatment started in time not only prevents further alterations, but may also reverse the already existing deteriorations.

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O6

**FOUR-DIMENSIONAL ULTRASOUND CALF MUSCLE IMAGING IN PATIENTS WITH GENETIC TYPES OF DISTAL MYOPATHY**

*E. Titianova<sup>1</sup>; T. Chamova<sup>2</sup>; V. Guerguelcheva<sup>2</sup>; I. Tournev<sup>2</sup>*

<sup>1</sup>Military Medical Academy, Department of Neurology and Neurosurgery, Sofia, Bulgaria; <sup>2</sup>Medical University, Department of Neurology, Sofia, Bulgaria

**Background:** To demonstrate the capabilities of spacetime (4D) ultrasound calf muscle imaging in patients with genetic types of distal myopathy (DM). **Methods:** The study was performed in 3 patients with genetically verified different types of DM: (1) 58-year-man with Vocal cord and pharyngeal weakness with distal myopathy (VCPDM), (2) 26-year-woman with Hereditary inclusion body myopathy type 2 (HIBM2) and (3) 36-year-woman with a Tibial muscular dystrophy (TMD). Ultrasonic characteristics of the calf muscle was assessed in rest and during maximal plantar flexion using multimodal color-duplex sonography, completed with a 3D/4D probe. The results were compared with the myosonograms of healthy controls. **Results:** All patients had clinical features of myopathic syndrome more pronounced for the distal muscles of the legs. Needle electromyography showed evidences of myogenic lesion. An advance muscular dystrophy was found by muscle biopsy. Compared to controls an abnormal calf muscle architectonics, a reduced muscle fibers contractility and combination of spot-like hyper- and hypoechoic areas as a result of muscle atrophy, fat tissue infiltration and fibrosis were established by 4D ultrasound imaging. **Conclusions:** Four-dimensional myosonology is a safe noninvasive method for spacetime imaging of the structural and functional changes in muscle architectonics in patients with DM. Further studies are needed to evaluate if the described findings are typical for specific genetic types of myopathy.

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O7

**DNA AND HISTONE METHYLATION IN ATHEROSCLEROTIC LESIONS OF CAROTID ARTERIES**

*J. Pelisek<sup>1</sup>; M. Culmes<sup>1</sup>; S. Dushenalieva<sup>1</sup>; R. Napieralski<sup>2</sup>; M. Schmitt<sup>2</sup>; H.-H. Eckstein<sup>1</sup>*

<sup>1</sup>Klinikum rechts der Isar der Technischen Universitaet Muenchen, Clinic for Vascular Surgery, Muenchen, Germany;

<sup>2</sup>Klinikum rechts der Isar der Technischen Universitaet Muenchen, Obstetrics and Gynaecology, Muenchen, Germany

**Background/Aims:** Epigenetic mechanisms such as DNA methylation or histone modifications significantly contribute to the regulation of gene expression. So far, no data are available about epigenetic modifications in atherosclerotic lesions of patients with advanced carotid artery stenosis. For this reason, the state of DNA and histone methylation was analysed in early and advanced human atherosclerotic carotid lesions and in serum between healthy individuals and patient with high graded carotid artery stenosis. **Methods:** In a pilot study, 26 carotid plaques of

patients with advanced carotid artery stenosis were included. Within each carotid plaque the early (I-III, AHA classification, n=10) and advanced (V-VI, n=16) stage of atherosclerosis were compared. All carotid lesions were characterised by means of histology to assess the plaque morphology and stained for DNA and histone methylation. DNA extraction from formalin fixed carotid tissue samples and serum was followed by DNA bisulfite conversion. The status of global DNA methylation was determined using quantitative PCR and primers specific for methylated LINE1 and Sat-alpha. Results: Carotid plaques in the advanced atherosclerotic stage (V-VI) showed global DNA hypomethylation compared to carotid lesions in the early stage of atherosclerosis (I-III) with a reduction of DNA methylation for up to 40% (p < 0.05). The changes in DNA methylation were observed also in the serum of patients with high graded carotid artery stenosis compared with healthy individuals (up to 60%, p < 0.05). Furthermore, different staining patterns were observed for histone methylation between advanced and early stage of carotid atherosclerosis. **Conclusions:** The extent of DNA and histone methylation analysed in our study was significantly associated with the stage and progression of atherosclerosis in patients with carotid artery stenosis. Thus, epigenetic changes seem to play an important role during atherosclerotic plaque progression.

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O8

**MOIA MOIA LIKE ARTERIOPATHY: NEUROSONOLOGICAL SUSPICION AND PROGNOSIS IN ADULT ASYMPTOMATIC PATIENTS**

*G. Malferrari<sup>1</sup>; M. Zedde<sup>2</sup>; G. De Berti<sup>3</sup>; M. Maggi<sup>3</sup>; A. Dallari<sup>2</sup>; A. Nucera<sup>2</sup>; S. Biguzzi<sup>2</sup>; I. Grisendi<sup>2</sup>; N. Marcello<sup>4</sup>*

<sup>1</sup>Neurology, viale Risorgimento 80, 42100, Reggio Emilia, Italy; <sup>2</sup>ASMN, Neurology, Stroke Unit, Reggio Emilia, Italy;

<sup>3</sup>ASMN, Neuroradiology, Reggio Emilia, Italy; <sup>4</sup>ASMN, Neurology, Reggio Emilia, Italy

**Objectives:** The epidemiology and the prognosis of asymptomatic moiamoia arteriopathy is virtually unknown, mainly in white western population, while symptomatic moiamoia arteriopathy is a more known disease, both in children and in adult people. We're presenting a single center case series of six adult people with a neurosonological (Transcranial Colour Coded Sonography - TCCS) suspicion of this type of cerebral arteriopathy, confirmed by DSA. For all patients the TCCS findings were incidental within a diagnostic pathway for not related symptoms. **Methods:** During a time period of three years we collected a series of six patients (5 female and 1 male, mean age 29.16 + 8.45 years) with a neurosonological suspicion and a neuroradiological diagnostic confirmation of moiamoia type arteriopathy. All patients underwent to neurosonological examination for episodic not related symptoms, like dizziness, or for a screening purpose in a family history of cerebrovascular atherosclerotic accidents. Besides the neurosonological examination with ultrasound study of the cerebroafferent vessels and of the intracranial arteries by TCCS, all patients underwent to brain MRI and MRA and DSA and blood sampling for differential diagnosis of immunological or infectious etiology. The mean follow-up was 1.8 years. **Results:** All patients but

one had a bilateral ICA stenosis at terminus and M1 MCA multiple stenoses. There is only one young patient with an atypical unilateral pathway and narrowing of extracranial ICA with prominent PCA compensation. No clinical events occurred during the follow-up and also brain MRI failed to find new ischemic lesions, compared with the baseline examination. TCCS and MRA findings did not change during follow-up. **Conclusions:** Asymptomatic cerebral moyamoya arteriopathy is an unfrequent but underestimated condition in young white people. More prognostic informations are needed in order to define the natural course and propose treatment.

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## Session III: Cerebral Hemodynamics in Ischemic Stroke

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### S5 IMPORTANCE OF COLLATERALS IN INTRACRANIAL ARTERIAL STENOSIS AND OCCLUSION

L. Wong

The Chinese University of Hong Kong, Department of  
Medicine & Therapeutics, Division of Neurology, Hong Kong,  
China

Collateral circulation via circle of Willis (COW) and leptomeningeal anastomosis stabilizes cerebral perfusion. Its role in the prevalent intracranial large artery occlusive disease (ILAD) among Chinese has not been explored. We recruited ischemic stroke patients who underwent MRI and digital subtraction angiography (DSA). COW was assessed by MRA. Composite circulation scores were derived to incorporate antegrade, collateral, and COW status. In 79 patients analyzed, the majority (n=56, 71%) had MCA stenosis and mild stroke (median NIHSS 3). 44 (58%) patients had good antegrade flow (TICI grade 2b and 3), 66 (89%) patients had good collateral flow (ASITN/SIR grade 2-4), and 55 (70%) patients had complete COW; corresponding to 65 (88%) patients with good circulation score. Patients with good circulation score had less severe index stroke, better stroke recovery with functional independence at 3-months (94% versus 6%, p=0.035), and less recurrent stroke or TIA in 12-months (91% versus 9%, p=0.073). Good circulation score (OR 13.9, 95% CI 1.37-142.4, p=0.026), and complete COW (OR 15.3, CI 2.50-93.83, p=0.003) predicted functional independence. A composite circulation score incorporating the leptomeningeal collateral and COW status was found to have prognostic value in patients with symptomatic ILAD.

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### S6 HEMODYNAMIC CAUSES OF DETERIORATION IN ACUTE STROKE

G. Tsvigoulis

Thrace University Medical School, Department of Neurology,  
Alexandroupolis, Greece

Early neurological deterioration is a relatively frequent unfavourable course after ischaemic stroke and can result in worse functional outcome. The underlying causes are mostly neurological including arterial reocclusion, oedema progression and significant haemorrhagic transformation. However, the pathogenic link between irregular breathing and early neurological deterioration in acute ischaemic stroke patients and sleep-disordered breathing (SDB) is poorly understood and is now a subject of clinical investigations. Vasomotor reactivity and intracranial blood flow steal in response to changing vasodilatory stimuli like carbon dioxide play a pivotal role in clinical deterioration with reversed Robin Hood syndrome (RRHS). Our group has recently shown that the presence of an intracranial blood flow steal in stroke patients with an acute proximal arterial occlusion and excessive daytime sleepiness may be related to greater neurological deterioration during hospitalization. The fact that an impaired cerebral autoregulation may be a round-the-clock mechanism accompanied by a diminished vasomotor reserve supports recent findings that patients with an acute ischaemic stroke and RRHS were more likely to have a higher risk of recurrent strokes. A mechanical ventilatory correction in selected acute stroke patients might have a beneficial effect on sleep-disordered breathing and brain perfusion.

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### O9 DYNAMIC CEREBRAL AUTOREGULATION ASSOCIATES WITH INFARCT SIZE AND OUTCOME AFTER ISCHEMIC STROKE

M. Reinhard<sup>1</sup>; S. Rutsch<sup>1</sup>; J. Lambeck<sup>1</sup>; C. Wihler<sup>1</sup>; M. Czosnyka<sup>2</sup>; C. Weiller<sup>1</sup>; A. Hetzel<sup>1</sup>

<sup>1</sup>Dept. of Neurology, Freiburg, Germany; <sup>2</sup>University of Cambridge, Clinical Neurosciences, Cambridge, United Kingdom

**Background:** Cerebral autoregulation is particularly challenged in acute ischemic stroke. We investigated (1) clinical and radiological factors related to dynamic autoregulation (DCA) in acute stroke, (2) the relationship between DCA and clinical outcome of stroke. **Methods:** 45 patients with middle cerebral artery (MCA) stroke were analyzed pooling two previous studies. DCA was measured by transcranial Doppler in both MCAs early (within 48 hours from onset) and late (day 5-7) using low frequency phase and correlation analysis (index Mx). Outcome was assessed by modified Rankin scale after a mean period of 4 months. **Results:** Mx increased between the early and late measurement, more so on affected (p=0.005) than on unaffected sides (p=0.014). Lower ipsilateral phase (early and late) and higher Mx (late measurement) were significantly related to larger infarction. More severe stroke was significantly related to poorer ipsilateral Mx and phase.

Ipsilateral phase in the early ( $p=0.019$ ) and Mx in the late measurement ( $p=0.016$ ) were related to poor clinical outcome according to univariate analysis. **Conclusions:** Impairment of DCA ipsilateral to acute ischemic stroke is associated with larger infarction. Dysautoregulation tends to worsen and spread to the contralateral side over the first days post stroke and is associated with poor clinical outcome.

## O10

### MEASURING CEREBRAL AUTOREGULATION WITH POSTURAL INDUCED BP FLUCTUATIONS IN ACUTE ISCHAEMIC STROKE

*M. Aries<sup>1</sup>; J. De Keyser<sup>2</sup>; B. Kremer<sup>1</sup>; P. Vroomen<sup>1</sup>; J.W. Elting<sup>1</sup>*

<sup>1</sup>University Medical Centre Groningen, Neurology, Groningen, Netherlands; <sup>2</sup>Free University Hospital Brussels, Neurology, Brussels, Belgium

**Background:** Cerebral autoregulation (CA) is impaired following acute ischaemic stroke. Current treatment strategies include early mobilization, but the effect on cerebral perfusion is unknown. We investigated whether the CA responses are impaired in acute stroke patients in response to blood pressure (BP) fluctuations induced by changes in body position. **Method:** Thirty-seven consecutive ischaemic stroke patients (mean age 62, median NIHSS 9) underwent recordings of beat-to-beat BP, cerebral blood flow velocity (bilateral TCD insonation) and end-tidal CO<sub>2</sub> recording within 24 hrs from onset. Patients were put in 4 different positions ranging from -15 to 90° in bed. Static CA was defined by the method of Tiecks et al. (1995). Dynamic CA was quantified in the supine position using transfer function analyses with the indices ARI and phase lag. The results were compared to 18 age-, hypertension history- and gender-matched controls. **Results:** Postural changes in BP (around 19 mmHg), HR, and CO<sub>2</sub> were comparable between both groups. Static CA was significantly reduced in the affected hemispheres of stroke patients compared to controls (73% +/- 25 vs. 78% +/- 12,  $p < 0.001$ ). ARI was significantly reduced in both affected (4.4 +/- 2.2 vs. 5.9 +/- 1.6,  $p < 0.001$ ) and unaffected hemispheres (4.8 +/- 2.0 vs. 5.9 +/- 1.6,  $p < 0.001$ ) compared to controls. The same result was found for the phase parameter with a correlation coefficient of around 0.60 ( $p < 0.001$ ) between ARI and phase for both hemispheres in stroke patients. The effects were more pronounced in patients with large strokes (NIHSS > 10) with static autoregulation values of 61% +/- 31 (n=10) and ARI values of 2.3 +/- 1.3 (n=3) in the affected hemisphere. **Conclusion:** With BP fluctuations induced by changing posture in bed, we were able to demonstrate impaired CA in acute ischaemic stroke patients. These results may have implications for mobilization in the acute phase, mainly for large strokes.

## O11

### HYPOCAPNIA INDUCED VASOCONSTRICTION SIGNIFICANTLY INHIBITS THE NEUROVASCULAR COUPLING

*L. Olah<sup>1</sup>; K. Szabo<sup>1</sup>; E. Lako<sup>1</sup>; T. Juhasz<sup>1</sup>; B. Rosengarten<sup>2</sup>; L. Csiba<sup>1</sup>*

<sup>1</sup>University of Debrecen, Department of Neurology, Debrecen, Hungary; <sup>2</sup>University of Giessen, Department of Neurology, Giessen, Germany

**Background:** Previous studies proved that vasodilation, caused by either hypercapnia or acetazolamide, does not inhibit significantly the visually evoked flow velocity changes in the posterior cerebral arteries. The aim of this study was to determine whether the hypocapnia induced vasoconstriction inhibits the neurovascular coupling. **Methods:** By using a visual cortex stimulation paradigm, the flow velocity response was measured in both posterior cerebral arteries of 14 young healthy adults by TCD sonography. The stimulation protocol consisted of 10 cycles with a resting phase of 20 s (baseline) and a stimulating phase of 40 s for each cycle. After the control examination, patients were taught to hyperventilate with a breathing frequency of 36-40/minute. Without removal of the TCD probes, the same protocol was repeated during hyperventilation (HV) with a difference that only 4 cycles were recorded in order to avoid the HV induced symptoms. Repeated-measures analysis of variance (ANOVA) was used to detect differences in visually evoked flow velocity time courses during the control and the HV phases. **Results:** The breathing frequency increased from 16±2 to 37±3/minute due to HV, resulting in a decrease of the end-tidal CO<sub>2</sub> from 37±3 to 25±3 mmHg. The resting flow velocity decreased from 58±11 to 48±11 cm/s as a result of HV ( $p < 0.01$ ). To allow comparisons between volunteers, absolute data were transformed into relative changes of flow velocity in relation to baseline. Repeated measures ANOVA revealed significant difference in the peak systolic relative flow velocity time courses during HV and normoventilation ( $p < 0.01$ ). The maximum percent change of visually evoked flow velocities were 26±7% and 12±5% during normoventilation and HV, respectively ( $p < 0.01$ ). **Conclusion:** The visually evoked flow velocity changes decreased significantly during HV, indicating that vasoconstriction significantly inhibits the neurovascular coupling.

## O12

### INTRA- AND EXTRACRANIAL STENOSES IN TIA, A PROSPECTIVE POPULATION-BASED STUDY - THE AARHUS TIA-STUDY

*P. von Weitzel-Mudersbach<sup>1</sup>; S.P. Johnsen<sup>2</sup>; G. Andersen<sup>3</sup>*

<sup>1</sup>Aarhus Hospital, Aarhus University Hospital, Department of Neurology, Aarhus, Denmark; <sup>2</sup>Aarhus University Hospital, Department of Clinical Epidemiology, Aarhus, Denmark; <sup>3</sup>Aarhus Hospital Aarhus University Hospital, Department of Neurology, Aarhus, Denmark

**Background:** In Denmark, only a small minority of patients with acute TIA or stroke is evaluated for intracranial artery stenosis (ICAS), even the risk of recurrent stroke is high.

The arguments have been the assumption that intracranial atherosclerotic disease in Caucasians is rare, and the lack of evidence for a specific treatment. Recently published data provides some evidence for the efficacy of dual platelet inhibition. Moreover, intra-arterial treatment may be an option in unstable ICAS. **Methods:** We examined prospectively the prevalence of stenosis of the pre- and intracerebral vessels using TCCD in a population based cohort of all TIA patients in the city of Aarhus, Denmark with a population of 328,542 inhabitants in the period 1.3.2007-29.2.2008. Artery stenosis was diagnosed applying the NASCET-criteria for carotid stenosis, and the Baumgartner-criteria for ICAS. **Results:** We identified 200 patients fulfilling the diagnostic criteria for TIA (all Caucasians). Of these, we examined 195 patients with extra- and intracranial TCCD. In 39 patients the transcranial part of the examination was partially inconclusive due to insufficient bone window. Any and symptomatic ICAS was found in 12.3% and 8.2%, respectively. The stenoses were located in the intracranial ICA in 3.6% and 3.1%, ACA in 0.5% and 0%, MCA in 4.6% and 2.6%, intracranial VA in 2.1% and 1.5%, and in the BA in 1.5% and 1.5%, respectively. In comparison, we found any and symptomatic stenosis in the extracranial carotid artery in 14.4% and 10.8%, and the extracranial VA in 5.6% and 2.1%, respectively. Carotid occlusion was found in 3.6%, combined extra- and intracranial stenosis in 4.9% **Conclusions:** ICAS in TIA-patients are more frequent than expected, even in a homogeneous Caucasian population, and may be proximately as frequent as carotid stenosis. Systematic evaluation for intracranial stenosis should be considered in all acute ischaemic cerebrovascular disease.

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**O13**  
**TRANSCRANIAL ULTRASOUND: A USEFUL TOOL IN GUIDING TREATMENT OF CEREBRAL VASOSPASM IN ANEURYSMAL SAH**

*F. Perren; B. Schatlo; M. Kotowski; P. Bijlenga; K. Schaller*  
HUG, Geneva, Switzerland

**Background:** Transcranial ultrasound monitoring allows assessment of vasospasm, which is a common complication of subarachnoid hemorrhage (SAH). We studied whether transcranial ultrasound-based treatment decisions influence outcome in a retrospective cohort. **Methods:** Consecutive non randomized patients admitted in a primary neurosurgical referral center suffering from acute SAH due to intracranial aneurysms as diagnosed with CTA/DSA were systematically monitored using transcranial ultrasound from baseline (day1) every 24-48h over 15-21 days. Vasospasm onset and severity were recorded using the Lindegaard index (positive if >3). All the patients underwent clinical assessment at baseline, onset of vasospasm and after treatment using the NIH stroke scale (NIHSS). Therapy onset (HHT, i-a vasodilatation, mechanical angioplasty) and clinical outcome were compared. Clinical outcome was evaluated at discharge and after 6 weeks. **Results:** 80 SAH patients (54 women, mean age 53.4 years) were included. Temporary neurological worsening after the detection of vasospasm on transcranial ultrasound as

measured using the NIHSS score (greater than or equal to 4 points) occurred in 50 patients. No cerebral vasospasm was detected with DSA which was not detected with transcranial ultrasound. In 29/50 of them therapy was started immediately after diagnosis of vasospasm. 21 of these 29 patients recovered completely and 8 had focal neurological deficit at discharge and after 6 weeks. In 21/50 patients therapy onset was delayed (greater than to equal 48h). 4 of them recovered completely and 17 had persistent neurological deficits at discharge and after 6 weeks (Fisher exact  $p < 0.0005$ , 2-tailed). **Conclusions:** This study supports the hypothesis that the use of transcranial ultrasound may guide treatment of vasospasm prior to clinical manifestation. its consequent use may contribute to a better outcome.

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**Session IV: The role of Internet in Diagnostics, Training and Research**

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**S7**  
**INTERNET STUDIES**

*S. Horner*  
Medical University Graz, Department of Neurology, Graz, Austria

Virtual worlds such as Second Life (SL) are increasingly used for educational endeavours ranging from consumer health education to graduate education, and many universities incorporate virtual worlds into their curricula and research. These simulated 3-D environments provide unique opportunities to simulate real-life scenarios and immerse the user into an environment that can be tailored to meet specific educational requirements, suitable for patients, students, nurses and physicians. Moreover, the World Wide Web is increasingly looked at as a means of surveying the public. Results of a questionnaire on risk awareness and knowledge of stroke entitled "The potential of the web-based virtual world of SL in stroke research" will be presented. Results of this ongoing international survey emphasize the potential of 3-D environments as a unique design feature in health-related activities and document that stroke awareness is suboptimal. These data support the need for targeted educational programmes and improvement of the impact of real-life health-related behaviours.

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**S8**  
**TELESTROKE – HOW DOES IT WORK?**

*S. Boy*  
University of Regensburg, Department of Neurology, Regensburg, Germany

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**S9**  
**TELEULTRASOUND IN THE SURGERY THEATRE**

*W. Mess*  
University Hospital Maastricht, Department of Clinical Neurophysiology

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**S10****FUTURE APPLICATIONS OF REMOTE CLINICAL DECISIONS***G. Rose*

University Magdeburg, IESK, Magdeburg, Germany

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**Session V: Therapeutic “no man’s land” – Asymptomatic Carotid Stenosis**

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**S11****DETECTION AND CLASSIFICATION: NON-INVASIVE METHODS AND GUIDELINES***L. Csiba*

University of Debrecen Medical and Health Science Center, Department of Neurology, Debrecen, Hungary

The aim of this lecture is to give an overview about the presence of extra- and transcranial ultrasound methods in the recent guidelines of diagnosis and therapy of stroke and stroke-risk diseases. The TCCS Consensus Group of the Neurosonology Research Group summarized (2009) how examinations should be performed in acute stroke, including criteria to assess the quality of the acoustic bone window, the use of echo contrast agents, and the evaluation of intracranial vessel status. The AHA guideline on noninvasive assessment of subclinical atherosclerosis in children and adolescents (2009) evaluates the noninvasive methods of assessing atherosclerotic risk in youth and summarizes the current recommendations for standard assessment for clinical research. A recently published (2010) comprehensive review and meta-analysis of randomized (6) and nonrandomized (3) studies confirmed the safety and efficacy of ultrasound enhanced thrombolysis in acute stroke. The European Association of Echocardiography (2010) recommends the use of suprasternal TTE to identify arch atheromas. Transesophageal ultrasound may be indicated when image quality is inadequate to reliably rule out atheromas or define plaque characteristics. The recently published AHA/ASA guideline on primary prevention of stroke (2011) confirms, that „Duplex ultrasound is the least expensive and lowest-risk noninvasive method of screening the extracranial carotid artery for an atherosclerotic stenosis. Although there can be considerable variation in the accuracy of duplex scanning among laboratories, certification programs are available that set standards for levels of performance and accuracy”. The AHA/ASA guideline of secondary prevention of stroke (2011) also deals with ultrasound, CAS is indicated as an alternative to CEA for symptomatic patients at average or low risk of complications associated with endovascular intervention when the diameter of the lumen of the internal carotid artery is reduced by >70% by noninvasive imaging or >50% by catheter angiography.

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**S12****VIEW OF A NEUROLOGIST: CEA – TREATMENT OF CHOICE!***H. Berger*

Klinikum rechts der Isar der Technischen Universität München, Department of Radiology

Carotid surgery is the currently accepted standard of treatment for revascularisation of a-symptomatic extra-cranial carotid occlusive disease. Valide data comparing endovascular treatment with surgery are provided only for treatment of symptomatic patients. The efficiency in secondary stroke prevention seems to be similar according to mid-term results of recently published results from randomized trials. In regard to procedural safety however non-inferiority of CAS has not been proven so far.

Subgroup analysis of the SPACE trial identified age > 68 years as a favourable selection criteria for CAS; this might reflect aortic arch configuration and supra-aortic vessel elongation as access related risk parameters. Other factors with impact on procedural safety of CAS might include calcification, plaque composition and unfavourable anatomy for use of neuroprotection devices. Further experience in regard to augmentation of CAS safety will be gained with results from ongoing randomized trials with treatment of a-symptomatic patients. Results from SAPPHIRE, CAVATAS, ACST trials indicate the potential of CAS as an treatment option for patients with a-symptomatic carotid disease in selected groups.

Proper patient selection, individual operator training, and technical improvements might be major issues of endovascular procedural safety in the future.

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**S13****VIEW OF A VASCULAR SURGEON: CAS – STENTING EVEN BETTER!***H.-H. Eckstein*

Klinikum rechts der Isar der Technischen Universität München, Clinic for Vascular Surgery, München, Germany

H.-H. Eckstein as a leading vascular surgeon in the field of carotid surgery has been assigned the task to bring forward arguments for carotid artery stenting.

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**S14****DON'T TOUCH – BEST TREATMENT IS MEDICAL! / THE CASE FOR MEDICAL THERAPY***N. Bornstein*

Tel Aviv Sourasky Medical Center, Neurology, Tel Aviv, Israel

Asymptomatic significant ( $\geq 50\%$ ) carotid stenosis (ASCS) is a frequent finding in the aging population. The prevalence of moderate stenosis (50-70%) increases from 3.6% for those less than 70 years to 9.3% in those 70 years and above. The prevalence of severe (70-99%) stenosis is 1.7%. The natural history of ASCS is quite benign. Patients with ASCS have an overall risk of stroke of around 2% per year and within

this patients' group higher degrees of stenosis are associated with higher risks. Yet during the same period the estimated risk for coronary events is around 7%! Similarly the stroke mortality is around 0.6% annually whereas the overall mortality is estimated to be 4-7%. The above figures were mostly retrieved a few decades ago and are probably overestimating the real risk of vascular events as there is a shift towards lower risks comparing observations from older and more recent trials, probably resulting from better medical treatment nowadays. More specifically, temporal changes in the annual average rate of ipsilateral stroke in patients with >50% asymptomatic carotid stenosis who were treated by medical means only during the years 1985 to 2008 clearly show a gradual reduction in the average annual risk from approximately 2.5% in the mid-1980s to approximately 1% by 2008. Also, the overall stroke risk and even that of ipsilateral risk may result from causes other than the stenosed artery. Clearly, future strokes of cardioembolic origin and most lacunar strokes cannot be prevented by successful carotid endarterectomy. Carotid endarterectomy (CEA) for asymptomatic carotid stenosis has been evaluated in several studies, mainly ACAS and ACST. An overall modest benefit of about 1% annual risk reduction was found for CEA versus medical treatment over a five year period. A questionable effect in women and in those over 75 years of age along with the excellent peri-operative (PO) risk observed, mainly in ACAS, which was not repeated in the "real world" raised concerns regarding the overall applicability of the results of these studies. In conclusion,

- the risk is now lower with medical therapy than with surgery or stenting
- Only ~10% of patients can benefit from CEA or CAS
- The high risk patients who can benefit can be identified by TCD microemboli
- Imaging of vulnerable plaque will identify a small additional percentage in future

### S15 VALUE OF NEUROSONOGRAPHY FOR DECISION MAKING?

K. Niederkorn  
Medical University of Graz, Department of Neurology, Graz, Austria

The ACAS and ACST studies showed a significant benefit of endarterectomy in clinically asymptomatic carotid stenoses (ACS) of more than 60% stenosis-although these clinical results are discussed controversially today. The data of these studies were based on intraarterial angiography and were extrapolated to noninvasive methods like Color Coded Carotid Duplex scanning (CCDS). Similar to symptomatic carotid stenosis, the extent of the arterial narrowing- and especially an increasing degree of stenosis over time- remains one of the main decision parameters for surgical or endovascular treatment of ACS. Problems with CCDS in relation to the so called "gold standard"

DSA are definition criteria –correlation with the NASCET or ECST DSA method to measure stenosis- and the inability of a single parameter like the most frequently used peak systolic velocity to correctly quantify the severity of stenosis sonographically. A "multiparametric approach", including maximum poststenotic systolic velocity, collateral flow and other hemodynamic parameters like the ICA/CCA ratio allows a more precise diagnosis of ACS by CCDS (Arning et al, *Ultraschall Med* 2010; 31(3):251-257)- especially in the 60-80% stenosis range. Another significant step forward in the assessment of the probability of stroke in ACS is TCD monitoring. The presence of ipsilateral embolic signals was associated with an absolute annual stroke/TIA risk of 7.1% versus 3.0 % without (Markus et al. *Lancet Neurol* 2010; 9:663-71)

### O14 WHEN TO PERFORM TRANSCRANIAL DOPPLER TO PREDICT CEREBRAL HYPERPERFUSION AFTER CAROTID ENDARTERECTOMY?

C. Pennekamp<sup>1</sup>; S. Tromp<sup>2</sup>; R. Ackerstaff<sup>2</sup>; M. Bots<sup>3</sup>; R. Immink<sup>4</sup>; J.-P. de Vries<sup>5</sup>; J. Kappelle<sup>6</sup>; F. Moll<sup>1</sup>; W. Buhre<sup>4</sup>; G.J. de Borst<sup>1</sup>

<sup>1</sup>University Medical Center, Vascular Surgery, Utrecht, Netherlands; <sup>2</sup>St Antonius Hospital, Clinical Neurophysiology, Nieuwegein, Netherlands; <sup>3</sup>University Medical Center, Julius Center for Health Sciences, and Primary Care, Utrecht, Netherlands; <sup>4</sup>University Medical Center, Anaesthesia, Utrecht, Netherlands; <sup>5</sup>St Antonius Hospital, Vascular Surgery, Nieuwegein, Netherlands; <sup>6</sup>University Medical Center, Neurology, Utrecht, Netherlands

**Background:** Cerebral hyperperfusion syndrome (CHS) following carotid endarterectomy (CEA) is defined by a combination of symptoms and at least a doubling of pre-operative cerebral blood flow. Cerebral blood flow is correlated to the peak systolic velocity (V) of the ipsilateral middle cerebral artery (MCA) measured with transcranial Doppler (TCD). Currently, an increase in V of >100% 3 minutes after carotid declamping compared to pre-clamping helps to predict CHS. However, applying this method, not all patients at risk for CHS are identified, while others may be treated unnecessarily. We hypothesize that the positive predictive value (PPV) of TCD in the prediction of CHS can be increased by an additional post-operative TCD measurement within two hours after CEA. **Methods:** In 184 CEA patients the pre-operative (V1), pre-clamping (V2), post-clamping (V3) and post-operative V (V4) was measured by TCD and standard blood pressures were scored. The intra-operative V increase  $((V3 - V2) / V2)$  was compared to the post-operative increase  $((V4 - V1) / V1)$  in relation to clinical CHS. Outcome was reported as PPV and ROC-curve analysis. **Results:** An intra-operative V increase of >100% was noted in 16 patients (9%), and a post-operative V increase in 22 (12%) patients. In 10 patients (5%) CHS was diagnosed; two of those had an intra-operative V increase of >100% and nine a post-operative V increase >100%. These results in a PPV of 13% for the intra-operative and 41% for the postoperative measurement and 29% for the two measurements combined. ROC curve analysis showed an area under the

curve of 0.641 for the intra-operative and 0.904 for the post-operative FV measurements. **Conclusions:** A post-operative increase of the peak systolic velocity in the ipsilateral MCA of >100% as measured by TCD is superior to an intra-operative velocity increase, for the identification of patients at risk for the development of CHS after CEA.

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### O15 INCIDENCE AND CLINICAL IMPACT OF CAROTID ARTERY IN-STENT RESTENOSIS

*K. Wasser<sup>1</sup>; S. Schnaudigel<sup>1</sup>; J. Wohlfahrt<sup>1</sup>; M. Psychogios<sup>2</sup>; K. Gröschel<sup>1</sup>*

<sup>1</sup>Universitätsmedizin Göttingen, Neurology, Göttingen, Germany; <sup>2</sup>Universitätsmedizin Göttingen, Neuroradiology, Göttingen, Germany

**Background:** Carotid angioplasty and stenting (CAS) is frequently being used as a treatment alternative to endarterectomy (CEA) for patients with significant carotid stenosis. However, the long-term efficacy and safety of CAS is still debated and prospective data are sparse. The aim of this study was to assess the incidence and clinical significance of in-stent restenosis (ISR) diagnosed with serial duplex sonography investigations. **Methods:** We prospectively analysed 216 patients treated with CAS during 05.2003-06.2010. Clinical and serial carotid duplex ultrasound investigations were obtained before CAS, within 3 days after intervention and during long term follow-up. We assessed the incidence of peri-procedural and long-term clinical complications (stroke related to the treated artery or death of any cause) and ISR as assessed during duplex sonography according to ECST criteria. **Results:** Over a median 32-months follow-up (IQR 15.4-48.1) of 216 patients (71.8% male, mean age 68y) a total of 59 ISRs of  $\geq 50\%$ , 22 ISRs of  $\geq 70\%$ , and 13 ISRs of  $\geq 80\%$  were found (27.3%, 10.2%, 6.0%, respectively). 25 strokes (11.6%) and 22 death (10.2%) were observed. A higher degree of ISR was significantly associated with more frequent clinical complications during follow-up compared to patients without restenosis ( $\geq 50\%$  p=0.56,  $\geq 70\%$  p=0.33,  $\geq 80\%$  p=0.01). **Conclusions:** According to current duplex criteria ISR was frequently found during the long-term follow-up after CAS. Whereas low grade ISR ( $\geq 50\%$ ) seems not to bear a higher risk for clinical complications, our data showed a significantly higher proportion of clinical complications in patients with high grade ISR ( $\geq 80\%$ ). Against the background of a lack of established treatment of ISR these should be taken into account when offering CAS as a treatment alternative to CEA

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### O16 ULTRASONIC ESTIMATION OF CEREBROVASCULAR REACTIVITY IN PATIENTS UNDERWENT CAROTID SURGERY

*I. Timina; D. Suntsov; G. Karmazanovsky; E. Burtseva*  
Vishnevsky Institute of Surgery, Radiology, Moscow, Russian Federation

**Aims:** To estimate changes of cerebral circulation during hypercapnic probes in patients with stenosis of carotid artery and compare with backup flow pressure and systolic blood velocity measured during carotid endarterectomy. **Material:** 137 operated patients (mean age 56 + 5) years with stenosis of carotid arteries were divided into 3 groups: 1) 15 patients with occlusion of one internal carotid artery (ICA) combined with 70 % (or more) stenosis of contralateral ICA; 2) 55 patients with 70% (or more) stenosis of both ICA; 3) 67 patients with 70% stenosis of one ICA and less than 60% stenosis of contralateral ICA. Ultrasonic investigation included: duplex scanning (DS) of carotid arteries (ultrasound device - Logiq-9, General Electric), transcranial DS of the Willis circle arteries and intraoperative measure systolic blood flow in middle cerebral artery (MCA) before and during hypercapnic probes. Difference between those velocities were normalized to the initial systolic velocity and designated as reserve of collateral circulation (in %). **Results:** Asymptomatic patients had normal circulation reactivity independently on the degree of stenosis of ICA (in all 3 groups). So reserve of collateral circulation was decreased in 65 % of patients with symptoms of cerebrovascular insufficiency (42% of them with open Willis circle). We have found a correlation ( $r = 0.81$ ) between initial systolic velocity of blood flow and systolic velocity during the hypercapnic probe. Also the correlation ( $r = 0.68$ ) was between the backup flow arterial pressure and systolic velocity of blood flow in MCA at the moment of common carotid artery occlusion. Hypercapnic probes in postoperative period were unaffected in 64 (46.7%) patients. Cerebrovascular reserve was improved in 63 (46%) patients. **Conclusion:** Reactivity was decreased in 50% of patients with hemodynamically significant stenosis of one ICA but in 90 % of patients with occlusion of one ICA and >75% stenosis of contralateral artery.

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### O17 POST-CAROTID STENT ULTRASOUND PROVIDES CRITICAL DATA TO AVOID RARE BUT SERIOUS COMPLICATIONS

*J. Volpi<sup>1</sup>; Z. Garami<sup>2</sup>; R. Kabir<sup>3</sup>; O. Diaz-Daza<sup>4</sup>; R. Klucznik<sup>4</sup>*

<sup>1</sup>The Methodist Hospital, Department of Neurology, Houston, United States; <sup>2</sup>The Methodist Hospital, Cardiovascular Surgery, Neurology, Houston, United States; <sup>3</sup>The Methodist Hospital, Neurology, Houston, United States; <sup>4</sup>The Methodist Hospital, Interventional Radiology, Houston, United States

**Background:** Carotid stenting is an accepted form of revascularization in the US, and many parts of the world, based on the recent results of the CREST trial. Follow-up imaging for post-stent patients remains variable, and some

patients receiving no follow-up imaging immediately post stent. Furthermore, there are relatively few publications documenting normative results on in-stent velocities. **Methods:** We reviewed the last 12 months of patients who received a carotid stent or who received a post-stent ultrasound to assess the normative range of in-stent velocity and to assess the benefit of post-stent ultrasound exam. **Results:** We identified 45 patients who received an ultrasound exam post stent in the prior 12 months. On routine follow-up we measured the mean non-stenotic peak systolic velocity to be 83 cm/s, and end diastolic velocity to be 24 cm/s, with a range for peak systolic velocity of 33 to 150 cm/s, and end diastolic velocity 11 to 52 cm/s. We also identified 2 cases in this sample where immediate post-stent ultrasound provided critical data. In one case, a patient had no focal neurological deficits, but was found with low flow in the stented vessel. The stent appeared to be properly deployed, but on follow-up angiogram was found to be in the dissected false lumen of the carotid. This was subsequently corrected with no adverse events. In a second case, the stented carotid was normal, but the contralateral carotid artery was found to have a new flow-limiting dissection with clot. This vessel was also stented subsequently without any adverse events. **Conclusions:** In all cases, post stent ultrasound provides a means for establishing a baseline for future follow-up. In rare cases, immediate post stent ultrasound can identify potentially serious complications of stenting not seen during angiography.

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## Session VI: Novel Technologies I

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### S16 BRAIN PERFUSION, SONOTHROMBOLYSIS AND CNS DRUG DELIVERY – NEUROSONOGRAPHY IN 2020.

S. Meairs

University Hospital of Mannheim, University of Heidelberg,  
Department of Neurology

Recent advances in ultrasound technology have enabled tremendous progress in brain perfusion imaging. Real-time low mechanical index imaging of microbubbles flowing through brain capillaries now enable acute diagnosis of cerebral infarction and assessment of vulnerable tissue. New developments in brain imaging, particularly those exploiting time reversal techniques, will exploit these techniques and lead to further advances in brain perfusion imaging. Devices capable of visualizing the entire brain through the skull will emerge, thus allowing monitoring of brain microvascular blood flow in new dimensions. Enhanced algorithms will allow first quantification of cerebral blood flow using ultrasound and microbubbles. These advances will improve treatment of stroke patients and enhance early diagnosis. Great steps will be undertaken in the treatment of acute stroke with sonothrombolysis. While research has previously concentrated on directing ultrasound to enhance tPA-mediated opening of occluded vessels, recent studies suggest the exciting possibility of treating the microcirculation with ultrasound. These first observations will be substantiated by further experimental studies to foster development of novel ultrasound equipment designed to treat

the microcirculation. Use of magnetic resonance imaging-guided focused ultrasound (MRgFUS) will lead to new treatment strategies for focused sonothrombolysis of clots arising from intracerebral hemorrhage. A particularly promising application with high translational capacity is ultrasound-targeted drug delivery to the brain. Most substances and drugs that would be potentially useful for treatment of a variety of brain disorders cannot be applied due to their inability to penetrate the blood-brain barrier (BBB). This is particularly true for large-molecule agents such as monoclonal antibodies, recombinant proteins, or gene therapeutics. Although a variety of approaches have been investigated to open the BBB for facilitation of drug delivery, none has achieved clinical applicability. New developments in drug delivery to the brain with highly innovative microbubbles carrying nanoparticle-loaded agents will open totally new avenues for treatment of brain disease. Magnetic resonance-guided focused ultrasound will allow targeted drug release of vectors capable of passing the BBB at the site of interest, thus alleviating the need to open the BBB with ultrasound. This new targeting strategy will allow non-invasive therapies to the brain with substances such as immunoglobulins, viral vectors, plasmid DNA, siRNA, mRNA and high molecular weight drugs. It is anticipated that drug delivery to the brain with MRgFUS will be one of the most important advances in neurology in the next decade and lead to new therapies for a variety of brain diseases.

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### S17 IMAGING OF PLAQUE PERFUSION USING CONTRAST-ENHANCED ULTRASOUND

E. Vicenzini

Sapienza Università di Roma, Dept Neurology and  
Psychiatry, Rome, Italy

Inflammation is recognized to be a fundamental factor for atherosclerosis development and progression. Histological studies have indeed shown that carotid and coronary arteries symptomatic plaques are characterized by the infiltration of an active inflammation process that leads to plaque fissuration and subsequent distal embolization. Periadventitial vasa-vasorum and intraplaque newly-formed, immature microvessels has also been recognized as markers of plaque instability in atheromatic lesions of cardio and cerebrovascular patients in histological studies, being expression of the vessel wall disease. In these regards, it is indeed well known that microvessels are not present in the normal human intimal layers and that intima becomes vascularized only with the developing of the atherosclerotic process and when its layer growths in thickness. The “in vivo” identification of these features has been the focus of development of new radiological imaging. Contrast Carotid Ultrasound is not only able to provide an enhanced assessment of the arterial lumen and plaque morphology with an improved resolution of the carotid intima-media thickness, but even to directly visualize adventitial vasa-vasorum and plaque neovascularization. Further studies are needed to determine the prognostic role of these microvessels when detected during vascular work-up.

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**O18****MONITORING OF BRAIN TISSUE PERFUSION UTILIZING SONOPOD FOR TRANSCRANIAL COLOR DUPLEX SONOGRAPHY**

T. Shiogai<sup>1</sup>; M. Koyama<sup>1</sup>; M. Yamamoto<sup>1</sup>; K. Yoshikawa<sup>2</sup>; T. Mizuno<sup>3</sup>; M. Nakagawa<sup>3</sup>

<sup>1</sup>Kyoto Takeda Hospital, Clinical Neurosciences, Kyoto, Japan; <sup>2</sup>Hoshigaoka Kouseinenkin Hospital, Stroke Medicine, Osaka, Japan; <sup>3</sup>Kyoto Prefectural University of Medicine, Neurology, Kyoto, Japan

**Objective:** We have improved a transducer holder (Sonopod) for transcranial color duplex sonography (TCDS) monitoring via both temporal and foramenal windows (TW/FW). The objective is to clarify clinical usefulness and identify problems in TCDS-Sonopod monitoring in the evaluation of brain tissue perfusion. **Methods:** Brain tissue perfusion monitoring via TW was evaluated in 11 neurological patients (ages 31-94, mean 66), and utilized a SONOS5500 S3 transducer installed in the Sonopod. After a bolus intravenous Levovist, power modulation imaging (PMI) in all cases and second harmonic imaging (SHI) in two cases were evaluated at the diencephalic horizontal plain via bilateral (7 cases) and unilateral (4 cases) TWs. Acetazolamide (ACZ) cerebral vasoreactivity was evaluated in 9 cases. **Results:** 1) All patients could be monitored continuously by one examiner. 2) Fixed-probe shifts during monitoring due to patients movements were easily readjustable at the same position. 3) Brain tissue perfusion could be precisely quantified before/after ACZ in the same regions of interest (ROI). 4) Due to Sonopod re-fixation during contralateral TW monitoring, it was not possible to evaluate completely in the same ROIs. 5) PMI proved superior to SHI in quantitative evaluation of the bilateral hemispheres via the unilateral TWs. **Conclusions:** TCDS-Sonopod monitoring succeeds in continuously and quantitatively evaluating precise and reproducible intracranial hemodynamics in the brain tissue.

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**O19****FOUR-DIMENSIONAL ULTRASOUND IMAGING IN NEURO-OPHTHALMOLOGY**

E. Titianova<sup>1</sup>; S. Cherninkova<sup>2</sup>; S. Karakaneva<sup>1</sup>; B. Stamenov<sup>3</sup>

<sup>1</sup>Military Medical Academy, Department of Neurology and Neurosurgery, Sofia, Bulgaria; <sup>2</sup>Medical University, Department of Neurology, Sofia, Bulgaria; <sup>3</sup>Medical University, Department of Neurology and Neurosurgery, Pleven, Bulgaria

**Background:** To demonstrate diagnostic abilities of spacetime (4D) ultrasound imaging in patients with eye pathology and neuro-ophthalmic syndromes. **Methods:** Fifteen healthy controls and 13 patients with different visual problems were studied: 10 patients with papilledema, 2 patients with retinal detachment and 1 man with right intraocular tumor. Multimodal sonography (color duplex, B-flow and 3D/4D imaging) was used for evaluation of morphology of the eye structures. **Results:** Optic disc drusen (calcific nodules) were found in 3 controls. The patients with papilledema had a smoothly contoured

hyperechoic prominence, arising from the optic disc and protruding into the vitreous. The prominence correlated with the severity of congestion, measured by ophthalmoscopy. The optic nerve sheath diameter was increased in association with the degree of optic disc swelling. The retinal detachment was seen as a hyperechoic undulating membrane in the posterior to lateral globe. The tumor was imaged as a heterogenic irregular unifocal formation within the lateral part of the affected vitreous. These changes and their dimensions were well documented by ultrasound 4D imaging. **Conclusions:** Four-dimensional neuro-ophtho-sonology offers the quick, noninvasive and spacetime imaging of the type, size, location and severity of the visual pathology originated from the nervous system. It can be helpful in avoiding the need from lumbar puncture, CT or MRI.

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**O20****HIGH EFFICIENT EVALUATION METHOD FOR SONOTHROMBOLYSIS**

Z. Wang<sup>1</sup>; T. Fukuda<sup>2</sup>; H. Furuhashi<sup>1</sup>

<sup>1</sup>Jikei University School of Medicine, Medical Engineering Laboratory, Research Center for Medical Science, Tokyo, Japan; <sup>2</sup>Jikei University School of Medicine, Division of Neuropathology, Department of Neuroscience, Research Center for Medical Science, Tokyo, Japan

**Background:** The efficacy of ultrasound (US) in thrombolysis has been demonstrated by many studies. However, it is difficult for conventional evaluation methods to find out the best settings of US because of the tremendous amount of possible combinations of its several parameters. This study established a high efficient method to resolve this problem. **Methods:** Two flat discoid clots with a diameter of 15 mm and a thickness of 1.5 mm were made simultaneously in specially designed wells, which having thin (0.3 mm) polycarbonate base transparent to light and with little reflection to US. They were set into a custom made spectrometer, and light absorbance value (LAV) at a wavelength of 412 nm was measured automatically at a total of 200 positions (100 for each clot along 8 radial directions) in about 2 minutes. Then each clot was covered with plasma with (or without) tissue plasminogen activator and closed with a thin (0.3 mm) polycarbonate plate. Then they were set into separated positions of a fixture and immersed in a 37°C water-bath. The fixture aligned an US probe precisely with one of the clots. After 30 minutes of incubation in the water-bath with or without US treatment, both clots were washed with normal saline and LAVs of the same 200 positions were measured again. These LAVs were automatically translated to clot thicknesses according to a previously determined calibration curve. Then the clot thickness losses of the 200 positions were determined, and every 8 points with a same distance from clot center were averaged to evaluate the relationship between ultrasonic spatial intensity and sonothrombolytic effect. **Results:** With this method, a significant enhancement of thrombolysis by a 500 kHz US was found in intensity from 0.1 to 0.7 W/cm<sup>2</sup> with only 6 pairs of clots. **Conclusion:** The new method could be used to evaluate quickly the intensity dependent sonothrombolytic effects with a throughput about 100 times as large as that of conventional methods.

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O21

**INTRAVASCULAR SONOTHROMBOLYSIS USING EKOS SYSTEM IN ACUTE STROKE PATIENTS - A PILOT STUDY**

*D. Skoloudik<sup>1</sup>; T. Fadrna<sup>1</sup>; M. Roubec<sup>1</sup>; M. Kuliha<sup>1</sup>; V. Prochazka<sup>2</sup>; T. Jonszta<sup>2</sup>; D. Czerny<sup>2</sup>; J. Krajca<sup>2</sup>*

<sup>1</sup>University Hospital Ostrava, Neurology, Ostrava, Czech Republic; <sup>2</sup>University Hospital Ostrava, Radiology, Ostrava, Czech Republic

**Background:** Sonothrombolysis is a new therapeutic procedure for arterial recanalization. The aim of study was to confirm the safety and efficacy of intravascular sonothrombolysis using EKOS system with 3F mikrocatheter EkoSonic and 2.05 – 2.35 MHz ultrasound frequencies. **Methods:** Nine patients admitted to the stroke unit since August 2009 to November 2010 with acute middle cerebral artery (MCA) or basilar artery (BA) occlusion were enrolled to the study. Treatment using EKOS system started within 8 hours after stroke onset. Neurological deficit on admission (using NIHSS), after 24 hours and after 7 days, MCA/BA recanalization at the end of intervention, occurrence of symptomatic intracerebral hemorrhage (SICH), and 3-month clinical outcome (using mRS) were evaluated. **Results:** Nine patients were included in the pilot study (6 males, 3 females, age range 51-80, mean 65±10.4 years) with NIHSS 10-33 (median 19.0) on admission. Five patients had MCA occlusion, 4 patients had BA occlusion. Complete/partial recanalization at the end of EKOS treatment was achieved in 3 (33%) / 4 (44%) patients, resp. Median NIHSS at the end of EKOS treatment/24 hours/7 days after stroke onset were 17.0/12.0/6.0, resp. No SICH was detected on control CT. Four (44%) patients were independent at 3 months (mRS 0-3); median mRS 4. **Conclusion:** EKOS system seems to be a new treatment option for acute stroke patients. Supported by: IGA MH CR grants NT/11386-5/2010, NT/11046-6/2010.

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O22

**ULTRASOUND CAN CONTROL EMBOLUS GROWTH**

*Y. Sawaguchi; Z. Wang; H. Furuhashi*

Medical Engineering Laboratory, Jikei University School of Medicine, Nishi-shinbashi, Minato-ku, Tokyo, Japan

**Background:** In order to prevent the reocclusion occurred after recanalization by t-PA treatment was in acute ischemic stroke (AIS) patients, we tested the hypothesis that ultrasound (US) can control the growth of embolus, by in vitro experiment. **Methods:** Discoidal clots were made by bovine plasma with CaCl<sub>2</sub> (final conc. 0.025 M) at 37 degrees C in a circular container with diameter 15 mm and depth 1.5 mm. Discoidal clots were enclosed to container and added bovine plasma, and ultrasonicated for 30 min in water bath at 37 degrees C. Thrombus growth control effect was evaluated by the optical absorbance changes before and after the ultrasonication. Thickness of clot was automatically calculated from the absorbance. US condition: frequency 500 kHz, continuous wave, average intensity 0.47 W/cm<sup>2</sup> (0.72 ~ 0.07 W/cm<sup>2</sup>), probe diameter 10 mm. The growth ratio of thrombus obtained that

ultrasound intensity and spatial change of clot thickness in one discoidal clot. **Results:** The thrombus growth was significantly suppressed in US group compared with non-US group. The thrombus growth effect was controlled by the intensity range from 0.72 to 0.28 W/cm<sup>2</sup> (p < 0.05). Moreover, the effect was escalated according to the intensity. **Conclusions:** Our hypothesis was verified by this experiment. It is anticipated that a transcranial US can be a clinical used for a novel the safety and simplified clinical method to prevent reocclusion cursed by thrombus regrowth. It is anticipated that transcranial US with low frequency and low intensity can be used for preventing the reocclusion after t-PA treatment to AIS patients.

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## Session VII: Veins and Brains

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S18

**BRAIN DRAIN - HEMODYNAMICS OF THE CEREBRAL VENOUS SYSTEM**

*S. Schreiber*

University Hospital Charité, Neurology, Berlin, Germany

How does the blood leave the brain? - a question too infrequently addressed? Approximately 60-70% of the global cerebral blood volume is located in the intracranial venous circulation. Although the cerebral veins and sinuses play an essential role in maintaining the equilibrium of cerebral perfusion, the focus in vascular research has always been on the brain supplying arteries. However, the knowledge about the physiology and pathophysiology of arterial hemodynamics can not directly be transferred to the venous system. Cerebral veins have a number of unique features, anatomical variants and blood flow characteristics that are important for the understanding of classical venous diseases like venous thrombosis, arteriovenous malformations or intracranial hemorrhage. Knowledge about venous hemodynamics is needed for a number of therapeutic decisions, e.g. placement of a central venous catheter or for performance of a radical neck dissection. It also helps to judge and interpret upcoming hypotheses, like the recently revived postulate of a causal relationship between venous stasis and multiple sclerosis. The presentation will give an overview about cerebral venous anatomy as well as its hemodynamic specifics with a special focus on venous vascular ultrasound.

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S19

**FACT OR FICTION: CHRONIC CEREBRO-SPINAL VENOUS INSUFFICIENCY (CCSVI)**

*C. Baracchini*

Clinica Neurologica I, Department of Neuroscience, University of Padua, Padua, Italy

Multiple sclerosis (MS) is an inflammatory and neurodegenerative disease of the central nervous system (CNS); its autoimmune origin has been recently challenged by a substantially different mechanism termed chronic cerebrospinal venous insufficiency (CCSVI), which has attracted significant attention in the scientific community but especially in the media and among MS patients. According to this hypothesis,

an abnormal drainage of venous blood from the brain and the spinal cord induces an increased intracranial pressure and a disintegration of the blood brain barrier in perivenular regions promoting local iron deposition and activation of pro-inflammatory factors leading ultimately to MS. After the initial report by Zamboni and coworkers of a perfect (100%) association between CCSVI and MS, a very uncommon finding in biological systems, different groups have found normal cerebral venous drainage in MS patients, casting doubts on the credibility of the CCSVI concept in MS. A critical appraisal of the CCSVI hypothesis is of an utter social importance, since many MS patients are asking for endovascular treatment, as suggested by Zamboni and coworkers, in spite of a lack of evidence and recent reports of serious adverse events.

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**O23**  
**CEREBROCERVICAL VENOUS DRAINAGE IN MULTIPLE SCLEROSIS - A COMPARATIVE STUDY OF ULTRASOUND AND MRI**

*F. Doepp<sup>1</sup>; F. Paul<sup>1</sup>; J. Würfel<sup>2</sup>; J. Valdueza<sup>3</sup>; S. Schreiber<sup>1</sup>*

<sup>1</sup>University Hospital Charité, Neurology, Berlin, Germany;

<sup>2</sup>University Hospital Charité, Radiology, Berlin, Germany;

<sup>3</sup>Segeberger Kliniken, Neurology, Bad Segeberg, Germany

**Background:** A chronic congestion of cerebrocervical venous outflow due to stenoses of cervical and thoracic veins might play a substantial role in the pathophysiology of MS. However, data are contradictory - possibly caused by the use of different diagnostic tools for assessment of the venous drainage. Here, we perform a combined comparative analysis using duplex ultrasound (DUS) and MR-venography (MRV). **Methods:** 37 patients (25 females, age 44±12 years, 29 RRMS, 8 SPMS) were enrolled. DUS of both internal jugular and vertebral veins (IJV/VV) was performed in a supine and in a sitting body position. Blood flow direction, blood flow velocity (BFV), cross-sectional area (CSA), and blood volume flow (BVF) were analysed. All patients underwent contrast-enhanced MRV for assessment of IJV and azygos vein stenoses. Both procedures were performed by different investigators blinded for the results of the other method. **Results:** DUS did detect one IJV-stenosis and in no patient a retrograde blood flow in the above described veins. MRV analysis yielded IJV-stenoses in 18 patients (49%; right:4, left:7, bilateral:7) but no stenosis in the azygos vein. Supine position BVF did not differ between patients with and without MRV detected IJV-stenosis (IJVs: 478±185 vs. 586±154 ml/min; p=0.1, VVs: 24±21 vs. 26±18 ml/min; p=0.8). Corresponding values in the sitting position were 199±170 vs. 123±82 ml/min (p=0.17) and 85±54 vs. 111±49 ml/min (p=0.22), respectively. **Conclusions:** MRI analysis of the cerebrocervical venous outflow in patients with MS is more sensitive in detection of proximal IJV stenoses compared to DUS. However, venous flow parameters between patients with and without IJV stenosis do not differ – arguing against the hemodynamic hypothesis of cerebrocervical insufficiency.

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**O24**  
**CHRONIC CEREBROSPINAL VENOUS INSUFFICIENCY (CCSVI) IN THE IRANIAN MS PATIENTS:THE PRILIMINARY REPORT**

*M. Mehrpour<sup>1</sup>; M. R. Motamed<sup>1</sup>; M. Nabavi<sup>2</sup>; M. A. Sahraian<sup>3</sup>*

<sup>1</sup>Tehran University of Medical Sciences, Department of Neurology, Firoozgar General Hospital, Behafarin St., Valiasr Sq, 1593748711, Tehran, Islamic Republic of Iran;

<sup>2</sup>Department of Neurology, Mostafa Khomeini Hospital, Shahed University of Medical Sciences, Tehran, Islamic Republic of Iran; <sup>3</sup>Tehran University of Medical Sciences, Department of Neurology, Sina Hospital, Tehran, Islamic Republic of Iran

**Introduction:** According to the recent studies, there is a great variability of CCSVI findings in both MS patients (ranging from 0 to 100%) and in control subjects (from 0 to 23%). This large variability is explained by methodological aspects, problems in assessing CCSVI, and differences among clinical series. The CCSVI theory does not fit into the existing bulk of scientific data concerning the pathophysiology of MS. Furthermore, most of the data we have comes from one source only. At our hospital and other MS Centres in the Tehran, we receive approximately inquiries per month about this treatment. Therefore we designed an observational study for determining the prevalence of CCSVI in Iranian and control group. We are in progress for this study. **Method:** We performed an extended extra- and transcranial color-coded sonography study including analysis of extracranial venous blood volume flow (BVF), cross-sectional areas and CCSVI criteria. Until now forty eight MS patients were studied including CIS, RRMS, SPMS AND PPMS. **Result:** Except for two patients, blood flow direction in the IJVs and VVs was normal in all subjects. In 18 of the subjects was IJV stenosis detected (37.5%). IJV and VV BVF in both groups were equal in the supine body position. No differences between patients were seen in intracranial veins and during VM. None of the subjects investigated in this study fulfilled >1 criterion for CCSVI. **Conclusion:** Our results challenge the hypothesis that cerebral venous congestion plays a significant role in the pathogenesis of MS. It needs to perform appropriate epidemiological studies to define the possible relationship between CCSVI and MS. Future studies should clarify the difference between patients and healthy subjects in BVF regulation. Based on the current scientific position we cannot justify invasive “therapeutic” approaches, especially if they are performed outside of clinical trials.

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**O25****ULTRASOUND FINDINGS OF THE OPTIC NERVE AND ITS ARTERIALVENOUS SYSTEM IN MULTIPLE SCLEROSIS PATIENTS**

*N. Carraro<sup>1</sup>; G. Servillo<sup>1</sup>; V. M. Sarra<sup>1</sup>; A. Bignamini<sup>2</sup>; G. Pizzolato<sup>1</sup>; M. Zorzon<sup>1</sup>*

<sup>1</sup>Az Osp-Univ "Ospedali Riuniti" Trieste, DUC SMTT - UCO di Clinica Neurologica Stroke Unit, Trieste, Italy; <sup>2</sup>University of Milan, School of Specialization in Hospital Pharmacy, Milano, Italy

**Background:** Optic Neuritis (ONe) is common in Multiple Sclerosis (MS). The aim of this study was to evaluate the Optic Nerve (ONr) and its vascularisation in MS patients with and without previous ONe and in healthy controls (HC). **Methods:** We performed high-resolution echo-color ultrasound examination in 50 subjects (29 MS patients and 21 HC). By a suprabulbar approach we measured the ONr diameter at 3 mm from the retinal plane and at an unfixed point. We assessed the flow velocities of: Ophthalmic Artery (OA), Central Retinal Artery (CRA) and Central Retinal Vein (CRV) measuring the Peak Systolic Velocity (PSV) and the End Diastolic Velocity (EDV) for the arteries and the Maximal Velocity (MaxV), Minimal Velocity (minV) and mean Velocity (mV) for the veins. The Pulsatility Index (PI) and the Resistance Index (RI) were also calculated. **Results:** We didn't find any major variations as block, obstruction or reverse flow. We found a trend for higher OA PSV in ONe MS eyes vs. HC; a trend for higher velocities (especially for PSV) in the CRA of non-ONe MS eyes vs. HC; significant higher PI in the CRV of non-ONe MS eyes vs. both HC and ONe MS eyes. ONr diameter decreased significantly from HC to non-ONe MS eyes and ONe MS eyes. **Conclusions:** Ultrasound examination of ONr and its vascularisation is feasible and can demonstrate ON atrophy. Higher PSV in the OA of the affected nerves may suggest a sort of flow diversion from the atrophic ONr. The increase of CRV PI in unaffected eyes of MS patients is intriguing and seems not associated to ONr atrophy. Larger studies are needed to confirm our results.

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**O26****JUGULAR VALVE INCOMPETENT IN TRANSIENT GLOBAL AMNESIA. A PROBLEM REVISITED**

*P. Lochner<sup>1</sup>; M. Kaps<sup>2</sup>; M. Nedelmann<sup>2</sup>; E. Stolz<sup>2</sup>*

<sup>1</sup>Tappeiner Hospital, Neurology, Merano, Italy; <sup>2</sup>Justus-Liebig Universität Giessen, Neurology, Giessen, Germany

**Background:** Previous studies have suggested the possibility that transient global amnesia (TGA) could be provoked by a cerebral venous congestion due to a reflux during Valsava manoeuvre (VM) jugular venous valve incompetence (IJVVI). However, so far intracranial venous circulation has not yet been examined. Furthermore, in up-right position the jugular veins collapse and it is not clear, whether then jugular valve incompetence does matter at all. **Methods:** IJVVI was assessed by means of extracranial colour-coded duplex sonography and defined as reflux >0.8 s during VM in 20 patients with TGA and 10 controls. The basal veins were examined by transcranial colour-coded sonography through the temporal bone window

registering flow velocities (FV) during rest and the lowest as well as the fastest FV during VM. These measurements were performed in the supine and in a sitting position. **Results:** IJVVI was identified in supine position in 14/20 (70%) of TGA patients and in 3/10 (30%) of controls ( $p < 0.05$ ) and in sitting position in 12/20 TGA patients and in 2/10 controls showing no effect of posture on IJVVI. Intracranial venous FV at rest and during VM did not differ between patients and controls, nor between persons with and without IJVVI. **Conclusions:** Consistent with results of other groups we found a significant preponderance of IJVVI in TGA patients compared to controls. However, no differences were found between intracranial venous FV at rest and during VM did not differ between patients and controls, nor between persons with and without IJVVI, which sheds doubt on the assumption of retrograde pressure wave during VM and in IJVVI.

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**O27****IPSILATERAL EVALUATION OF THE TRANSVERSE SINUS: TCCS APPROACH IN COMPARISON WITH MR VENOGRAPHY.**

*M. Zedde<sup>1</sup>; G. Malferrari<sup>1</sup>; G. De Berti<sup>2</sup>; M. Maggi<sup>2</sup>; N. Marcello<sup>3</sup>*

<sup>1</sup>ASMN, Neurology, Stroke Unit, Reggio Emilia, Italy; <sup>2</sup>ASMN, Neuroradiology, Reggio Emilia, Italy; <sup>3</sup>ASMN, Neurology, Reggio Emilia, Italy

**Background** The ultrasound examination of intracranial venous structures by TCCS is a validated application and the venous planes are well standardized, often as different from the arterial ones. Similarly some intracranial venous sinuses are known for their relatively low insonation rate, as straight sinus (SRS) and transverse sinus (TS), ranging from 35% to 73%. The relatively high frequency of hypoplasia of TS can partially take account for these data, with the course close to the occipital bone, and these data make difficult to distinguish between hypo-aplasia and thrombosis of TS. During the intracranial venous examination with Virtual Navigation protocol, we applied also an ipsilateral approach to the TS, for identifying both the proximal and the distal segments. The aim of this study is to evaluate the feasibility of this approach in a standard TCCS examination, in comparison with MR findings. **Patients and Methods** The standardized approach to the TS was a contralateral insonation, starting to the SRS plane and angulating downwards the probe. In this way it is possible to insonate the proximal segment of the contralateral TS. We proposed a new approach with an extreme downwards tilting and a slow opposite angulation of the probe for examining the ipsilateral TS. 40 consecutive subjects were chosen among patients who underwent standard TCCS examinations at our lab and had a suitable temporal acoustic window and a recently performed intracranial MR venography. The contralateral insonation rate of the transverse sinus was compared with the ipsilateral insonation with the new approach. **Results** The insonation rate was 61/80 (76.25%) for the contralateral TS and 75/80 (93.75%) for the ipsilateral approach. 2 of 5 not detectable TS were aplasic in MRA and the others were not identified by a poor acoustic window. **Conclusions** The Ipsilateral approach

could be associated to the contralateral standard study for insonating the TS.

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## Session VIII: Novel Technologies II

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### S20

#### ACT ON STROKE – OPTIMIZE THE MATURITY LEVEL OF CLINICAL PROCESSES AND WORKFLOW FOR STROKE DIAGNOSIS AND TREATMENT

*B. Hofmann*

Siemens AG, Healthcare Sector Neuroscience, Erlangen, Germany

### S21

#### FUNCTIONAL GUIDANCE IN INTRACRANIAL TUMOR SURGERY / ACCURACY OF PREOPERATIVE NAVIGATED BRAIN STIMULATION FOR SURGERY IN CENTRAL REGION TUMORS

*B. Meyer*

Klinikum rechts der Isar der Technischen Universität München, Neurosurgical Clinic and Policlinic

**Objective:** Navigated brain stimulation (NBS) is a newly evolving technique. For neurosurgical purposes, e.g. preoperative mapping of the central region little is known about the accuracy compared to direct cortical stimulation (DCS) and functional MRI (fMRI). **Methods:** We examined 26 patients with tumors in motor eloquent cerebral regions using navigated brain stimulation (NBS) with the Nexstim eXimia system. In 14 cases the lesion was located within or adjacent to the precentral gyrus, whereas it was in the subcortical white matter motor tract in 12 cases. Navigated transcranial magnetic stimulation was performed for motor cortex mapping, data was sent to the neuronavigation system, and compared with intraoperative mapping. **Results:** In 14 cases of lesions of the precentral gyrus, preoperative motor cortex mapping correlated well with intraoperative DCS with a deviation of  $4.4 \pm 3.4$  mm. Comparing NBS with fMRI, deviation was  $9.6 \pm 7.9$  mm for upper and  $14.7 \pm 12.4$  mm for lower extremity. In 13 out of 14 cases the surgeon admitted identification of the central region to be easier by NBS data whereas it increased confidence of the surgeon in 7 cases. In 5 out of 12 cases, the surgeon recognized a positive influence of on the operative result while it even changed strategy in 2 cases. One patient experienced NBS as unpleasant, none as painful. **Conclusion:** NBS correlates well with DCS as gold standard despite many factors, which are supposed to contribute to inaccuracy of the method. Moreover, NBS is accepted by the surgeon as an additional and helpful modality during resection of tumors within motor eloquent areas but also during preoperative planning.

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### S22

#### COMBINED MR-SYSTEMS AS A CHANCE IN STROKE DIAGNOSTICS

*M. Pflaum*

Siemens AG, Healthcare Sector Neuroscience, Erlangen, Germany

Combined systems or better said 'Hybrid' systems are offering greatly enhanced capabilities by combining the advantages of each of the modalities. Prominent examples are PET-CT or recently introduced PET-MR systems. We are exploring the potential of the combination of MR and angiographic systems to further advance stroke diagnosis and therapy.

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### O28

#### VIRTUAL NAVIGATOR STUDY. SUBSET OF PRELIMINARY DATA ABOUT VENOUS CIRCULATION.

*M. Zedde<sup>1</sup>; G. Malferrari<sup>1</sup>; G. De Berti<sup>2</sup>; M. Maggi<sup>2</sup>; L. Lodigiani<sup>3</sup>; N. Marcello<sup>4</sup>*

<sup>1</sup>ASMN, Neurology, Stroke Unit, Reggio Emilia, Italy; <sup>2</sup>ASMN, Neuroradiology, Reggio Emilia, Italy; <sup>3</sup>Esaoite, Ultrasound Operational Marketing, Genova, Italy; <sup>4</sup>ASMN, Neurology, Reggio Emilia, Italy

**Background:** Neuroradiological techniques are known for their high spatial resolution in imaging of intracranial structures, in comparison with neurosonological techniques (TCCS), known for their high temporal resolution. An ideal study of intracranial circulation should combine the high temporal resolution of ultrasound with the high spatial resolution of MR. This imaging fusion system is actually used for the ultrasound liver examination and it is known as Virtual Navigator. But this ideal tool could improve the evaluation not only of the arterial system but also of intracranial veins and sinuses, because of the lower insonation rate of the last ones by standard TCCS. Therefore we implemented and applied to a preliminary small sample the Virtual Navigator system for the examination of the intracranial venous haemodynamics. **Patients and Methods:** 14 consecutive subjects (7 men and 7 women, mean age 51.5 years) were chosen among patients who underwent standard TCCS examinations at our lab and had age > 18 years, a suitable temporal acoustic window and a recently performed intracranial MR venography. The MR study was uploaded in the ultrasound platform and the Virtual Navigation protocol was performed, matching the ultrasound examination and MR by using a magnetic tracking system, solidary with the probe, and a reference alignment plane. The axial scanning approach was used from the temporal window and the standard TCCS examination was compared with the Virtual Navigator examination, according to the validated scanning planes for the venous study, for the insonation rate of the basal vein of Rosenthal (BVR), Galen vein (GV), Straight sinus (SRS) and transverse sinus (TS). **Results:** The insonation rates of the venous structures are only slightly improved for BVR (from 92.8% to 100%) but are substantially increased for SRS and TS (for this last one from 71.43% to 85.71%). **Conclusions:** The Virtual Navigator protocol can help to insonate the intracranial venous system.

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O29

**CLINICAL ASSESSMENT OF NON-INVASIVE METHOD FOR ABSOLUTE INTRACRANIAL PRESSURE MEASUREMENT**

A. Ragauskas<sup>1</sup>; R. Sunokas<sup>1</sup>; R. Zakelis<sup>1</sup>; G. Daubaris<sup>1</sup>; V. Matijosaitis<sup>2</sup>; K. Petrikonis<sup>2</sup>; D. Rastenyte<sup>2</sup>

<sup>1</sup>Kaunas University of Technology, Telematics (biomedical) Scientific Laboratory, Kaunas, Lithuania; <sup>2</sup>Hospital of Lithuanian University of Health Sciences Kaunas Clinics, Neurology, Kaunas, Lithuania

**Background:** An absolute ICP (aICP) measurement method was proposed which at first time does not need calibration of the system "individual patient and non-invasive aICP meter". Objective of the clinical study was to collect simultaneous non-invasive and "golden standard" invasive ICP measurement data for a wide group of neurological and neurointensive care patients (patients with idiopathic intracranial hypertension, multiple sclerosis, etc.) in the wide range of aICP values below and above the critical threshold 20 mmHg. **Methods:** Method is based on two-depth TCD technique for aICP and external absolute pressure (aPe) comparison. The intracranial segment of the ophthalmic artery (OA) is compressed by aICP, whereas extracranial - by the controlled aPe. The blood flow parameters in both OA segments are approximately the same in the case aPe=aICP. Two depth TCD device is used as an indicator of aPe=aICP. Clinical study of simultaneous invasive and non-invasive aICP measurements has been performed on neurological patients during standard lumbar puncture procedure. The average age of patients was 38.72 years (from 18 to 78 years). Spinal CSF pressure which is equal to aICP was measured using invasive "golden standard" CSF column method and disposable invasive aICP meters. **Results:** 54 simultaneous "golden standard" invasive and non-invasive aICP measurements on 45 neurological patients were performed increasing Pe step by step (Pe sampling step was 4.0 mmHg) from 0 mmHg until 24 mmHg. Bland Altman plot of the differences between simultaneous invasive and non-invasive aICP measurements showed mean difference of 0,31 mmHg in the mean aICP range of 0-24 mmHg. **Conclusions:** New non-invasive aICP measurement method does not need calibration of the system "individual patient and non-invasive aICP meter". The evidence of that is a negligible systematic error (Mean  $\Delta=0,31\text{mmHg}$ ). New method is accurate enough for clinical practice ( $\text{SD}\pm 2,23\text{ mmHg}$ ).

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O30

**SONOGRAPHIC ASSESSMENT OF THE OPTIC NERVE SHEATH IN IDIOPATHIC INTRACRANIAL HYPERTENSION**

J. Bäuerle<sup>1</sup>; M. Nedelmann<sup>2</sup>

<sup>1</sup>Gesundheitszentrum Wetterau, Department of Psychiatry and Psychotherapy, Friedberg, Germany; <sup>2</sup>Justus-Liebig-University Giessen, Department of Neurology, Giessen, Germany

**Background:** To investigate the potential of ultrasound-based optic nerve sheath diameter (ONSD) measurements in detecting raised intracranial pressure in patients with idiopathic intracranial hypertension (IIH) and to describe ONSD response to lumbar puncture. **Methods:** In ten patients with newly diagnosed IIH, transorbital sonography was carried out assessing ONSD, OND (optic nerve diameter) and optic disc elevation before and after lumbar puncture. 25 patients with other neurological disorders served as controls. **Results:** Subjects with IIH showed a significantly enlarged ONSD on both sides ( $6.4 \pm 0.6\text{ mm}$  vs.  $5.4 \pm 0.5\text{ mm}$  in controls;  $p < 0.001$ ). The best cut-off value of ONSD for detecting raised ICP was 5.8 mm with a sensitivity of 90% and a specificity of 84%. After lumbar puncture ONSD decreased bilaterally (right  $5.8 \pm 0.7\text{ mm}$ ,  $p < 0.004$ ; left  $5.9 \pm 0.7\text{ mm}$ ,  $p < 0.043$ ). No post-puncture changes could be observed with regard to OND and optic disc elevation. **Conclusions:** Sonographic ONSD evaluation may be useful as an additional tool to identify patients with raised intracranial pressure, as in IIH. In addition, our data suggest a potential usefulness of this method for monitoring of treatment effects. The degree of ONSD response to lumbar puncture is differing in subjects with IIH, which may possibly be related to findings of a defective CSF circulation in the optic nerve sheath in this disorder, a state that is referred to as optic nerve compartment syndrome.

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O31

**SAFETY EVALUATION OF SUPERHEATED PERFLUOROCARBON NANODROPLETS FOR NOVEL NEUROLOGICAL THERAPY**

J. Shimizu<sup>1</sup>; R. Endoh<sup>1</sup>; T. Fukuda<sup>2</sup>; T. Inagaki<sup>2</sup>; H. Hano<sup>3</sup>; R. Asami<sup>4</sup>; K.-I. Kawabata<sup>4</sup>; M. Yokoyama<sup>5</sup>; H. Furuhashi<sup>1</sup>

<sup>1</sup>Medical Engineering Laboratory, Research Center for Medical Sciences, Jikei University School of Medicine, Tokyo, Japan; <sup>2</sup>Division of Neuropathology, Department of Neuroscience, Research Center for Medical Sciences, Jikei University School of Medicine, Tokyo, Japan; <sup>3</sup>Department of Pathology, Jikei University School of Medicine, Tokyo, Japan; <sup>4</sup>Life Science Research Center, Central Research Laboratory, Hitachi, Ltd, Tokyo, Japan; <sup>5</sup>Kanagawa Academy of Science and Technology and Medical Engineering Laboratory, Research Center for Medical Sciences, Jikei University School of Medicine, Kanagawa and Tokyo, Japan

**Background and Purpose:** Sonothrombolysis using diagnostic ultrasound (US) in combination with microbubble (MB) contrast agents is an attractive trial. Superheated perfluorocarbon nanodroplets (SPN), which can turn into MB

upon US trigger, may have advantages in sonothrombolysis. As a preliminary investigation of SPN-assisted sonothrombolysis, we performed a safety evaluation in vivo. **Method:** 19 male rabbits (2.59±0.14kg) were assigned to three groups: Control group (n=6), 2.2 ml/kg of physiological saline i.v. in auricular vein; PL group (n=7), 25 mg/kg of phospholipid-coated SPN i.v.; AA group (n=6), 25mg/kg of SPN coated with poly (aspartic acid) derivative i.v.. Anesthesia: midazolam (0.4mg/kg) + medetomidin (0.08mg/kg) i.m.. Rectal temperatures were maintained at 39.08±0.98°C. Neurological evaluation and biochemical blood examination were performed at pre-injection, 1, 4, 7 days after injection. Organ samples including heart, lungs, liver, spleen and kidneys were harvested after euthanasia. Neurologically positive brain was obtained after perfusion of 10% buffered formalin. **Results:** Within an hour after administration of SPN, four cases in both PL and AA showed a reversible change in respiration. One animal in AA showed transient horizontal nystagmus about 20 minutes after administration, however there was no neuropathological damage. No histological damage was confirmed in any organ sample of all animals. Moreover, in biochemical blood examination, no significant difference was found between PL, AA, and control groups (Dunnet test, p>0.05). **Conclusions:** No neurological damage or histological change was confirmed with two SPNs. According to our previous experiments with rats, the SPN dose used this time is assumed to be high enough to generate microbubble in vivo by 1 or 3 MHz US. We'll further investigate the SPN-assisted sonothrombolysis, using previously obtained in vitro results that the 500 kHz US exposure with bubble liposome can accelerate rt-PA efficacy.

### O32

#### DOPPLERSONOGRAPHIC EXAMINATION OF THE MIDDLE MENINGEAL ARTERY'S EXTRACRANIAL PORTION

M. Lepic<sup>1</sup>; T. Lepic<sup>1</sup>; D. Veljancic<sup>1</sup>; O. Jovanikic<sup>2</sup>; B. Labovic<sup>1</sup>; Z. Krsmanovic<sup>1</sup>; R. Raicevic<sup>1</sup>

<sup>1</sup>Military Medical Academy, Department of Neurology, Belgrade, Serbia; <sup>2</sup>Military Medical Academy, Department of Neurosurgery, Belgrade, Serbia

**Background and purpose:** Vasoneural mechanisms and secondary vasodilatation of meningeal arteries are the basis of migraine pathophysiology. In order to study meningeal hemodynamic phenomena in vascular headaches, dopplersonography may be used as the only noninvasive, safe and reproducible method, which is often interfered by the skull shadowing of the ultrasound signal, and therefore not used commonly. Middle meningeal artery, branch of the internal maxillary artery (first mandibular portion), is the largest of the arteries which supply the dura mater and its role in headache genesis is of great importance. **Methods and results:** The aim of the study was to test and present a dopplersonographic method to examine the extracranial part of the middle meningeal artery. 40 subjects were examined (20 migraine patients and 20 controls). Satisfying presentation of the artery at the depth of 20-30 mm was made below the zygomatic arch, in front of the temporomandibular joint, using the 7-11 MHz linear transducer

in color and pulse Doppler mode. A significant difference in registered flow between left and right artery was more common in migraine patients. **Conclusion:** A dopplersonographic examination of the middle meningeal artery blood flow may be helpful in understanding the hemodynamic changes in migraine patients and the pharmacologic treatment effects.

### O33

#### IMPROVED PERI-OPERATIVE NEUROLOGICAL SCREENING REDUCES POSTOPERATIVE DELIRIUM AFTER CABG SURGERY.

R. W. M. Keunen<sup>1</sup>; W. Palmbergen<sup>2</sup>; A. van Sonderen<sup>2</sup>; A. Falsafi<sup>3</sup>

<sup>1</sup>Haga Teaching Hospitals, Neurology & Clinical Neurophysiology, The Hague, Netherlands; <sup>2</sup>Haga Teaching Hospitals, Neurology, The Hague, Netherlands; <sup>3</sup>Haga Teaching Hospitals, Cardiovascular Surgery, The Hague, Netherlands

**Background:** Postoperative delirium in cardiac surgery is a severe complication. Risk factors are higher age, bilateral carotid artery stenosis, pre-existing cognitive disturbances, previous episodes of delirium, substance abuse and perioperative silent cerebral ischemia. To reduce delirium rate after CABG surgery the Haga Brain Care Strategy (HBCS) has been developed, consisting of preoperative evaluation of cerebral hemodynamics by transcranial Doppler (TCD) and perioperative cerebral oximetry. The difference in delirium rate in patients who had surgery before implementation is compared to the rate in patients who had surgery during implementation of the strategy. **Methods:** A total number of 643 patients was enrolled. The control group had surgery in 2009, before HBCS implementation. Patients in the study group underwent surgery during implementation in 2010. These patients were subjected to preoperative TCD (Delica 9 series, Shenzhen Delicate Electronics Co. LTD., China) and perioperative cerebral oximetry (Invos, Somanetics, USA). If cerebral oximetry showed desaturations during surgery, measures were taken to restore oxygenation into the normal range. Data of the occurrence of delirium and the length of stay were collected to evaluate the effect of the HBCS. **Results:** Due to functional reasons, we were not able to perform TCD and oximetry in every patient in the study group: 64.1% was subjected to TCD, 49.1% had cerebral oximetry. The overall rate of delirium decreased from 13.3% in the control group to 7.3% in the study group (p < 0.019). The mean length of stay at the ICU decreased from 2.1 days in 2009 to 1.8 days in 2010. A significant reduction was seen in the number of patients who was at the ICU for 3 days or longer (p < 0.019). **Conclusion:** Improved neurological screening was associated with a reduced delirium rate in the study group. Randomized studies are needed to confirm this effect and to determine the influence of TCD and cerebral oximetry separately.

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## Session IX: My Worst Case / My Best Case

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### INTRODUCTION

F. Schlachetzki (Germany)

University of Regensburg, Department of Neurology,  
Regensburg, Germany

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### O34

#### “TO STENT OR NOT TO STENT.” SPONTANEOUS DISSECTION OF THE ICA WITH IMMINENT MALIGNANT MCA INFARCTION

M. A. Ritter; R. Dittrich; F. Dechent; E. B. Ringelstein  
University Hospital of Muenster, Department of Neurology,  
Muenster, Germany

**Background:** Spontaneous Dissection of the internal carotid artery is one of the most frequent causes for stroke in persons under the age of 50. There is no clear evidence which therapy is the best to prevent first or subsequent stroke in case of near occlusion of the carotid artery. **Case description:** A 37-year old man had suffered acute spontaneous dissection of the right ICA presenting with local symptoms only. On clinical exam, he showed Horner's syndrome on the right, but there were no signs of stroke. Imaging showed a dissection of the right carotid artery with only minimal collateral flow. Ultrasound showed a pre-occlusion signal in the cervical ICA and pseudo-venous flow in the MCA and ACA. There was no functional cross flow from the AcomA or the ipsilateral PcomA. Furthermore, both ACAs originated from the affected right ICA, the left A1-segment was hypoplastic. Therefore, in case of complete occlusion of the right ICA the patient would have suffered from complete MCA infarction on the right, and ACA infarctions in both hemispheres. Therefore, stenting of the dissected right ICA to prevent disabling stroke was considered and heavily debated. Finally, the patient was treated with induced hypertension and continuous clinical monitoring on our intensive care unit, and stenting was omitted. Within days the hypoplastic ipsilateral PcomA became functional, and within 10 days the occluded ICA reopened spontaneously. No stroke symptoms occurred and no silent brain infarctions could be detected on DWI imaging either. Six months after the event, the patient was free of symptoms. **Conclusion:** Stenting of dissections of the brain supplying arteries is a tempting procedure in case of severely compromised flow in the basal brain arteries. However, it is justified to treat conservatively in the absence of definite stroke symptoms.

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### O35

#### INTRAVASCULAR PAPILLARY ENDOTHELIAL HYPERPLASIA AT THE ORIGIN OF INTERNAL CAROTID ARTERY

N. Carraro<sup>1</sup>; V. M. Sarra<sup>1</sup>; A. Gorian<sup>1</sup>; P. Martingano<sup>2</sup>; F. Pancrazio<sup>3</sup>; S. Bucconi<sup>4</sup>; G. Pizzolato<sup>1</sup>; F. Chioldo Grandi<sup>1</sup>  
<sup>1</sup>Az Osp-Univ "Ospedali Riuniti" Trieste, DUC SMTT - UCO di Clinica Neurologica Stroke Unit, Trieste, Italy; <sup>2</sup>Az Osp-Univ, DUC SMTT - UCO di Radiologia, Trieste, Italy; <sup>3</sup>Az Osp-Univ, DUC ACADEM - UCO di Chirurgia Vascolare, Trieste, Italy; <sup>4</sup>Az Osp-Univ, DUC ACADEM - UCO di Anatomia e Istologia Patologica, Trieste, Italy

**Introduction:** Intravascular papillary endothelial hyperplasia (IPEH), also known as Masson's tumor, is a rare non neoplastic vascular lesion caused by the abnormal endovascular proliferation of endothelial cells. We described the case of an ischemic stroke due to an IPEH localized at the origin of the Internal Carotid Artery. **Case Report:** A 43 yrs old female with no previous history of neurological diseases, was admitted to our Department of Clinica Neurologica - Stroke Unit because of a left hemiparesis. She felt her left arm somehow strange, weak and "cold" in the previous afternoon, but believing it was just fatigue she went to sleep. A mild left sensorimotor hemiparesis, with a NIHSS of 8, was found at the first neurological examination. The brain CT scan performed at the admission showed a right fronto-parietal ischemic stroke (PACI). The Extracranial US showed at the origin of Internal Carotid Artery a hyperechogenic lesion different from an atherosclerotic plaque, being homogeneous, lightly separated from the arterial wall in its distal portion, with no flapping movement evident, with a cross sectional area reduced of 77% without flow acceleration. At TCCD all the major brain arteries were insonated and an asymmetry of the MCA velocities (R

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### O36

#### “A HORSE, A HORSE, MY KINGDOM FOR A HORSE”. SADDLE THROMBOSIS OF CAROTID BIFURCATION IN ACUTE STROKE

E. Vicenzini<sup>1</sup>; M. F. Giannoni<sup>2</sup>; G. Sirimarco<sup>3</sup>; M. C. Ricciardi<sup>4</sup>; C. Zuco<sup>3</sup>; E. Sbarigia<sup>5</sup>; V. Di Piero<sup>4</sup>; F. Speziale<sup>5</sup>; G. L. Lenzi<sup>3</sup>

<sup>1</sup>Sapienza Università di Roma, Dept Neurology and Psychiatry, Rome, Italy; <sup>2</sup>Sapienza Università di Roma, Dept Paride Stefanini Vascular Surgery, Vascular Ultrasound Investigation, Rome, Italy; <sup>3</sup>Dept Neurology and Psychiatry, Viale dell'Università 30, 00185, Roma, Italy; <sup>4</sup>Sapienza University of Rome, Dept Neurology and Psychiatry, Rome, Italy; <sup>5</sup>Sapienza University of Rome, Paride Stefanini, Vascular Surgery, Policlinico Umberto I, Rome, Italy

**Background:** Saddle thrombosis, a common event observed at the sites of vessels bifurcations in peripheral arteries embolism, is less frequently detected in carotid arteries. The clot and the distal vessel patency have to be promptly recognized in these cases, because if the vessel is open distally, chances may arise for successful emergent surgical procedures to remove the thrombus. At conventional static imaging, mobile floating

thrombus may be difficult to differentiate from carotid stenosis of atherosclerotic origin. Ultrasound, with its unique capability of real-time imaging, adds important data for pathophysiology understanding. We describe 2 cases of uncommon carotid bifurcation saddle thrombosis of cardiac origin, a case of retrograde thrombosis from siphon occlusion and a case of local thrombus superimposed on the ruptured surface of an atherosclerotic plaque. **Methods:** Carotid ultrasound has been performed in acute stroke patients with high-resolution probes. Real-time clips are analyzed and imaging presented. **Results:** Saddle carotid bifurcation thrombosis of cardiac origin has been identified in 2 patients with acute homolateral ischemic stroke, with prompt successful surgical removal in one case. These cases could be easily differentiated from retrograde internal carotid artery thrombosis due to distal intracranial siphon occlusion, where surgery is not indicated. Moreover, an example of local thrombosis superimposed on the ruptured surface of a complicated atherosclerotic plaque in an acute symptomatic patient, that brought the patient to successful emergent surgery, is described. **Conclusions:** High-resolution ultrasound with real-time imaging can easily identify peculiar characteristics of carotid vulnerable diseases. Different clinical implications result from the identification of these different conditions in acute stroke patients, modifying the therapeutical strategies.

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## Session X: Call for Neurosonography Multicenter Trial Collaborations

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### INTRODUCTION

*E. B. Ringelstein*

University Hospital of Muenster, Department of Neurology,  
Muenster, Germany

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### O37

#### ITALIAN MULTICENTER STUDY ON VENOUS HEMODYNAMICS IN MULTIPLE SCLEROSIS. BASIC PROTOCOL.

*M. Del Sette<sup>1</sup>; G. Malferrari<sup>2</sup>; M. Zedde<sup>2</sup>; S. Sanguigni<sup>3</sup>; N. Carraro<sup>4</sup>; C. Baracchini<sup>5</sup>; M. Mancini<sup>6</sup>; E. Stolz<sup>7</sup>*

<sup>1</sup>Ospedale Sant'Andrea, Neurology, La Spezia, Italy; <sup>2</sup>ASMN, Neurology, Stroke Unit, Reggio Emilia, Italy; <sup>3</sup>Ospedale madonna del Soccorso, Neurology, San Benedetto del Tronto, Italy; <sup>4</sup>Ospedale Cattinara, Neurology, Trieste, Italy; <sup>5</sup>Azienda Ospedaliera di Padova, Neurology, padova, Italy; <sup>6</sup>Consiglio Nazionale delle Ricerche, Istituto di Biostrutture e Bioimmagini, Napoli, Italy; <sup>7</sup>Giessen University, Neurology, Giessen, Germany

**Background:** In the recent literature it has been proposed the involvement of the cerebrospinal venous haemodynamic in multiple sclerosis. The evaluation of venous hemodynamic was performed by sonological techniques, but both methodological pitfalls and huge range of prevalence rate among different studies are a claim for further investigations. In order to achieve stronger evidences from a large sample of subjects, a neurosonological study, designed with a strictly rigorous methodology is needed.

The aim of our study is to compare the prevalence of Chronic Cerebro-Spinal Venous Insufficiency (CCSVI) in patients with Multiple Sclerosis (MS), with the prevalence in patients affected by other neurodegenerative disorders and in healthy subjects. **Study design:** This is a multicenter, observational study. A minimum of 1200 adults with MS, 400 healthy subjects and 400 subjects with other neurodegenerative disorders (2000 subjects in total) will be enrolled in the study. The Echo Color Doppler examination will always be performed according to a standard protocol, whose measurements are mandatory for all clinical centers. The basic protocol includes the evaluation of the already published diagnostic criteria for CCSVI, measure in a "double blind design". The neurosonologists involved in the study were carefully selected by their background and experience and were properly trained for the application of the protocol during the preliminary phase before the study started. Then, the ultrasound examination done at each clinical site will be followed by a second centralized blinded evaluation. This will also give information on the inter-observed agreement for the diagnosis of CCSVI. The prevalence of CCSVI in MS will be estimated, and compared with the prevalence in normal controls and in other neurological diseases. The sensitivity, specificity and accuracy of the technique will be estimated with their 95% confidence intervals.

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### O38

#### ITALIAN MULTICENTER STUDY ON VENOUS HEMODYNAMICS IN MULTIPLE SCLEROSIS. ADVANCED PROTOCOL

*G. Malferrari<sup>1</sup>; M. Del Sette<sup>2</sup>; M. Zedde<sup>2</sup>; S. Sanguigni<sup>3</sup>; N. Carraro<sup>4</sup>; C. Baracchini<sup>5</sup>; M. Mancini<sup>6</sup>; E. Stolz<sup>7</sup>*

<sup>1</sup>ASMN, Neurology, Stroke Unit, Reggio Emilia, Italy;

<sup>2</sup>Ospedale Sant'Andrea, Neurology, La Spezia, Italy;

<sup>3</sup>Ospedale Madonna del Soccorso, Neurology, San

Benedetto del Tronto, Italy; <sup>4</sup>Ospedale Cattinara, Neurology, Trieste, Italy; <sup>5</sup>Ospedale di Padova, Neurology, Padova, Italy;

<sup>6</sup>Consiglio Nazionale delle Ricerche, Istituto di Biostrutture e Bioimmagini, Napoli, Italy; <sup>7</sup>Giessen University, Neurology, Giessen, Germany

**Background:** Because of the recent hypothesis of involvement of the cerebrospinal venous haemodynamics in multiple sclerosis, and because of the potential methodological pitfalls of these studies, there is the need to achieve a definite conclusion from a large sample of subjects by using a strict and controlled neurosonological protocol. This protocol should be somehow independent from the not fully- validated sonological techniques shown in some recent studies. The aim of the advanced protocol, designed for a subgroup of the FISM study, is to analyze several items of the extracranial and intracranial venous hemodynamics in the selected population (patients and controls) in order to obtain more pathophysiological data on venous circulation. **Study design:** This is a multicenter, observational study. From a pool of about 1200 adults with MS, 400 healthy subjects and 400 subjects with other neurodegenerative disorders (2000 subjects in total) will be selected a population able to be examined by the advanced protocol. The examiner will always be blind on the clinical diagnosis, and the exams will be performed according to a

standard protocol, whose measurements are mandatory for all participating centers. The advanced protocol is on a voluntary basis and it is optional. It includes, besides the basic one, measurements of blood flow volumes in carotid and vertebral arteries and in jugular and vertebral veins (inflow and outflow), with the definition of the drainage pattern. The neurosonologists are selected by strict criteria, including their previous experience and are properly trained for the application of the advanced protocol. The ultrasound examination at each clinical site will be followed by a second centralized blinded evaluation. The prevalence of CCSVI in MS will be estimated, with confidence intervals at 95%, and compared with the prevalence in other groups. Moreover, multiple analysis will be done comparing venous hemodynamics in the three different groups.

### O39

#### PLANNING A MULTI-CENTER EFFICACY TRIAL OF SONOTHROMBOLYSIS

A. V. Alexandrov<sup>1</sup>, G. Brandt<sup>2</sup>, A. Barreto<sup>3</sup>, P. D. Schellinger<sup>4</sup>, M. Kohrmann<sup>5</sup>, K. Barlind<sup>6</sup>, R. Mikulik<sup>7</sup>, M. R. Vosko<sup>8</sup>, G. Tsvigoulis<sup>9</sup>, K. Muir<sup>10</sup>, G. Ford<sup>11</sup>, C. A. Molina<sup>12</sup>

<sup>1</sup>University of Alabama Hospital, Department of Neurology, Comprehensive Stroke Center, Alabama, United States; <sup>3</sup>The University of Texas Medical School at Houston, Department of Neurology, Houston, United States <sup>4</sup>Klinikum Minden, Neurological Clinic, Minden, Germany; <sup>5</sup>Universitätsklinikum Erlangen, Department of Neurology, Erlangen, Germany; <sup>6</sup>Technische Universität Dresden, Neurological Clinic and Neuroclinic, Dresden, Germany; <sup>7</sup>St. Anna Hospital, Masaryk University, Brno, Czech Republic; <sup>8</sup>General Hospital of the City of Linz, Neurological Clinic, Linz, Germany; <sup>9</sup>Thrace University Medical School, Department of Neurology, Alexandroupolis, Greece; <sup>10</sup>Southern General Hospital Glasgow, Clinical Neurosciences, Glasgow, United Kingdom; <sup>11</sup>Newcastle University, <sup>11</sup>Clinical Research Facility Royal Victoria Infirmary, Newcastle, United Kingdom; <sup>12</sup>Vall d'Hebron Stroke Unit, Hospital Universitari Vall d'Hebron, Barcelona, Spain

**Background & Purpose:** A recent meta-analysis (Stroke 2010;41:280-287) showed that ultrasound with or without microspheres can safely double the rate of tissue plasminogen activator (tPA)-induced early recanalization after acute ischemic stroke. **Subjects & Methods:** Our multi-center group is confirming safety and applicability of a novel operator-independent device for sonothrombolysis (Cerevast Therapeutics, Seattle, WA) in an ongoing phase II clinical study sponsored through the NINDS-SPOTRIAS program (UT-Houston and University of Alabama Stroke Programs). **Results:** Based on phase I-II clinical trials data, we are organizing a multi-national controlled clinical trial to demonstrate the efficacy of sonothrombolysis for acute ischemic stroke patients treated with systemic tPA as standard of care. All patients will receive iv tPA and will be randomized 1:1 to treatment with pulsed wave 2 MHz ultrasound vs sham treatment. Outcomes (mRS 0-1) will be assessed at 3 months. **Conclusions:** Sonothrombolysis can be applied as a front-line technology to augment the only approved therapy for acute ischemic stroke, and our collaborative group is preparing for an efficacy trial.

## Poster Presentations

### I Atherosclerotic Plaque 1

#### P1

#### ARTERIAL STIFFNESS INDICES IN PATIENTS WITH CHRONIC PERIODONTITIS

I. Puhar<sup>1</sup>; A. Lovrencic-Huzjan<sup>2</sup>; D. Plancak<sup>1</sup>; D. Sodec-Simicevic<sup>2</sup>; M. Strineka<sup>2</sup>; V. Demarin<sup>2</sup>

<sup>1</sup>School of Dental Medicine, Department of Periodontology, Zagreb, Croatia; <sup>2</sup>University Hospital "Sestre milosrdnice", University Department of Neurology, Zagreb, Croatia

**Background:** Inflammatory periodontal disease is recognized as a risk factor for the development of atherosclerosis. The aim of this study was to assess the relationship between periodontal condition and arterial stiffness, compared to the periodontally healthy subjects. **Methods:** The study included 20 patients with chronic periodontitis (test group, 9 men and 11 women, mean age  $57.5 \pm 11.0$  years) and 18 patients with healthy periodontium (control group, 7 men and 11 women, mean age  $58.4 \pm 8.2$  years). Periodontal condition was assessed in terms of clinical attachment level with a periodontal probe. Arterial stiffness measurements on common carotid artery (CCA) were performed using Aloka ProSound ALPHA 10 with 13 MHz linear probe. **Results:** In comparison with the control group, test group showed statistically significant difference ( $p < 0.01$ ) in the mean beta stiffness ( $11.06 \pm 3.96$ ), augmentation index ( $14.93 \pm 11.36$ ) and pulse wave velocity ( $7.48 \pm 1.33$ ), but only when measured on left CCA. Test group also showed statistically significant difference ( $p < 0.05$ ) in the mean beta stiffness and pulse wave velocity when measured on the left and right CCA, respectively. No statistically significant differences were observed among groups regarding body mass index, blood pressure, pulse pressure and intima media thickness. **Conclusions:** Our results demonstrate that inflammatory periodontal disease can affect arterial haemodynamics, regardless alterations of intima media thickness. Further investigation with a larger patient sample is required in order to more accurately assess the arterial stiffness in patients with periodontitis.

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## P2

### CAROTID ARTERY INTIMA - MEDIA THICKNESS AND RISK OF LACUNAR INFARCT

S. A. Mousavi<sup>1</sup>; T. Hoseini<sup>2</sup>; F. Khorvash<sup>3</sup>

<sup>1</sup>Neurology, Alzahra Hospital, Isfahan, Islamic Republic of Iran; <sup>2</sup>Isfahan University of Medical Sciences, Radiology, Isfahan, Islamic Republic of Iran; <sup>3</sup>Isfahan University of Medical Sciences, Neurology, Isfahan, Islamic Republic of Iran

**Background:** Increases in the thickness of the intima-media of the carotid artery have been associated with an increased risk of myocardial infarction and stroke in subjects without a history of cardiovascular disease. Lacunar infarcts, one of the most common subtypes of ischemic stroke, show unique pathological and clinicoradiological characteristics. The present study examined the relationship between carotid artery intima media thickness (IMT), and lacunar infarct. **Methods:** We collected data from patients admitted to hospital with Lacunar stroke. 87 Patients and 96 control subjects underwent B-mode ultrasonographic measurements of IMT of the common carotid artery. We examined the association of lacunar and non-lacunar infarcts with age, sex, and potential vascular risk factors. **Results:** The 5 classic lacunar syndromes accounted for 97% of the lacunar infarctions; other lacunar syndromes accounted for only 3%. The average of left and right IMTs was considered for statistical analysis as a parameter of atherosclerosis. Mean IMT mm (SD) in Patients with Lacunar infarct was 1.1 ( $\pm$ 0.2) and in Control was 0.58. **Conclusions:** This study indicated that increasing of carotid IMT may be a marker for Ischemic stroke in Iranian patients. **KEY WORDS:** Lacunar infarction, Intima media thickness, ultrasonography

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## P3

### CAROTID INTIMA-MEDIA THICKNESS IN SUBCLINICAL HYPOTHYROIDISM

S. M. Mousavi; S. A. Mousavi; H. Rezvanian; M. Ghasemi; S. A. Mousavi

Isfahan University of Medical Sciences, Neurology, Isfahan, Islamic Republic of Iran

**Objective:** The aim of the present study was to determine the effect of L-thyroxine replacement on carotid thickness in subclinical hypothyroidism (SH). **Methods:** Forty patients with SH, as judged by elevated serum TSH levels and free thyroid hormones within the normal range, and 38 sex- and age-matched euthyroid volunteers underwent two-dimensional conventional ultrasonography, at baseline and after one year in both groups (in patients with L-thyroxine replacement for 1 year). Correlation analysis was carried out on data from SH patients. **Results:** In comparison with 38 age and sex-matched controls, SH patients had significant elevated total cholesterol and triglyceride levels ( $p < 0.05$ ) and higher mean IMT values ( $p = 0.01$ ). In regression analysis, mean IMT was positively related to age and lipid profile, and negatively to T4 level. After 12-14 months of normalization of thyroid function, mean carotid IMT (SD) was decreased by 0.08 mm in SH patients (0.71 (0.15) mm). Difference in mean IMT with 11-13 months interval

between two groups was statistically significant ( $p < 0.001$ ). **Conclusions:** The results of the present study confirm that SH is associated with preclinical vascular wall alteration, characterized by increased carotid IMT. The severity of this thickening process seems to be related to the T4 and lipid levels; furthermore, IMT may decrease following SH treatment by L-thyroxine. **Keywords:** Subclinical hypothyroidism (SH), Carotid IMT, L-thyroxine, lipid profile.

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## P4

### MES AND PLAQUE VASCULARIZATION –FURTHER EVIDENCE FOR THE SMOKING GUN THEORY

R. Dittrich; K. Theismann; M. Schmiedel; E. B. Ringelstein; M. A. Ritter

University Hospital of Muenster, Department of Neurology, Muenster, Germany

**Objectives:** MicroEmbolic Signals (MES) can be measured in the intracranial arteries downstream of atherosclerotic lesions of the internal carotid artery. MES are known to indicate "active atherothrombotic lesions" or "smoking guns", as patients with MES are much more prone to first ever or recurrent stroke due to ICA stenosis. Recently, neovascularization detected by Contrast-Enhanced UltraSound (CEUS) has been claimed to be also an indicator of active embolic lesions. In this ongoing study we investigate, whether MES are associated with increased plaque neovascularization. **Methods:** In patients with symptomatic carotid artery disease with different degrees of stenosis, we perform microembolus detection for 30min in the ipsilateral middle cerebral artery. Thereafter, the degree of plaque neovascularization is assessed semi-quantitatively (0=no neovascularization, 1=slight neovascularization, 2=pronounced neovascularization, 3=intra plaque vas vasorum) by CEUS. **Results:** At present 36 patients are investigated. Interim results for the first 20 patients showed a significant correlation between pronounced vascularisation and the presence of MES. More detailed results will be presented at the conference. **Conclusions:** CEUS is a minimal invasive and fast to perform method to assess degree of plaque neovascularization and is a risk marker for cardiovascular disease. In association with the presence of MES the method could be a promising risk marker of active cerebrovascular disease with a high risk of developing clinical events.

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P5

**COMPARATIVE ANALYSIS OF ARTERIAL WALL THICKNESS AND STIFFNESS IN SMOKING AND NON-SMOKING STUDENTS**

*B. Léránt; L. Csiba*

University of Debrecen Medical and Health Science Center,  
Department of Neurology, Debrecen, Hungary

**Background:** Our aim was to detect the adverse effects of smoking on arterial wall thickness and arterial wall stiffness in young, healthy university students. **Methods:** We recruited 25 smoking and 25 non-smoking young volunteers aged 19-33 for our examinations. Exclusion criteria included any known diseases, abnormally high cholesterol levels, BMI value exceeding 30 kg/m<sup>2</sup>. Only regular smokers were allowed to participate in the smoking group (at least for 6 months, minimum 5 cigarettes a day). We measured the intima-media thickness (IMT) on both common carotids by means of carotid ultrasound, then we examined the stiffness parameters of the blood vessels (pulse wave velocity - PWV, augmentation index - Aix) with the help of arteriograph. **Results:** In case of smokers morphological, hemodynamic and stiffness parameters showed significantly higher values compared to non-smokers. Mean bilateral IMT was 0.52±0.034 mm in case of smokers, while in non-smokers we measured 0.46±0.036 mm (this difference is significant: p<0.01). PWV and heart rate also showed significantly higher values in smoking group (PWV: p<0.01; heart rate: p<0.05). Unadjusted to age, gender and smoking status there was a significant correlation between IMT and PWV (0.1 mm thicker IMT - 0.6354 m/s faster PWV). Gender differences were found in vascular changes caused by smoking. **Conclusions:** The adverse effects of smoking on arterial wall thickness and arterial wall stiffness can be seen even at a young age, only after a few years of smoking. Both higher IMT and higher PWV sensitively predict vascular damages.

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P6

**CONTRAST ENHANCED ULTRASOUND OF CAROTID PLAQUE NEOVASCULARISATION: ACCURACY OF VISUAL ANALYSIS**

*A. Viacozzi<sup>1</sup>; H. Muller<sup>1</sup>; I. Kuzmanovic<sup>1</sup>; C. Bonvin<sup>1</sup>; D. Mugnai<sup>2</sup>; N. Murith<sup>2</sup>; K. Burkhardt<sup>3</sup>; M.-L. Bochaton-Piallat<sup>3</sup>; R. Sztajzel<sup>1</sup>*

<sup>1</sup>University Hospital Geneva, Neurology, Geneva, Switzerland; <sup>2</sup>University Hospital Geneva, Cardiovascular Surgery, Geneva, Switzerland; <sup>3</sup>University Hospital Geneva, Pathology, Geneva, Switzerland

**Background:** To evaluate whether neovascularisation of the carotid plaque may be accurately assessed by visual analysis of contrast enhanced ultrasound imaging and to correlate these findings with a time to peak analysis program and with histopathology. **Methods:** Patients with >50% symptomatic or >60% asymptomatic stenoses were included. Ultrasound examination (Antares apparatus, Siemens) included assessment of degree of stenosis and contrast (Sonovue) enhanced imaging using a cadence CPS program. Contrast enhancement was evaluated visually by 4 investigators

(grade 0: no, grade 1: intermediate and grade 2: extensive enhancement). Positive agreement (at least 3 unanimous investigators) was correlated to a time to peak analysis (program written in MATLAB). Intensity was expressed as the difference between minimum and maximum level of intensity within the region of interest of the plaque measured at the peak of microbubbles concentration. A histopathological examination (microvessel CD34 staining) was completed whenever endarterectomy was performed. **Results:** Thirty-six patients, 18 symptomatic and 18 asymptomatic, were included (mean age 74.5). Interobserver agreement was of 94%. The grade of contrast enhancement assessed visually correlated with the mean delta value: grade 0 (n=16) with 0.015, grade 1 (n=13) with 0.03 and grade 2 (n=7) with 0.04 (grade 0 vs 2, p<0.001). In 22 patients, a histopathological examination was carried out. Median value of CD34 + area was larger in patients with grade 2 in comparison with grade 1 or grade 0 (respectively 21.5 vs 12.5 and 11.5x10<sup>-3</sup> mm<sup>2</sup>); a statistical difference however was not obtained. **Conclusion:** Visual analysis of contrast enhanced ultrasound imaging seems accurate with a high ratio of interobserver agreement and correlated significantly with a time to peak analysis program. A larger number of patients is needed however in order to confirm these results and to demonstrate a relationship with histopathological findings.

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P7

**THE CA2+ BINDING PROTEIN CALPROTECTIN IS INCREASED IN PATIENTS WITH ECHOLUCENT CAROTID ARTERY PLAQUE**

*A. Abbas<sup>1</sup>; M. Skjelland<sup>1</sup>; P. Aukrust<sup>2</sup>; B. Halvorsen<sup>2</sup>; D. Russell<sup>1</sup>*

<sup>1</sup>Oslo University Hospital, Neurology, Oslo, Norway; <sup>2</sup>Oslo University Hospital, Research institute for Internal Medicine, Oslo, Norway

**Background:** Atherosclerosis is a chronic progressive disease in which inflammation plays a key role. An echolucent plaque in the carotid artery is related to an increased risk of ischemic stroke compared to more echogenic plaques. Previous studies have suggested an association between echolucency and inflammation. The calcium-binding proteins calgranulins S100A8 (calgranulin A), S100A9 (calgranulin B) and S10012 (calgranulin c) are predominantly expressed by neutrophils, monocytes and activated macrophages, and have predominantly pro-inflammatory functions. S100A8 and S100A9 form a heterocomplex, S100A8-A9 (calprotectin). In this study we examined the relationship between plasma levels of calprotectin S100A8-A9 and carotid plaque echogenicity. **Methods:** 156 patients with high-grade carotid stenosis (diameter reduction >70%) were consecutively recruited. Plaque echogenicity was determined by Color Duplex ultrasound examination. Plasma levels of calprotectin were measured in blood samples taken prior to carotid endarterectomy or angioplasty. **Results:** Patients with carotid stenosis had significantly higher levels of calprotectin compared to healthy individuals (n=22). Patients with echolucent plaques (n=47) had significantly higher levels of calprotectin compared to those patients with heterogenic/echogenic plaques (n=109, p=0.034). **Conclusion:** Our results

suggest that calprotectin S100A8-A9 may be a mediator for inflammation, plaque instability and echolucency in carotid plaques.

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**P8**  
**THE ASSOCIATION OF CAROTID ARTERY INTIMA-MEDIA THICKNESS AND STROKE**

*S. Harris<sup>1</sup>; M. Kurniawan<sup>2</sup>*

<sup>1</sup>Faculty of Medicine University of Indonesia, Neurology, Jakarta, Indonesia; <sup>2</sup>Neurology, Jl. Diponegoro no.71, 10430, Jakarta, Indonesia

**Background:** Non invasive assessment of intima-media thickness (IMT) is widely used currently, as an intermediate end point of vascular disease. However, data showing that IMT associate with cerebrovascular disease are still limited especially in Indonesia. In this study, we tried to find whether IMT is associated to stroke in Indonesia people. **Methods:** We used a cross-sectional approach among 295 patients which then divided into 2 groups, stroke and non-stroke. Non invasive measurements of the intima-media of the common carotid artery were performed with high-resolution ultrasonography to all the patients in both groups. **Results:** From 295 patients, aged range from 12 to 86 years old, who came to our clinic in 2010, we divided them into Stroke group (n=176) and Non-Stroke group (n=118), we found abnormal IMT occurred in 130 patients of Stroke group, while only 46 in Non-Stroke group (P<0.001). **Conclusion:** Many studies have previously reported the positive associations between cardiovascular risk factors and carotid artery intima media thickness, and also positive association between carotid-artery intima media thickness and the incidence of myocardial infarction and stroke amongst Caucasian people. In this study, we found strong associations of the carotid artery-intima media thickness and stroke (p<0.0001) in Indonesian people. This association can happened because intima-media thickness is the marker of generalized atherosclerosis. And since atherosclerosis plays an important role in the patogenesis of cerebro and cardiovascular event like stroke, this association can be explained. Moreover, this result can be applied to predict the cerebrovascular events. But, since our study have some weaknesses such as the small number of participants and methodology which was not prospective, it can be used as preliminary data in finding the correlation of intima-media thickness and stroke amongst Asian especially Indonesian people.

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**P9**  
**INTIMA-MEDIA THICKNESS OF THE COMMON CAROTID ARTERY IN OBSTRUCTIVE SLEEP APNEA (OSAS) PATIENTS**

*S. Andonova<sup>1</sup>; D. Petkova<sup>2</sup>; Y. Bocheva<sup>3</sup>*

<sup>1</sup>University Hospital"St Marina"- Varna, Second Clinic of Neurology, Varna, Bulgaria; <sup>2</sup>University Hospital"St Marina"- Varna, Clinic of Pneumology and Physiology, Varna, Bulgaria; <sup>3</sup>University Hospital"St Marina"- Varna, Central Clinical Laboratory, Varna, Bulgaria

**Aims:** To evaluate the changes of intima-media thickness of the common carotid artery in patients suffering by obstructive sleep apnea (OSAS). **Materials and methods:** The participants of the study are divided into 2 groups: 27 patients suffering OSAS and a control group of 27 participants (mean age 56.1±1.4 years), having risk factors (RF) for cerebrovascular diseases (CVD) but not OSAS. The morphology of the artery wall-the intima media thickness (IMT) of the common carotid arteries (CCA), the presence of atherosclerotic plaques, their magnitude, echogenicity and stability - are determined by a color duplex sonography of the main arteries of the head. **Results:** In the OSAS group, CCA-IMT was significantly increased when compared with the non-OSAS patients, having risk factors for CVD, which correlates with night hypoxemia level. Additionally, the formation of plaques was more pronounced and carotid stenoses were more common in the OSAS patients. **Conclusions:** These findings are in favor of an independent influence of obstructive sleep apnea on carotid artery atherosclerosis.

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**P10**  
**QUANTITATIVE MEASUREMENT OF CAROTID PLAQUE PERFUSION WITH CONTRAST ENHANCED ULTRASOUND**

*K. Theismann; M. A. Ritter; E. B. Ringelstein; R. Dittrich*  
University Hospital of Muenster, Department of Neurology, Muenster, Germany

**Background:** Contrast Enhanced UltraSound (CEUS) is a novel technique to detect intra-plaque neovascularisation in atherosclerotic plaques of the carotid artery. The degree of neovascularisation can be graded semi-quantitatively from 0 (absent), 1 (minimal), 2 (moderate) to 3 (extensive). We aimed to determine the intra-plaque neovascularisation quantitatively by software and compared the results to the semi-quantitative measurements. **Methods:** In 16 patients with carotid artery stenosis >20%, the degree of vascularisation (0-3) has been determined after bolus injection of 2.5ml contrast agent (SonoVue®) and achievement of a steady-state condition. Afterwards the amount of perfusion was calculated off-line by software (Qontrast 4.00, Bracco) and expressed in regional blood flow (RBV) **Results:** In seven patients, the degree of the semi-quantitative measurement was 0 and showed no neovascularisation, the RBV varied between 0 and 0.456 (mean 0.15). In three patients, the degree was 1 and the RBV was 1.8-3.281 (mean 2.069). In another three patients the degree was 2 and the RBV 15.1-17.6 (mean 16.7) and in the rest of the

patients the degree was 3 and the RBV was 20.4-39.2 (mean 31.6). **Conclusion:** There was a good agreement between the investigator dependent semi-quantitative measurements and the software based objective quantification of plaque vascularisation. However, these results have to be reproduced in a larger patient cohort.

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## II Emboli Detection

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### P11

#### A TCD STUDY OF ZERO-CROSSING DYNAMICS OF SOLID AND GASEOUS MICROEMBOLIC SIGNALS AND ARTEFACTS.

*R. Hoogenboezem; R. W. M. Keunen*  
Haga Teaching Hospitals, Neurology & Clinical  
Neurophysiology, The Hague, Netherlands

**Background:** Microemboli of both, solid or gaseous origin can occur during cardiac surgery. It is important to differentiate both, because solid emboli are generally associated with an increased stroke risk, whilst gaseous emboli are not. Intensity and duration of MES are not reliable indices for discrimination. Therefore, the zero-crossing dynamics of solid and gaseous MES were examined to look whether this parameter could make a reliable distinction between gaseous and solid MES. **Methods:** From a recording of a cardiovascular procedure 300 MES which were clearly associated with the entrapment of air into the circulation were selected and labeled by a human expert. Another 300 MES were selected and labeled from a recording of the postoperative phase of carotidendarterectomy. These events were associated with the presence of solid emboli. To make the problem more practical another 300 HITS which were clearly no MES were selected from both files. Resulting in a three class problem with equal class frequencies. The discussed feature was computed for each selected signal. Repeated ten fold cross validation was used to test classification performance. **Results:** Individual classification performance of the discussed feature was 86% for the given three class problem. In combination with other features such as length and intensity classification performance was over 90%. **Conclusion:** Signals produced by gaseous emboli, solid emboli and artefacts exhibit different zero-crossing dynamics. This observation could be of value for the development of an automatic TCD embolus detection system which can monitor cardiovascular surgical procedures.

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### P12

#### A TRANSCRANIAL DOPPLER STUDY OF CEREBRAL HEMODYNAMICS AND EMBOLI DURING SEPTIC SHOCK.

*R. W. M. Keunen<sup>1</sup>; M. Hunfeldt<sup>1</sup>; M. Remmers<sup>1</sup>; R. Hoogenboezem<sup>1</sup>; D. Tavy<sup>1</sup>; H. S. Moeniralam<sup>2</sup>; E. H. J. F. Boezeman<sup>2</sup>; S. Tromp<sup>2</sup>; M. Mee van der<sup>2</sup>; M. Frank<sup>3</sup>*  
<sup>1</sup>Haga Teaching Hospitals, Neurology, Clinical Neurophysiology, IC, The Hague, Netherlands; <sup>2</sup>Antonius Hospital, Clinical Neurophysiology and ICU, Nieuwegein/ Utrecht, Netherlands; <sup>3</sup>Haga Teaching Hospitals, Intensive Care, The Hague, Netherlands

**Objective:** A severe septic shock is characterized by a transition of the physiological monophasic TCD waveforms into a biphasic waveform. The objective of this study was to design and validate a new index that characterizes the TCD waveform alterations seen in septic shock and to relate this new index to outcome. Moreover, the frequency and extent of cerebral microemboli during sepsis were investigated. Ongoing silent cerebral emboli during sepsis might play a factor in the development of septic encephalopathy. **Methods:** 20 patients, admitted to the intensive care unit with a septic shock, were examined with a 2 MHz transcranial Doppler (Delica 9 series, Shenzhen Delicate Electronics Co. LTD., China) for 30 minutes. Patients with pre-existent active embolic sources were excluded. Clinical data analysis included age, gender, cause of sepsis (gram positive or negative microorganisms), an index of severity of illness (the APACHE II score) and outcome (survivor/non survivor). Cerebral emboli were quantified by an automatic embolus detection system (EDS, SMT Medical, Wuerzburg, Germany). The "septic index" (SIX) is proposed to characterize the septic waveform. SIX is based on the peaksystolic and endsystolic velocities (resp. PSV and ESV) and the decay time between PSV and ESV. **Results:** 13 male and 7 female patients were investigated, with a mean age of 61.3 yrs (range 23 — 79 yrs). APACHE II scores varied between 11 and 47. 65% of the patients died due to sepsis. Biphasic waveforms were observed in 50% of the patients. SIX correlated to the visual waveform analysis by human experts in 18/20 observations. SIX did not correlate to outcome. No patient showed cerebral emboli. **Conclusions:** The alterations of the blood flow velocity waveform observed during a septic shock can be quantified by the use of the proposed SIX. The SIX reflects the severity of the sepsis rather than its outcome. Moreover, a septic shock as such is not associated with silent ongoing cerebral emboli.

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**P13****PREVENTING STROKE RECURRENCE BY TCD EMBOLUS DETECTION: A PILOT STUDY**

R. W. M. Keunen; M. Hunfeld; A. van Sonderen; M. Remmers; D. Tavy; B. de Bruijn

Haga Teaching Hospitals, Neurology and Clinical Neurophysiology, The Hague, Netherlands

**Background:** Current protocols stress the importance of short-term diagnosis and treatment in recent TIA or minor stroke. The risk of a recurrent event can be predicted with emboli detection. Studies have shown that the presence of microemboli is associated with an increased risk of recurrent events. We tried to reduce this risk in our patient population by detection and treating microemboli as soon as possible.

**Methods:** Patients with a recent TIA or minor stroke were randomly assigned to a study group or control group. Both groups were treated according to European Stroke guidelines, including prompt start of antithrombotic therapy, statins and short-term carotid arteries duplex scanning. The study group was subjected to TCD embolus detection as soon as possible (TCD Delica 9 series, Shenzhen Delicate Electronics Co.,LTD., China. EDS, SMT Medical, Wuerburg, Germany). If emboli were detected, treatment was started immediately to stop cerebral embolisation. This was achieved by either an altered drug regimen (clopidogrel) or angioplasty or carotid endarterectomy within one or two days. If carotid intervention was indicated in the control group, it was performed within two weeks, according to European guidelines. **Results:** 133 patients were enrolled in the study with three months follow-up. 61 patients were subjected to the control group, 72 patients were enrolled in the study group. Recurrent events occurred in 10.2% and 3.0% respectively ( $p = 0.145$ ). **Conclusion:** The current study shows a non-significant reduction in recurrent events in the study group. Possibly, sample size in this pilot study was insufficient to detect a significant decline. These promising results support the start of a multicenter randomized trial to assess the clinical value of emboli detection in patients with a recent TIA or minor stroke.

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**P14****THE OCCURRENCE OF MICROEMBOLIC SIGNALS IN TIA PATIENTS WITHOUT CAROTID ARTERY STENOSIS.**

A. Van Sonderen; M. Hunfeld; D. Tavy; R. W. M. Keunen  
Haga Teaching Hospitals, Neurology, The Hague, Netherlands

**Background:** The occurrence of microembolic signals (MES) in patients with carotid stenosis has been widely investigated. However, the majority of the patients with a TIA or minor stroke do not have carotid artery disease. Emboli from other sources seem to play a role in these patients, although in the majority of cases no cause can be identified. Emboli detection can possibly be of value in discovering these currently unknown causes. Before investigating the value of emboli detection in patients without carotid stenosis, the prevalence of MES in this group needs to be determined.

**Methods:** Consecutive patients with TIA or minor stroke ( $mRS < 4$ ) were enrolled in the study. Exclusion criteria were vertebrobasilar events, a poor temporal bone window and the use of oral anticoagulants. Sixty-eight patients were enrolled. In the first 28 days after the event they were examined with transcranial Doppler to detect embolic signals. Emboli detection software was used to detect and distinguish MES and artifacts, with a survey by two human experts. The carotid arteries were examined with duplex sonography. **Results:** MES were detected in the ipsilateral middle cerebral artery only and occurred in 12 of the 68 patients in our study population (17.6%). Duplex sonography showed 50-99% carotid stenosis in 14 of 68 patients, of whom six were MES positive (42.9%). 2/68 patients had carotid artery occlusion, one of them showing MES (50%). The remaining fifty-two patients had no carotid artery pathology on duplex examination. In this group, MES were detected in 5/52 patients (9.6%). **Conclusions:** Results in patients with symptomatic carotid stenosis are in line with earlier studies. The prevalence of MES in patients without carotid artery disease is only 9.6%. Although we investigated a limited number of patients, establishing this prevalence can be helpful in investigating the value of emboli detection in TIA and minor stroke patients without carotid artery stenosis

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**P15****PRESENCE OF MICROEMBOLIC SIGNALS ON TRANSCRANIAL DOPPLER IS ASSOCIATED WITH UNSTABLE CAROTID PLAQUE**

S. Tromp<sup>1</sup>; G. van Lammeren<sup>2</sup>; R. van de Mortel<sup>3</sup>; J.-P. de Vries<sup>3</sup>

<sup>1</sup>St Antonius Hospital, Clinical Neurophysiology, Nieuwegein, Netherlands; <sup>2</sup>University Medical Center, Experimental Cardiology, Utrecht, Netherlands; <sup>3</sup>St Antonius Hospital, Vascular Surgery, Nieuwegein, Netherlands

**Background:** Plaque composition in the carotid artery is associated with cerebrovascular symptoms and formation of thromboemboli. Detection of microembolic signals (MES) with transcranial Doppler (TCD) can identify individuals at increased risk of stroke among patients with carotid stenoses. The objective of the current study was to investigate whether presence of MES in patients scheduled for carotid endarterectomy (CEA) was associated with the underlying carotid plaque composition. **Methods:** Between 2008 and 2010, MES were detected by means of TCD recordings during at least 30 minutes from the ipsilateral middle cerebral artery in 28 symptomatic patients in the 1-14 days waiting time for CEA. Carotid plaques harvested during CEA were subjected to histopathological examination for macrophages (CD68), smooth muscle cells (SMC;  $\alpha$ -actin), collagen (Picro-sirius Red, PSR), calcifications (hematoxylin and eosin, H&E), presence of large atheroma covering >40% of the plaque surface (H&E and PSR) and intraplaque hemorrhage (H&E). **Results:** Of the 28 patients (mean age 68 yrs, 21 men) 7 (25%) had at least 1 MES during 30 minutes. Plaques from patients with MES contained large atheroma in 4/7(57%), compared with 3/21(14.3%) in plaques from patients without MES ( $P=0.023$ ). Presence of MES was also associated with presence of a luminal thrombus: 43%(3/7), as opposed

to 10%(2/21) in the absence of MES (P=0.046). Moderate or heavy SMC staining tended to be less in the presence of MES: 3/7(43%) versus 17/21(81%) without MES (P=0.053). No statistically significant differences were observed for the other histological parameters. **Conclusions:** Presence of MES detected with TCD in symptomatic patients scheduled for CEA is associated with an atheromatous plaque and presence of luminal thrombus, and thus an unstable underlying carotid plaque composition. TCD might be a useful tool to help identify patients with vulnerable plaques, who are at increased risk for secondary events.

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**P16**  
**DETECTION OF MICROEMBOLI SIGNALS IN PATIENTS WITH TRANSIENT ISCHEMIC ATTACKS OF BRAIN**

*Z. Jovanovic; A. Pavlovic; M. Mijajlovic; A. Sundic; N. Sternic Covickovic*  
Clinic of Neurology Clinical Center of Serbia,  
Cerebrovascular diseases, Belgrade, Serbia

**Background:** Transcranial-doppler (TCD) registration of microemboli signals (MESs) is very important method for detection of embolic mechanism of transient ischemic attacks (TIAs). The aim was TCD detection of MESs in both of middle cerebral arteries (MCA) and analyzing the source of cerebral embolism in patients with TIAs. **Patients, method:** We investigated 110 patients with TIAs by color doppler flow imaging of carotid arteries, TCD, TCD detection of MESs and analyzed source of embolism. **Results:** We found 32/110 (29.1%) patients with embolic mechanism of TIAs. TCD monitoring detected MES in 23/110 TIA patients (20.9 %), or 23/32 emboligenic TIA patients (71.8%). Nine of 32 patients (28.2%) with embolic TIA hadn't MESs - exulcerated plaques have already been emptied, probably. Eleven of 23 MES+ patients (47.8%) had MES in one MCA only, and it correlated with exulcerated plaques on carotid artery on the same side. The others MES+ patients had MES in both of MCAs: 2/23 (8.7%) had exulcerated plaques on arch of aorta, 3/23 (13.1%) cardioembolism and 2/23 (8.7%) condition for paradoxal embolism (R-L cardiac shunt-atrial and crural veins thrombosis). Five of 23 (21.7%) patients had MESs in both of MCA, but we didn't find source of embolism. **Conclusion:** We registered MESs in 20.9% of all TIA patients, or 71.8% of emboligenic TIA patients. Among emboligenic TIA patients, correlation between MESs, clinical findings and source of embolism was present in 56.2%. Some emboligenic TIA patients hadn't MESs, but some patients without emboligenic TIA, had MESs- it is not clear why?

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**P17**  
**MICROBUBBLE SIGNAL PROPERTIES FROM PFO TESTS USING TRANSCRANIAL DOPPLER ULTRASOUND**

*C. Banahan<sup>1</sup>; R. Patel<sup>2</sup>; V. Jeyagopal<sup>2</sup>; J. Hague<sup>3</sup>; E. Chung<sup>2</sup>; D. Evans<sup>2</sup>*

<sup>1</sup>University Hospitals of Leicester NHS Trust, Medical Physics, Leicester, United Kingdom; <sup>2</sup>University of Leicester, Cardiovascular Sciences, Leicester, United Kingdom; <sup>3</sup>Open University, Physics and Astronomy, Leicester, United Kingdom

**Background:** A limitation of transcranial Doppler (TCD) ultrasound is the inability to distinguish tiny benign bubbles from potentially hazardous particulate emboli based only analysis of the intensity of backscattered ultrasound. This study examines the Doppler characteristics of small microbubbles detected during screening of patients for a patent foramen ovale (PFO). The aim of the study was to try and identify if any unique properties exist for microbubbles that could help to distinguish between solid and gaseous emboli. **Methods:** Bilateral TCD monitoring of the middle cerebral artery (MCA) was performed for 31 patients during PFO screening using agitated saline. Patients were injected up to three times and asked to perform a valsalva manoeuvre. The raw audio data was recorded onto an external laptop for subsequent analysis. **Results:** Ten patients tested positive for a PFO, yielding 200 embolic signals with intensities < 35 dB. The average peak measured-embolus-blood-ratio (MEBR) was  $23 \pm 3$  dB and the duration was  $47 \pm 29$  ms. The majority of signals lasted between 20 and 30 ms which is much longer than previously reported for thrombus particulate where the majority of signal durations are between 5 and 20 ms. MEBR values were used to estimate microbubble diameter using a model based on standard scattering theory. A strong positive correlation was found between peak MEBR and bubble size (0.93,  $p < 0.01$ ). **Conclusions:** Doppler signal properties were analysed for over 200 microbubbles recorded in-vivo. Microbubble signal duration was found to be higher than that measured for thrombus. Further analysis will be carried out on the signal shape and frequency modulation observed to aid in microbubble characterisation using Doppler ultrasound.

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**P18****ARE EMBOLIC SIGNAL PROPERTIES AFFECTED BY EMBOLUS POSITION WITHIN THE ULTRASOUND BEAM?**

V. Jeyagopal<sup>1</sup>; E. Chung<sup>2</sup>; C. Banahan<sup>3</sup>; J. Cowe<sup>3</sup>; D. Evans<sup>1</sup>

<sup>1</sup>University of Leicester, Department of Cardiovascular Sciences, Leicester Royal Infirmary, Leicester, United Kingdom; <sup>2</sup>University of Leicester, Department of Cardiovascular Sciences, Leicester Royal Infirmary, Leicester, United Kingdom; <sup>3</sup>University Hospitals Leicester NHS Trust, Medical Physics, Leicester Royal Infirmary, Leicester, United Kingdom

**Background:** Information about the physical properties of emboli, such as embolus size and composition, are contained within the backscattered Doppler ultrasound signal. However, embolus position in the insonated vessel also strongly influences embolic signal shape, and could therefore affect our estimates of embolic signal properties such as 'measured embolus-to-blood ratio' (MEBR) and signal duration. Here we describe a novel computational model designed to simulate the backscattered Doppler signal from emboli passing through various positions in an insonated vessel. In this experiment, the results of our simulations are used to investigate the effects of embolus trajectory on embolic signal properties. **Methods:** A gear pump was used to circulate a validated BMF through 4 mm diameter C flex tubing at a flow rate of 29 cm sec<sup>-1</sup>. The tubing was insonated in a water bath at a fixed angle of 30° using a 2 MHz transducer. Several sizes of calibrated microspheres were injected into the flow-rig and a range of backscattered signals were generated and recorded using an 'in-house' multigate Doppler system. The results of our experiment were then compared to simulated results from the analytical model. **Results:** For 1000 µm microspheres the average MEBR (averaged over 80 signals) was 25 ± 3 dB. A similar MEBR of 24 ± 3 dB was produced by 500 µm microspheres. In our simulations, the trajectories of the emboli through the ultrasound beam produced a variety of signal shapes, many of which were reproduced successfully in vitro. **Conclusions:** Comparison between in vitro measurements and predictions from our analytical model demonstrate that embolus trajectory through a vessel affects embolic signal properties. This information may be used in the future to provide a better estimate of embolus properties and trajectory based on detailed analysis of the Doppler signal.

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**P19****MICROEMBOLIC SIGNALS IN PATIENTS WITH ANTIPHOSPHOLIPID SYNDROME**

C. Cantu-Brito; L. Villa-Gutierrez; I. Reyes-Melo; A. Mimenza-Alvarado; G. Garcia-Ramos

National Institute of Medical Sciences, Neurology, Vasco de Quiroga #15, Col. Sección XVI, Mexico, Mexico

**Background and purpose:** The pathogenesis of cerebrovascular involvement in patients with antiphospholipid syndrome (APS) is not completely understood. Detection of cerebral microembolic signals (MES) by transcranial Doppler (TCD) may be useful for determining stroke risk in patients with APS. In this study, we investigated the prevalence of MES and assess their association with the use of antithrombotic agents in patients with APS. **Methods:** We studied 103 patients with APS according to Sapporo Criteria, including 32% with primary APS and 68% with secondary to systemic lupus erythematosus APS. Both middle cerebral arteries were monitored by TCD ultrasound for at least 30 minutes. Presence of MES was correlated with the use of antithrombotic agents. **Results:** MES were present in 22.3% of the patients overall (primary APS 12.1% versus secondary APS 27.1%; P=0.08) and the frequency of the MES varied between 2 and 56 (mean 8.3; SD 12). Moreover, MES were found in 58% of the patients that were not receiving antithrombotic agents, in 30% of those receiving aspirin, in 13% of those taking oral anticoagulants, and in only 4% when patients were taking both anticoagulant and aspirin (P=0.001). Of 23 patients with history of ischemic stroke or TIA, MES were detected in 44% versus 23% of those patients without history of stroke (P=0.045). **Conclusions:** The high prevalence of MES in patients with APS may support the possible contribution of MES to the complex pathophysiology of this syndrome. The monitoring of MES may also help in choosing better antithrombotic treatment for the long-term prophylaxis, but further long-term follow-up studies are required to confirm our results.

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**P20****AMOUNT OF MICROEMBOLIC SIGNALS AND LESION PATTERNS IN PATIENTS WITH CRYPTOGENIC STROKE**

G. Xiping; D. Kehui; Z. Xingquan; W. Yongjun

Department of Neurology, Beijing Tiantan Hospital, affiliated to Capital Medical University, Beijing, China

**Objective:** The purpose of this study was to discuss the inter-relation between the amount of microembolic signals (MES) on transcranial doppler (TCD) and lesion patterns on MR/DWI sequence. **Methods:** We enrolled 217 patients diagnosed with cryptogenic stroke in this study consecutively. For detection of PFO, TEE was carried out in all patients and 46 were diagnosed PFO. All 46 patients received contrast-enhanced TCD and MR/DWI sequence during the first week after onset. Three groups were formed according to the amount of MES on TCD: a small amount of MES (0-10 MES); a moderate amount of MES (countable MES higher than 10); and multiple MES. **Results:** According to TCD, there were 21 patients (45.7%) with

a small amount of MES, 13 patients (38.3%) with a moderate amount of MES, and 12 patients (26.0%) with multiple MES on TCD. According to DWI, there was no difference between ischemic lesions located on anterior or posterior circulation. A strong relationship between the amount of MES on contrast transcranial Doppler was found ( $P=0.01$ ), such that the more the MES on TCD the more lesions on DWI. We did not find a specific difference in neuroradiological lesion size with the size of PFO. **Conclusion:** There is a high correlation between the amount of the MES on TCD and the amount of lesion on DWI in stroke patients with PFO.

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### III Nerve and Brain, Muscle and Vein

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#### P21 EXTRA-CRANIAL VENOUS FLOW IN PATIENTS WITH MULTIPLE SCLEROSIS

*E. Auriel; N. M. Bornstein; A. Karni; T. Nissel; A. Gadoth;  
H. Hallevi*

Tel Aviv Sourasky Medical Center, Neurology, Tel Aviv, Israel

**Introduction:** Recently, a chronic state of impaired venous drainage from the central nervous system, termed chronic cerebrospinal venous insufficiency (CCSVI) was claimed to be a pathologic condition exclusively seen in patients with multiple sclerosis (MS), suggesting that cerebral venous congestion plays a significant role in the pathogenesis of MS. This hypothesis has gained enormous attention among patients and physicians but has been questioned since. **Methods:** Twenty seven patients with MS and 32 healthy controls underwent color extra cranial Doppler exam aimed to detect four parameters of abnormal venous flow: no Doppler-detected flow in the IJV or vertebral veins (VV), reflux in the internal jugular veins (IJVs), venous flow stenosis in the IJVz (cross sectional area  $<0.3$  cm) or reverted postural control in the IJV. **Results:** Except for one healthy patient, blood flow direction in the IJVs was normal in all subjects. When aiming to detect at least one parameter of abnormal venous flow per subject, two parameters or three parameters no significant difference was found between subjects and controls ( $p=0.707, 0.62, 0.849$  respectively). **Conclusion:** We found no evidence to suggest that MS patients have excess of CCSVI. In addition we failed to observe a typical venous flow pattern in MS patients. Until carefully designed controlled studies to investigate CCSVI have been completed, invasive and potentially dangerous endovascular procedures as therapy for MS should be discouraged.

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#### P22 PROGRESSIVE MULTIPLE SCLEROSIS IS NOT ASSOCIATED WITH CHRONIC CEREBROSPINAL VENOUS INSUFFICIENCY

*F. Farina; P. Perini; M. Calabrese; F. Rinaldi; P. Gallo; C. Baracchini*

Clinica Neurologica I, Dept. of Neuroscience, University of Padua, Padua, Italy

**Background:** Chronic Cerebrospinal Venous Insufficiency (CCSVI) had been suggested to play a major pathogenetic role in multiple sclerosis (MS), but recent data on early stages of MS have not confirmed this theory. Nonetheless, CCSVI could represent a late phenomenon of MS or be associated with progression of disability. Thus we studied CCSVI prevalence in primary progressive (PP) and secondary progressive (SP) MS, to clarify whether CCSVI characterizes the progressive forms of this disease. **Materials and Methods:** 35 SPMS, 25 PPMS and 60 age-/gender-matched normal controls (NC) were enrolled into the study. Extracranial and transcranial high-resolution venous echo-color-Doppler sonography (ECDS-TCDS) was performed in all patients and NC. Those patients having any abnormal ultrasound findings were asked to undergo selective venography (VGF). **Results:** PPMS (11 females, 14 males; mean age  $47\pm 11$  years) had a disease duration of  $11\pm 7$  years and EDSS of  $6.0\pm 0.5$ . SPMS (22 females, 13 males; mean age  $45\pm 14.5$  years) had a disease duration of  $18\pm 14$  years and EDSS of  $6.0\pm 0.8$ . TCDS was normal in all patients. ECDS showed one or more abnormal findings in 9/60 (15.0%) patients [7/35 (20.0%) SPMS, 2/25 (8.0%) PPMS] and in 14/60 (23%) NC ( $p$  not significant for all comparisons). CCSVI criteria were fulfilled in 0 NC and 4 (6.7%) MS patients: 3 SPMS and 1 PPMS. VGF, performed in 6/9 patients, was abnormal only in one case who had bilateral internal jugular vein stenosis. **Conclusions:** Our findings indicate that CCSVI is not a late secondary phenomenon of MS and is not responsible for disability progression.

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#### P23 TRANSCRANIAL ULTRASOUND IN NEURODEGENERATION WITH BRAIN IRON ACCUMULATION (NBIA)

*J. Liman<sup>1</sup>; A. Wellmer<sup>2</sup>; K. Rostasy<sup>3</sup>; M. Bähr<sup>1</sup>; P. Kermer<sup>1</sup>*

<sup>1</sup>University of Göttingen, Neurology, Göttingen, Germany;

<sup>2</sup>Ludmillenstift Hospital, Neurology, Meppen, Germany;

<sup>3</sup>Medical University of Innsbruck, Department of Paediatrics, Division of Paediatric Neurology, Innsbruck, Austria

**Objective:** NBIA/HSS is a neurodegenerative disorder associated with iron accumulation in specific brain regions. To date, the diagnosis is obtained by typical MRI changes followed by genetic PANK2 mutation analysis. This procedure is laborious and limited to a few specially equipped medical centers. Since transcranial ultrasound sonography (TCS) is widely used for the early diagnosis of PD in adults displaying parenchymal metal deposits, it is likely to be a reliable diagnostic tool for the early diagnosis of NBIA. **Methods:** In 7 patients with proven NBIA and 13 age-matched controls without record of

neurological disease TCS was performed. Data were analysed by two blinded investigators regarding hyperechogenicity and size of the substantia nigra (SN). **Results:** SN size and hyperechogenicity was significantly increased in patients with NBIA compared to controls. **Interpretation:** TCS appears to be a non-invasive and inexpensive screening technique in children with suspected NBIA. Performed by an experienced physician, it could enable an earlier diagnosis and pre-selection of children for the MRI scan and genetic testing, which are still the diagnostic gold-standard.

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**P24**  
**TRANSCRANIAL SONOGRAPHY IN PSYCHIATRIC DISEASES**

*M. Mijajlovic*

Neurology Clinic, Clinical Center of Serbia, Ultrasound  
Neurovascular Laboratory, Belgrade, Serbia

Transcranial sonography (TCS) revealed reduced echogenicity of the brainstem raphe (BR) as a characteristic finding in unipolar depression and in depression associated with Parkinson's or Wilson's disease, but not in healthy adults, bipolar affective disorders, schizophrenia, multiple sclerosis with depression or Parkinson's disease (PD) without concomitant depression. Similar finding was showed also for adjustment disorder with depressed mood. BR hypoechogenicity could be caused by a modification of tissue cell density, the interstitial matrix composition or an alteration of fiber tracts integrity representing involvement of the basal limbic system in the pathogenesis of unipolar depression and depression associated with certain neurodegenerative diseases. One of our studies which compared depressed and non-depressed PD patients with normal and hypoechogenic BR, showed using magnetic resonance diffusion tensor imaging, microstructural changes of the BR in depressed patients with hypoechogenic BR on TCS. Recently, one study showed that nigrostriatal dopaminergic system is abnormal in children with attention-deficit hyperactivity disorder, expressed by significantly larger echogenicity of substantia nigra. The increasingly broad application of TCS in the early and differential diagnosis of neurodegenerative and psychiatric disorders in many centers all over the world is probably the best evidence for the value of the method. Main advantages include the easy applicability, the fact that it is quick and repeatedly performable with no limitations as known from other neuroimaging techniques and that it is relatively cheap and side effect free.

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**P25**  
**POSSIBILITIES OF TRANSCRANIAL COLOR-CODED SONOGRAPHY AT PATHOLOGY OF DEEP BRAIN VEINS AT CHILDREN**

*M. Abramova; I. Stepanova; S. Shayunova; S. Novoselova; Y. Nesterovsky*

Russian State Medical University, Laboratory of  
Cerebrovascular Pathology at Children, Pediatric Faculty,  
Moscow, Russian Federation

**Background:** The studies of headache associating mainly with a venous haemodynamics disturbance have been done. We examined patients from 3 till 17 years with craniovertebral junction abnormalities (46 children, Group A); hypoplasia cerebral deep veins: transverse sinus and different combinations with hypoplasia of sigmoid sinus, superior sinus sagittal, the Chiari abnormalities (42 children, Group B). **Methods:** The surveyed children had typical headache (100%), dizziness (50%), vomiting (40%), noise in ears (35%), tics (3%), nasal bleedings as a fountain (60%), expressed vegetative symptoms. Transcranial Doppler (TCD) and color-coded duplex (TCCD) were carried out in the brain vessels. We proposed an access to sinus cavernous. This approach provides perfect determination of a form and peculiarities of its haemodynamics disturbance. **Results:** Expressed increase velocity systolic on straight sinus  $56 \pm 5,6$  cm/s, great cerebral vein of Galen  $57 \pm 9,4$  cm/s have been found at all patients. Peculiarities of basilar ( $71 \pm 3,1$  cm/s) and vertebral vein plexus ( $51 \pm 3,6$  cm/s) have been revealed in Group A. Disturbances of the venous outflow and structural features of the right cavernous sinus (95% of patients) have been revealed in Group B. MRI showed an absence of blood flow in left transverse sinus. According to TCD and duplex scanning data a therapy was elaborated and gave positive results (72% of children). **Conclusion:** The obtained data confirms the significant role of infringements in deep brain veins in pathogenesis of cerebrovascular pathology at children with cerebral abnormalities. Revealing of venous haemodynamics disturbance by TCCD is necessary in complex diagnostics at children with cerebral structural abnormalities to carry out preventive maintenance and treatment.

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**P26**  
**HIGH RESOLUTION SONOGRAPHY IN CHILDREN WITH CHARCOT-MARIE-TOOTH DISEASE 1A**

*K. Böntert<sup>1</sup>; A. Borchert<sup>1</sup>; O. Schwartz<sup>2</sup>; G. Kurlemann<sup>2</sup>; P. Young<sup>1</sup>; M. Schilling<sup>1</sup>*

<sup>1</sup>University Hospital Münster, Neurology, Münster, Germany;

<sup>2</sup>Pediatrics, Münster, Germany

**Objective:** High-resolution sonography of peripheral nerves in children is a cost-efficient, easy available and painless diagnostic procedure, which could easily and rapidly provide an informative basis for the diagnostic of peripheral neuropathies. The aim of this study was to describe the features of high-resolution sonography in healthy children and juveniles or subjects with hereditary peripheral neuropathy type I (Charcot-Marie-Tooth 1A). Furthermore children with CMT 1A were investigated longitudinally after a follow-up period of 12 and

24 months. **Methods:** A group of 26 healthy subjects between 4 and 19 years and 25 children and juveniles with genetically confirmed duplication of the PMP22-gene underwent high-resolution sonography. A 10 MHz linear array probe was used for axial scans, measuring the nerve cross-sectional area of the median and ulnar nerve at the level of the radiocarpal joint and in the middle of the forearm. **Results:** A positive correlation was found between body height and nerve cross-sectional area (NCSA). In CMT 1A - patients NCSA was significantly increased compared to the healthy children ( $p < 0.001$ ). Furthermore, enlargement of NCSA/ body height in CMT1A was disproportionate to healthy controls. These results were confirmed by a longitudinal follow-up in 4 children after 12 and 24 months. **Conclusion:** This study is the largest investigation using high-resolution sonography to evaluate the correlation between body height and NCSA in hereditary neuropathies. Longitudinal studies using high-resolution sonography are not available up to now. Thus, the present follow-up results showed an increased NCSA exceeding the natural annual growth. Already in early stages of CMT 1A, sonography could detect a significant difference between children and juveniles with PMP-22 duplication and healthy controls. Further studies will be necessary to assess the diagnostic worth of our findings in differential diagnosis of peripheral hereditary neuropathies.

**P27**  
**EFFECT OF NICOTINE AND VARENICLINE ON THE EXPRESSION OF NEURONAL NICOTINIC ACETYLCHOLINE RECEPTORS**

*C. Both<sup>1</sup>; C. Kaiser<sup>1</sup>; J. Birke<sup>1</sup>; C. Lange-Asschenfeldt<sup>2</sup>; G. Kojda<sup>1</sup>*

<sup>1</sup>Heinrich-Heine-University Duesseldorf, Institute for Pharmacology and Clinical Pharmacology, Duesseldorf, Germany; <sup>2</sup>Heinrich-Heine-University Duesseldorf, Department of Psychiatry and Psychotherapy, Duesseldorf, Germany

**Background:** Changes in receptor regulation after binding of nicotine may justify suggestions concerning the nicotine-induced improvements of cognitive abilities focusing on cortical and hippocampal alpha4 beta2 expression. Whether varenicline, a subtypeselective partial agonist on alpha4 beta2 receptors, induces similar effects is not known. **Methods:** Male C57/Bl6 mice, 3-4 months old, were subjected to a feeding protocol with either increasing nicotine (mean dose: 16 mg/kg/day), varenicline (0,01; 0,1; 1; or 3 mg/kg/day) or placebo via drinking water. Mice were treated for either 30 days (nicotine) or 14 days (varenicline). Following euthanasia of C57/Bl6 mice we determined receptor expression via western blotting in the main central regions for cognitive performance, the hippocampus and the cortex. **Results:** While varenicline upregulated the alpha4-subunit in the cortex in a dose-dependent manner (alpha4,Var0,01: 148,49±57,85; alpha4,Var0,1: 237,96±130,96; alpha4,Var1: 227,84±156,67; alpha4,Var3: 415,66±293,26), only the highest dose of varenicline increased the expression of the beta2-subunit (beta2,Var3: 133,12±41,69). In contrast, the beta2-subunit increased in the hippocampus independently of the dose within the dose-range used (beta2,Var0,01:

139,84±32,42; beta2,Var0,1: 157,24±41,72; beta2,Var1: 234,30±124,05; beta2,Var,3: 179,20±62,89), while there was no change of the expression of the alpha4-subunit. Likewise, we observed differential effects of nicotine which increased both subunits to a similar degree in the cortex (alpha4,Nik: 628,97±407,75; beta2,Nik: 440,06±300,48), while in the hippocampus there was no effect on the expression of the alpha4-subunit (alpha4,Nik: 107,49±43,13; beta2,Nik: 478,92±296,38). **Conclusions:** Our data suggest that nicotine and varenicline have differential effects on nicotinic receptor expression and that varenicline-induced receptor upregulation is subunit-specific depending on brain region.

**P28**  
**TRANSCRANIAL SONOGRAPHY AND 123I FP-CIT SPECT FINDINGS IN PATIENTS WITH MOVEMENT DISORDERS**

*T. Fadrna<sup>1</sup>; D. Skoloudik<sup>1</sup>; P. Bartova<sup>1</sup>; P. Rössner<sup>1</sup>; O. Kraft<sup>2</sup>; J. Bernatek<sup>3</sup>; M. Havel<sup>2</sup>*

<sup>1</sup>University Hospital Ostrava, Neurology, Ostrava, Czech Republic; <sup>2</sup>Nuclear medicine, 17. listopadu 1790, 70852, Ostrava, Czech Republic; <sup>3</sup>Bata Hospital, Nuclear medicine, Zlin, Czech Republic

**Background:** Diagnosis of Parkinson's disease (PD) could be difficult in early stages of the disease. Transcranial sonography (TCS) is able to detect structural changes in substantia nigra (SN) in PD patients. <sup>123</sup>I FP-CIT SPECT imaging is able to detect presynaptic dysfunction in several neurodegenerative diseases. The aim of our study was to assess correlation between TCS and SPECT findings in patients with PD and other parkinsonian syndromes (PS). **Methods:** 46 patients were included to the prospective study - 25 PD patients (16 males, mean age 57.1±10.1 years) and 21 PS patients (14 males, mean age 55.1±7.1 years). In all patients, SN echogenicity and SN area were evaluated. Increased echogenicity of SN with area >0.25 cm<sup>2</sup> was evaluated as pathological. SPECT evaluation of basal ganglia was performed using SPECT with DAT-ligand (<sup>123</sup>I-ioflupan). Both TCS and SPECT were performed within 2 months after clinical examination. Correlation between TCS and SPECT was evaluated, separately for PD and PS patients. Sensitivity, specificity, positive (PPV) and negative predictive value (NPV) for diagnosis of PD were assessed. **Results:** Agreement between TCS and SPECT findings was found in 21 (84%) PD patients and in 11 (52%) PS patients. TCS / SPECT sensitivity, specificity, PPV and NPV for diagnosis of PD were 80.0% / 96.0%, 52.4% / 71.4%, 66.7% / 80.0% and 68.8% / 93.8%. **Conclusions:** TCS and SPECT findings correlated better in PD than PS patients. TCS and SPECT may be used for differential diagnosis of PD and PS patients.

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**P29****HYPOPLASTIC INTERNAL JUGULAR VEIN AND HIGH FUNCTIONAL DISABILITY IN MULTIPLE SCLEROSIS**

*E. Dincic<sup>1</sup>; Z. Krsmanovic<sup>1</sup>; T. Lepic<sup>1</sup>; M. Zivkovic<sup>2</sup>; R. Raicevic<sup>1</sup>*

<sup>1</sup>Military Medical Academy, Neurology, Belgrade, Serbia;

<sup>2</sup>Institute of Nuclear Sciences "Vinca", Human genetics, Belgrade, Serbia

**Background:** There are contradictory opinions on role of chronic cerebrospinal venous insufficiency (CCSVI) in ethiopathogenesis of Multiple Sclerosis (MS) and its importance in possible therapeutic implications on the course of the disease.

**Objective:** The aim of the study was to determine presence of CCSVI in the group of clinically definitive MS and the control group consisting of healthy people. **Methodology:** The study included 58 CDMS patients (37 relapsing remitting and 21 secondary progressive). There were 20 examinees in the control group. They have all been examined on the same device, from the same examiner, using the criteria regarded by dr Zamboni and coworkers as highly specific and highly sensitive for MS with certain supplements to the basic criteria used in order to avoid the possibility of misinterpretation of the results. Duration of disease and expanded disability status scale (EDSS) score were determined. **Results:** Demographic characteristics do not show significant differences between group of MS patients and control group. Results were separately analyzed per each criterion. Nobody had any positive finding for reflux in deep brain veins. Out of 58 patients 13.79% was positive for CCSVI and none of controls ( $p=0.08$ ). We found significantly higher presence of hypoplastic internal jugular vein (IJV) in patients with high functional disability ( $EDSS \geq 6, n=21$ ) compared to other patients ( $EDSS < 6, n=37$ ) (OR = 13.4, CI 3.3 — 53.9,  $p=0.0002$ ) and controls (61.9 % vs. 10.8% vs. 25%, respectively;  $p < 0.01$ ). Also the high disability group had OR = 7.0 CI 1.2 — 40.2,  $p < 0.05$ , for CCSVI compared to other patients. **Conclusion:** Majority of our MS patients who fulfilled additional current ultrasound criteria for CCSVI had high functional disability. At least one hypoplastic IJV was significantly more frequent in MS patients with the  $EDSS \geq 6$ . Our results suggest that hypoplastic IJV may lead in more progressive MS.

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**P30****TRANSIENT GLOBAL AMNESIA. DIFFERENT VASCULAR RISK FACTOR PROFILE IN JUGULAR VEIN VALVE INCOMPETENTS?**

*M. M. Martinez-Martinez<sup>1</sup>; J. Fernandez-Travieso<sup>2</sup>; J. Oliva-Navarro<sup>2</sup>; G. Ruiz-Ares<sup>2</sup>; J. Medina-Baez<sup>2</sup>; P. Martinez-Sanchez<sup>2</sup>; B. Fuentes<sup>2</sup>*

<sup>1</sup>Neurology, Madrid, Spain; <sup>2</sup>Hospital Universitario La Paz, Neurology, Madrid, Spain

A casual relationship between Transient Global Amnesia (TGA) and Jugular vein valve incompetence (JVI) has been suggested on the past few years after the finding of a higher frequency of JVI in TGA patients, but the underlying physiopathological mechanism is not known. Other possible etiologies include epilepsy-related activity, migraine-like

mechanisms and transient ischemia. Differences in the presence of other potential risk factors (such as vascular (VRF)) in JVI patients with TGA have been pointed out to support the venous congestion theory as a different mechanism for the development of the transient memory loss. Our aim was to investigate the vascular risk factor profile of TGA patients according to the finding of JVI in ultrasonographic examinations. **Material and Methods:** Patients with a clinical episode diagnosed AGT from 2008 were included. All of the underwent a complete diagnostic protocol including blood test, cranial CT and EEG in the Emergency Room. Additionally a Doppler ultrasonographic examination including assessment of JVI was conducted. **Results:** 43 AGT patients, 33.3% men, mean age 65.05 (SD 7.19). 12 (27.9%) patients presented JVI. This group did not differ in the presence of VRF (Hypertension 8.3 vs 6.1 %,  $p 0.74$ ; Hypercholesterolemia 58.3 vs 59.4%,  $p 0.95$ ; Diabetes mellitus 41.7 vs 51.5%,  $p 0.79$ ; Cardiopathy 8.3 vs 6.1%,  $p 0.79$ ; Carotid Atherosclerosis 58.3 vs 48.5%,  $p 0.74$ ). No significant differences in reporting a valsalva maneuver preceding the episode in the JVI group (33.3 vs 21.2 %,  $p 0.40$ ) **Conclusions:** We found no differences in VRF between JVI+ and JVI- AGT patients that could support the theory of two clearly differentiated physiopathological models of development for the hippocampal dysfunction.

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**IV Case Reports**

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**P31****A RIDGE-SHAPED CAROTID PLAQUE EVOLVING INTO A DOUBLE LUMEN: A CASE REPORT**

*P. Slankamenac; B. Vitic; Z. Zivanovic*

Clinical Centre of Vojvodina, Clinic for Neurology, Novi Sad, Serbia

**Introduction:** Diametrical ridge-shaped plaques joining into a membranous plaque forming a double lumen is extremely rare. The diagnosis and follow-up of the plaque morphology has been improved by the newer neuroimaging methods **Case presentation:** A 57-year-old male was hospitalized for right-sided weakness and speech disturbances, which developed on the previous day, and the patient presented right-sided pyramidal tract signs on the admission day. Five years previously, the patient had undergone bilateral carotid thromboendarterectomy. The carotid arteries had not been followed up after the procedure. Conditions underlying the carotid disease were high blood pressure, non-insulin dependent diabetes and hyperlipoproteinemia. Brain computed tomography revealed an ischemic lesion in the left parieto-occipital area. Carotid duplex scan showed an occlusion of the right internal carotid artery and a 55% stenosis of the left internal carotid artery with a fibrolipid plaque of uneven surface on the posterior wall of the carotid bifurcation partly spreading into the internal carotid artery. Follow-up carotid duplex scan at year 1 showed a ridge-shaped plaque on the posterior wall of the common carotid artery located around 25 mm below the bifurcation obstructing the lumen for around 30%. On the follow-up at year 2, the plaque was enlarged and another small

lesion located diametrically on the intima media of the carotid artery was present. On the follow-up at year 3, the two plaques were joined forming a membranous plaque dividing the lumen of the common carotid artery. Magnetic resonance angiography confirmed a double lumen of the common carotid artery. **Conclusions:** This case is interesting since flapping, which is usually seen in dissections, is observed in the plaque whose development led to a double lumen. A ridge-shaped plaque requires evaluation of the lumen from several projections in order to avoid misinterpretations. Magnetic resonance angiography is useful.

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**P32**  
**REVERSIBLE CEREBRAL VASOCONSTRICTION SYNDROM AFTER PREECLAMPSIA**

*R. Müller; O. Meier; R. Haberl*

Städtisches Klinikum München, Klinikum Harlaching, Klinik für Neurologie und neurologische Intensivmedizin, Munich, Germany

We describe a case of a 32 year old primipara with reversible cerebral stenosis in different vessels after preeclampsia. The patient was admitted to our gynecological facility with a preeclampsia syndrom and a sectio cesario was done. A generalised tonic-clonic seizure was reported before sectio. After neurological examination a CT and later a MRI were done to exclude a cerebral sinus thrombosis or structural leasons. After the sectio there was a complicated course of disease: The patient needed intensive care treatment after an atonic bleeding of the uterus with haemoragic shock, later during the hospitalisation the patient showed pulmonary embolism and deep vein thrombosis. No dysfunction of the blood clotting could be found. The patient reported no neurological symptoms, especially no headache (e.g. thunderclap headache). The TOF angiografy showed intracranial stenosis in different vessels, also an ischemic stroke in the territory of the left cerebral anterior artery could be found. Transcranial ultrasound showed the same findings. Observation of the clinical course showed a decrease of the flow rate in transcranial color-coded duplex sonography and a MRI-TOF-angiografy one month after sectio showed no more intracranial stenosis. Due to the pulmonary embolism and deep vein thrombosis an oral anticoagulation with phenoprocumon was started. Due to missing signs of an angiopathy there was no immunmodulating therapy started. Women with acute neurological deficit after birth or sectio cesario need as soon as possible a transcranial color-coded duplex sonography to detect cerebral vasoconstricion syndrom. This syndrom seem to be diagnosed insufficiently. Therefore futher studies are necessary. Although in our reported case no headache was reported, thunderclap headache is one of the typical symptoms. Therefore the reversible vasoconstriction syndrom should be considered in differential diagnosis of thunderclap headache.

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**P33**  
**TRANSCRANIAL AND CERVICAL DUPPLEX, A FEASIBLE APPROACH TO THE DIAGNOSIS OF PULSATILE TINNITUS.**

*P. Cardona<sup>1</sup>; H. Quesada<sup>1</sup>; L. Cano<sup>1</sup>; A. Escrig<sup>2</sup>; P. Mora<sup>3</sup>; F. Rubio<sup>4</sup>*

<sup>1</sup>Bellvitge University Hospital. IDIBELL, Department of Neurology, Hospitalet de Llobregat. Barcelona, Spain; <sup>2</sup>Sant Boi Hospital, Department of Neurology, Sant Boi Llobregat. Barcelona, Spain; <sup>3</sup>Hospitalet de Llobregat, Department of Neuroradiology, Hospitalet de Llobregat. Barcelona, Spain; <sup>4</sup>Hospitalet de Llobregat. IDIBELL, Department of Neurology, Hospitalet de Llobregat. Barcelona, Spain

**Introduction:** Pulsatile tinnitus could be and non-specific sign of cerebral blood flow disturbances. Carotid dissection and arteriovenous fistulae could associate to these sounds. Pulsatile tinnitus can occur in up to 25% of patients with dissection of the internal carotid artery. An arteriovenous fistula is an abnormal connection or passageway between an artery and a vein with several hemodynamic changes with possible audible bruits. **Methods:** We present two patients 27 year-old woman and 43 year-old man that presented pulsatile tinnitus and headache. CT scan and MR showed normal brain structures. With compression maneuvers on neck was obtaining a transitory improvement of tinnitus. **Results:** Transcranial doppler demonstrated several disturbances in systolic flow as turbulences in middle cerebral artery in one patient and disturbances in vertebral artery in the other. Intracranial carotid dissection next to temporal bone and choclea was diagnosed by CT-angio in one patient. In the other patient duplex in extracranial vertebral artery showed dampened pulse wave and turbulence with audible bruit; Magnetic Resonance(MR) and CT angio confirmed the diagnosis of arteriovenous fistulae. Compression maneuvers diminished the flow and bruit of carotid an arteriovenous fistulae visualized by TCD and duplex. **Conclusions:** Direct or indirect hemodynamic findings in blood cerebral flow, found it through a non-invasive and feasible test as TCD or duplex, could be very useful to define etiological diagnosis of pulsatile tinnitus. MR and CT-angio are needed to confirm the diagnosis.

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**P34****OSCILLATING TRANSCRANIAL DOPPLER PATTERNS OF BRAIN DEATH ASSOCIATED TO THERAPEUTICS MANEUVERS.**

*P. Cardona<sup>1</sup>; H. Quesada<sup>2</sup>; L. Cano<sup>3</sup>; A. Escrig<sup>4</sup>; F. Rubio<sup>5</sup>*

<sup>1</sup>Bellvitge University Hospital. IDIBELL, Department of Neurology, Neurosonology Lab., Hospitalet de Llobregat. Barcelona, Spain; <sup>2</sup>Hospitalet de Llobregat. IDIBELL, Department of Neurology, Neurosonology Lab., Hospitalet de Llobregat. Spain; <sup>3</sup>Hospitalet de Llobregat. IDIBELL, Department of Neurology, Hospitalet de Llobregat. Barcelona, Spain; <sup>4</sup>Sant Boi Hospital, Department of Neurology, Sant Boi. Barcelona, Spain; <sup>5</sup>Bellvitge University Hospital. IDIBELL, Department of Neurology, Hospitalet de Llobregat. Barcelona, Spain

**Background:** TCD is a sensible or specific test for brain death diagnosis. Several doppler patterns could change slightly during increase of intracranial pressure associated to mass effect. We present two patients with severe changes in doppler patterns during evaluation of brain death. **METHODS:** We present two patients with clinical examination diagnosed of brain death but with blood benzodiazepines levels. Both suffered a hemorrhagic stroke, lobar hematoma and massive subarachnoid hemorrhage with initial exam in emergency hospital of coma with oral intubation and GCS of 3-5. **Results:** Transcranial doppler (TCD) was performed 24 hours after hospital admission. It showed in both cases a doppler pattern of reverse flow with small diastolic positive flow in both middle cerebral arteries and basilar arteries. We repeat TCD examination in next 6 hours with an increase of systolic and diastolic flow associated to high intracranial pressure (ICP). In another TCD after six hours finally showed low spikes diagnosed as cerebrovascular arrest. This transient improvement of blood cerebral flow could be related to use of adrenergic drugs in case of hypotension associated to brain herniation, or the use of osmotic drugs to decrease ICP. These therapeutics maneuvers could improve systemic organ perfusion and delay progression of TCD patterns associated to brain death, but we would make mistakes in follow-up process of brain vascular arrest. Also physiological disturbances previous to death and associated to herniation as polyuric phase and inhibition of vasopresine could increase intracranial pressure. **Conclusion:** The use of therapeutics drugs to decrease ICP and several physiological processes at a patient with large cerebral mass effect could change several patterns of TCD associated to progression of brain death.

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**P35****PITFALL OF VERTEBRAL ARTERY INSONATION: BIDIRECTIONAL FLOW WITHOUT SUBCLAVIAN ARTERY PATHOLOGY**

*S. Johnsen<sup>1</sup>; S. Schreiber<sup>2</sup>; F. Connolly<sup>2</sup>; K. Schepelmann<sup>1</sup>; J. M. Valdueza<sup>3</sup>*

<sup>1</sup>Schlei-Klinikum Schleswig MLK, Neurology, Schleswig, Germany; <sup>2</sup>University Hospital Charité, Neurology, Berlin, Germany; <sup>3</sup>Neurological Centre, Segeberger Kliniken, Neurology, Bad Segeberg, Germany

**Background:** A bidirectional flow-pattern within the intracranial segment of the vertebral artery (V4-VA) should be indicative of a proximal steno-occlusive disorder of the ipsilateral subclavian artery (SA). Here we present two patients revealing this ultrasound finding without evidence of a specific SA pathology. **Methods/Case reports:** Case 1: A 69-years old man was admitted after an episode of severe headache. Duplex sonography revealed mild atherosclerotic plaques. V2-segment VA diameter was 3.3 mm on the left, 2.7 mm on the right side. Normal flow signals were detected in the left V2-VA, a systolic flow deceleration was seen on the right side. Intracranially, a biphasic flow-pattern was observed in the right V4-VA. The left V4-VA, basilar artery and brachial artery (BrA) as well as the cuff-test were normal. Conventional angiography ruled out a SA or VA pathology. A bilateral fetal-type posterior cerebral artery (FT-PCA) was seen. Case 2: This 79-years old lady was seen after carotid surgery of a symptomatic right-sided internal carotid artery stenosis. Duplex sonography revealed a moderate left ICA stenosis. VA diameter of the left and right V2-segment was 3.3 and 2.3mm, respectively. Flow signals, similar to case 1 were observed in the non-dominant V2- and V4-VA segment. The remaining vessels and the cuff-test were normal. MR angiography demonstrated a FT-PCA and an incomplete posterior inferior cerebellar artery (PICA)-ending VA on the right side. **Conclusions:** A bidirectional flow in V4-VA can not prove a subclavian steal phenomenon. To avoid such a pitfall the flow-pattern of the BrA should be part of the examination. A normal triphasic flow signal excludes a relevant obstruction of the SA. Also, diameter measurements of the VA are mandatory. It seems that physiological variants of the vertebrobasilar circulation like a VA hypoplasia, PICA-ending VA or FT-PCA might also cause the above type of VA flow-pattern.

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**P36****MIGRAINE-LIKE PRESENTATION OF VERTEBRAL ARTERY DISSECTION AFTER CERVICAL MANIPULATIVE THERAPY***D. Jatuzis<sup>1</sup>; J. Valaikiene<sup>1</sup>; D. Palionis<sup>2</sup>; M. Mataciunas<sup>2</sup>*<sup>1</sup>Vilnius University, Centre of Neurology, Vilnius, Lithuania;<sup>2</sup>Vilnius University, Centre of Radiology, Vilnius, Lithuania

**Background:** Headache is the common symptom in patients with cervical artery dissection. However, it rarely occurs in isolation, without focal neurological signs, and even more rarely mimics migraine. We present clinical case of patient with new severe migraine-like hemiparesis after cervical manipulative therapy (CMT) in whom contralateral vertebral artery dissection (VAD) was diagnosed after ultrasound and neuroimaging assessment. **Case report:** 26 yrs old woman arrived due to severe pulsative unilateral left-side headache, predominantly in temporal region, which started 1 week ago after CMT. Nausea, photophobia, intolerance of physical activity was also present. Patient did not have migraine attacks earlier. Cervical manipulations were applied for right-side neck pain which alleviated after CMT and resolved 1 week before the onset of hemiparesis. Neurological examination revealed no focal signs. Extracranial color duplex ultrasound showed typical direct signs (narrowing of true lumen, dilation of V1 before the entrance into C6) of right VAD and abnormal extracranial flow in right VA (decreased flow velocities and high resistance index). Transcranial color-coded sonography confirmed normal flow within Willis circle, however, flow within intracranial segment of right vertebral artery was not detected. CT angiography confirmed long dissection of right VA, with large intramural hematoma and string-like true lumen. Diffusion-weighted MRI did not show any acute brain ischemic lesions. Follow-up 5 months later showed near-complete normalisation of lumen and flow of right VA. **Conclusions:** Causation between CMT and VAD remains unproven. However, the possibility of VAD should be considered in patients with first attack of migraine-like hemiparesis, especially if cervical manipulations or trauma were present recently. CMT should not be started without ultrasound screening of extracranial arteries in cases of atypical neck pain.

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**P37****ISOLATED CATAPLEXY IN A 55 OLD WOMAN WITH DOUBLE POSTERIOR TRIFURCATION***N. Simeonov<sup>1</sup>; E. Vavrek<sup>2</sup>; M. Mitev<sup>3</sup>*<sup>1</sup>National Cardiology Hospital, Neurology, Sofia, Bulgaria;<sup>2</sup>University Hospital Tzaritza Ioanna, Neurology, Sofia,Bulgaria; <sup>3</sup>National Cardiology Hospital, Radiology, Sofia, Bulgaria

**Background:** Variations in the origin of the basilar artery (BA) and posterior cerebral arteries (PCA) are not common. In less than 1% the BA arises from the primitive trigeminal artery, which originates from the internal carotid artery (ICA). In these cases often both VA are 'hypoplastic'. In about 10–30% of adults the PCA persists to arise directly from the ICA (posterior trifurcation). It may occur on the right side (10% of the general population), the left side (10% of the general population), or

bilaterally (8% of the general population). Association between double posterior trifurcation and cataplexy is not common. Cataplexy is characterized by sudden loss of muscle tone, while awake, typically triggered by a strong positive emotion. It can also be triggered less commonly by anger or fear. It is usually thought to be pathognomonic for narcolepsy. We present a case of a 55 old female with a history of two cataplectic seizures.

**Methods:** The patient was examined clinically and with Duplex ultrasound (DSG) and with CTA. Additional EEG and PSG were also planned. **Results:** The clinical examination was normal. DSG revealed tortuous and small, but not yet hypoplastic vertebral arteries (on V2) and congenital abnormality or variant was suspected and CTA proved double posterior trifurcation. During the first DSG posterior communicating arteries were not detected because of technical reasons and unfortunately posterior trifurcation was not suspected. **Conclusions:** Symptomatic cataplexy without narcolepsy is a very rare condition. It is described in connection with neoplastic lesions, multiple sclerosis and rare conditions but a possible vascular reason is not usual.

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**P38****MY WORST CASE WITH SONOTHROMBOLYSIS***E. Vavrek*

University Hospital Tzaritza Ioanna ISUL, Neurology, Sofia, Bulgaria

**Background:** Here is presented a case of a 63 old man with acute ischemic stroke due to extracranial thrombosis of the left internal carotid artery, associated with about 70% percents stenoses of the right common and internal carotid arteries.

**Methods:** The patient was treated with rtPA associated with temporal transcranial ultrasound for an hour during rtPA infusion. **Results:** During transcranial monitoring left middle cerebral artery (LMCA) was rated between 2 and 3 on TIBI scale. On the 24 hour were detected two small ischemic zones and two intracranial haematomas. No new symptoms were added. **Conclusions:** There are data that transcranial ultrasound monitoring (TCD) and microbubble administration in acute ischemic stroke patients are associated with early recanalization and a high rate of hemorrhagic transformation but does not seem to increase the risk of symptomatic intracranial hemorrhage. According to CLOTBUST TCD alone is safe in acute ischemic stroke patients. In the presented case report an association between the transtemporal insonation and the haematomas is possible but not probable.

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P39

**CAROTID DISSECTION PRESENTING WITH ISCHEMIC STROKE AND SUBARACHNOID HAEMORRHAGE**

*E. Vavrek*

University Hospital Tzaritza Ioanna ISUL, Neurology, Sofia, Bulgaria

**Background:** We present a case of a 43 years old patient, presented with left latent hemiparesis, left hemihypesthesia, headache and nausea. **Methods:** The patient was assessed physically, by duplex sonography (DSG) and by CT. **Results:** During the initial examination a carotid dissection was suspected, but the first CT and DSG failed to show any data for a dissection. Two days later the patient experienced subarachnoid haemorrhage. Only one CT slide showed a typical shape. The second DSG revealed data for vasospasm, greater velocities in the right internal carotid artery (RICA) than in the left and very high velocity in the intracranial RICA. **Conclusions:** When there is a clinical suspicion for a dissection in the internal carotid artery all possible segments should be examined even in the absence of supporting CT data.

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**SEMANTIC APHASIA IN SONOTHROMBOLYSED PATIENT (WITHOUT RTPA)**

*M. Klissurski<sup>1</sup>; E. Vavrek<sup>1</sup>; N. Nicheva-Vavrek<sup>2</sup>*

<sup>1</sup>University Hospital Tzaritza Ioanna ISUL, Neurology, Sofia, Bulgaria; <sup>2</sup>Sofia University Sveti Kliment Ohridski, FNPP, Sofia, Bulgaria

**Background:** We present a 59 years old man suffered acute ischemic stroke in the left hemisphere. The patient was hemiplegic and with total aphasia. **Methods:** The patient was treated with transcranial ultrasound and aspirin and later assessed by a neurologist and speech therapist and with duplex ultrasound (DSG) and respiratory polygraphy. **Results:** Till the second hour the patient's left middle cerebral artery was between 1 and 2 on TIBI scale and 5 on the sixth hour. On the first day the patient had mild semantic aphasia and data for a mild to moderate sleep apnea; he was otherwise normal (on examination and DSG). On the first month the patient achieved a complete neurological recovery. **Conclusions:** In this patient we observed very good recovery after sonothrombolysis without rTPA.

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**V Diagnostics in Stroke Management 1**

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**VERTEBRAL ARTERY HYPOPLASIA AND THE POSTERIOR CIRCULATION STROKE**

*A. Skultéty Szárazová<sup>1</sup>; E. Bartels<sup>2</sup>; P. Turčáni<sup>1</sup>*

<sup>1</sup>University Hospital of Bratislava, Dept. of I. Neurology Clinic, Bratislava, Slovakia;

<sup>2</sup>Center for Neurological Vascular Diagnostics, München, Germany

**Background:** The aim of this preliminary study is to evaluate a hypothesis of a possible causal link between the anatomical findings of vertebral artery hypoplasia (VAH) and the incidence of posterior circulation stroke. **Methods:** We used full ultrasound examination to examine patients with stroke in vertebrobasilar circulation territory over a period of 1,5 year. The diameter equal or less than 2.5 mm (in V1 and V2 segment of vertebral artery) was set as a feature of vertebral artery hypoplasia. MRT and MRA or CT and CTA were performed to confirm the anatomic variation of hypoplasia and the site of the cerebral ischemic territory. **Results:** In the group of 44 stroke patients, 9 (20%) had a hypoplastic vertebral artery and 35 (80%) were without VAH. **Conclusions:** Although vertebral artery hypoplasia in previously known literary data is seldom shown as a leading risk factor for stroke in vertebrobasilar (posterior) circulation, its occurrence is not negligible and in coexistence with known risk factors of stroke may increase the negative clinical impact. Vertebral artery hypoplasia can be diagnosed noninvasively with duplex ultrasound imaging. It is therefore a useful method for detection of this anatomic variation and follow-up examination.

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P42

**REFILL-KINETICS OF ULTRASOUND PERFUSION IMAGING TO ASSESS PERFUSION DEFICITS IN MCA STROKE PATIENTS**

*M. Bolognese; D. Artemis; A. Alonso; S. Meairs; M. G. Hennerici; R. Kern*

Universitätsmedizin Mannheim, Neurology, Mannheim, Germany

**Background:** Ultrasound perfusion imaging (UPI) with bolus kinetic has shown to be feasible at bedside for evaluation of perfusion deficits in stroke patients. Recent technical advances allow perfusion imaging with refill kinetics using a low mechanical index. **Methods:** We examined 31 acute MCA stroke patients with transcranial color-coded duplex ultrasound (TCCD) and UPI with low mechanical index (MI: 0.17). The first examination was done < 24 h and the follow up between 72 and 96 h after stroke onset. After bolus injection of SonoVue®, a repetitive ultrasound pulse with high MI (1.47) was performed to destroy the circulating microbubbles. The refill of microbubbles was calculated from regions of interest in the ischemic area and the contralateral MCA territory by using the exponential function  $y = A(1 - e^{-\beta t})$ ; A = acoustic intensity of the plateau (dB),  $\beta$  = slope (1/s). **Results:** We found significantly lower values of  $\beta$

in the ischemic area in comparison to the contralateral MCA territory (0.75 vs. 1.05 1/s,  $p < 0.05$ ), particularly in patients with a pathological MCA flow patterns on TCCD (0.61 vs. 1.01,  $p < 0.01$ ). At follow up there was no significant difference between  $\beta$  values (0.9 vs. 0.87,  $p = ns$ ), likely due to partial or complete recanalization of the MCA with symmetrical TCCD flow patterns. There was a high interindividual variance without significant difference of the plateau of acoustic intensity (A) in any subgroup of patients. **Conclusion:** The slope parameter  $\beta$  of refill kinetics is useful for assessing brain perfusion in acute stroke patients. The parameter A, however, seems more dependent from the quality of the temporal bone window. According to our data, the severity of the perfusion deficit as measured with  $\beta$  is related to the underlying vascular pathology and can be reversible after successful recanalization

#### P43

##### INTRACRANIAL STENOSES DETECTION USING TRANSCRANIAL DUPLEX SONOGRAPHY, CT ANGIOGRAPHY AND ANGIOGRAPHY

M. Roubec<sup>1</sup>; M. Kuliha<sup>1</sup>; T. Fadrna<sup>1</sup>; V. Prochazka<sup>2</sup>; T. Jonszta<sup>2</sup>; D. Skoloudik<sup>3</sup>

<sup>1</sup>University Hospital Ostrava, Neurology, Ostrava, Czech Republic; <sup>2</sup>University Hospital Ostrava, Radiology, Ostrava, Czech Republic; <sup>3</sup>Neurology, 17. Listopadu, Ostrava, Czech Republic

**Background:** Stenoses and occlusions represent the most frequent abnormalities detected in intracranial arteries. The aim of the present study was to compare the findings in the intracranial arteries using transcranial color-coded duplex sonography (TCCS), CT angiography (CTA) and digital subtraction angiography (DSA) in stroke patients. **Methods:** Sixty-seven patients were enrolled in a retrospective study. All patients underwent examinations of intracranial arteries using TCCS, CTA and DSA. Findings were divided into four groups: normal; mild stenosis (<50%); severe stenosis (50—99%); and occlusion. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and Cohen's kappa coefficient ( $\kappa$ ) were used for statistical evaluation of the comparison of the three methods. **Results:** Due to technical reasons or an insufficient bone window, 465 out of 536 arterial segments were evaluated. Values for sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) of CTA and TCCS in comparison with DSA were 81.5%, 98.7%, 78.6%, 98.6% and 88.9%, 94.8%, 51.1%, 99.3%, respectively. The correlation between CTA and DSA was 96.6%,  $\kappa = 0.697$ ; between TCCS and DSA was 93.9%,  $\kappa = 0.588$ ; and between CTA and TCCS was 93.8%,  $\kappa = 0.559$ . Only in 35 (7.5%) arteries was agreement noted in only two methods. In 2 (0.4%) cases, there was disagreement between all three methods. **Conclusions:** TCCS and CTA could be used as non-invasive or semi-invasive methods with high correlation with DSA in the detection intracranial arterial pathology. Supported by: IGA MH CR grants NT/11386-5/2010, NT/11046-6/2010.

#### P44

##### JAW CLAUDICATION: AN UNCOMMON SIGN INDICATING A SEVERE CEREBROVASCULAR CONDITION

C. Tanislav; M. Kramer; M. Kaps; J. Allendörfer  
Justus Liebig University Giessen, Department of Neurology, Giessen, Germany

**Background:** Cerebral ischemia may result in a various spectra of clinical manifestations. In the acute phase understanding the vascular disturbance is highly relevant for establishing the appropriate therapeutic measures. We report on a patient, who presented initially with jaw claudication as single symptom of a thrombotic occlusion of the common carotid artery. Case presentation: A 69-year-old woman complaining of double vision and numbness of the left arm was admitted to our neurological department. The symptoms resolved shortly after admission. On taking the medical history, the patients reported of recurrent pain located in the angle of the right mandible only occurring within 5 minutes while chewing food. The initial ultrasonography of the brain arteries revealed an occlusion of the right common carotid artery (CCA). The CT-angiography confirmed the CCA occlusion. In the MRI of the thorax a thrombus within the brachiocephalic trunk and the right arteria subclavia was observed. The patient was initially treated with heparin intravenously. No further cerebrovascular events were notable subsequently. After 5 days a beginning recanalization of the CCA was observed. On discharge a therapy with oral anticoagulans was established. After 5 months of treatment a complete recanalization of the right CCA was observed. **Conclusion:** Jaw claudication might indicate a severe cerebrovascular disturbance. As in our case demonstrated it occurred as the first sign of a CCA occlusion.

#### P45

##### NEUROSONOLOGIC PATTERNS OF ACUTE ISCHEMIC STROKE PATIENTS IN INDONESIA

S. Harris; M. Kurniawan

Faculty of Medicine, University of Indonesia, Neurology, Jakarta, Indonesia

**Background:** Neurosonologic examinations using carotid and transcranial Doppler ultrasound is still new in our country, but increasingly performed and become mandatory in the evaluation of acute ischemic stroke patients. Those examinations allow detection of structural changes in the vessels associated with atherosclerosis process and stroke etiology. This study was performed to describe the pattern of structural changes found in neurosonologic examination of acute ischemic stroke patients. **Methods:** We used a descriptive cross-sectional approach of 233 acute ischemic stroke patients in Cipto Mangunkusumo National Hospital in 2010 who performed carotid and transcranial doppler ultrasonography. **Results:** Age of subjects ranged from 23 to 86 years old, 168 (72.10%) were male and 170 (72.96%) were hypertensive. Thickening of carotid intima media occurred in 164 (70.38%) patients, 70 (30.04%) patients had carotid plaque, carotid thrombi occurred in 17 (7.29%) patients, extracranial stenosis occurred in 46 (19.74%) patients

and 2 patients had internal carotid artery dissection. From all of the patients, we also found that 43 (18.45%) had intracranial stenosis. **Conclusion:** Although neurosonologic evaluations were increasingly performed in ischemic stroke patients, until now, especially in Indonesia, there is still little data about pattern of structural vessels abnormalities found in those patients. Our study showed that in acute ischemic stroke patients, 164 (70.38%) has thickening of intima media and occurred 178 (76.39%) more advanced structural changes which 135 of them were happened in extracranial arteries (including plaque or thrombus formation, stenosis and arterial dissection) and 43 intracranial stenosis. These findings were very interesting, because they can prove that vascular changes were actually happened in acute ischemic stroke and found a fact that case of intracranial arterial stenosis is nearly equivalent with extracranial stenosis in our country.

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**P46**  
**TRANSIENT ISCHEMIC ATTACKS CAUSED BY CLOTH IN PROXIMAL INTERNAL CAROTID ARTERY Case report**

*S. Jolic<sup>1</sup>; M. Jolic<sup>2</sup>; M. Zivkovic<sup>1</sup>; N. Vukasinovic<sup>1</sup>; M. Ilic<sup>3</sup>*

<sup>1</sup>Clinical Centre Nis, Clinic for Neurology, Stroke Unit, Nis, Serbia; <sup>2</sup>Clinical Centre Nis, Clinic for Neurology, Nis, Serbia; <sup>3</sup>Clinical Centre Nis, Institute for Radiology, Nis, Serbia

A 57 years old male patient was admitted in our clinic, due to a repetitive, transient weakness of right limbs and transient left eye blindness. That happened from 2 to 6 times during each of previous 4 days. He only suffered from hypertension for 15 years. On admission there was no motor deficit and his vision fields were bilaterally undamaged. Except mild hypercholesterolemia, his laboratory results were normal. Just after admission carotid ultrasound examination revealed good morphological and hemodynamic finding in both vertebral arteries and right ICA, but high grade left ICA stenosis, caused by cloth. Also, on Doppler wave spectrum, recorded distal from cloth, there were seen sporadic hyper intense signals, that met all criteria for micro embolic signals. Transthoracic and transoesophageal echocardiography were normal. Brain CT and MR were performed, no ischemic lesions were found, and low molecular heparin was applied. Then angiography was performed, and, immediately after it, combined with distal cerebral protection, percutaneous transluminal balloon dilatation with stent placement was done. Control neurological status and brain MR were normal. In conclusion, ultrasound examination of carotid vessels might be crucial and technique of choice in some stroke cases.

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**P47**  
**VERY EARLY RECANALIZATION AFTER SYSTEMIC THROMBOLYSIS MONITORING BY TRANSCRANIAL COLOR FLOW IMAGING**

*H. Mitsumura<sup>1</sup>; R. Sengoku<sup>1</sup>; Y. Kono<sup>1</sup>; M. Morita<sup>1</sup>; H. Furuhashi<sup>2</sup>; S. Mochio<sup>1</sup>*

<sup>1</sup>Jikei University School of Medicine, Neurology, Tokyo, Japan; <sup>2</sup>Jikei University School of Medicine, ME Laboratory, Tokyo, Japan

**Background/Aims:** Cerebrovascular ultrasonography was useful clinically for evaluating cerebral hemodynamics rapidly and in real-time for the patients with acute ischemic stroke. We analyzed if the patients had early recanalization or not using by Transcranial color flow imaging (TC-CFI) in order to evaluate the usefulness of real-time monitoring in systemic thrombolysis. **Methods:** Subjects were the patients who had acute ischemic stroke with intravenous tissue plasminogen activator (tPA) within three hours from onset. We evaluated occlusion of intracranial arteries from transtemporal or suboccipital window by TC-CFI with Thrombolysis in Brain Ischemia (TIBI) flow-grading system and monitored residual flow in real-time every 15 minutes until 120 minutes after the t-PA bolus. **Results:** We could monitor residual flow in 5 patients who had good echo windows (4 male, mean age; 60.8±6.4y.o.). Three patients were distal occlusion of middle cerebral artery (MCA), one patient was proximal occlusion of MCA and one patient was distal occlusion of unilateral vertebral artery. Four patients had early complete recanalization within 60 minutes after the t-PA bolus (two patients were 60 minutes and other two patients were 30 minutes), however, occlusion persisted during 120 minutes monitoring in one patient with proximal occlusion of MCA. NIH Stroke Scale of two patients with very early recanalization was 0 at the end of the treatment. There was no symptomatic and asymptomatic intracranial hemorrhage in 4 patients except for the patients without recanalization. **Conclusions:** It is anticipated that real-time ultrasound monitoring is useful for evaluating very early thrombolytic effect of tPA connected with early clinical recovery.

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**P48**  
**ACCURACY OF NEUROSONOLOGICAL EXAMINATION FOR INTERNAL CAROTID OCCLUSION DIAGNOSIS IN ACUTE STROKE**

*J. C. Portilla Cuenca; A. Falcon Garcia; A. Serrano Cabrera; M. Gomez Gutierrez; M. L. Calle Escobar; G. Gámez-Leyva; I. Casado Naranjo*

HSPA, Stroke Unit, Neurology, Caceres, Spain

**Background and aim:** Neurovascular ultrasound examination (NVUE) in cerebrovascular disease has proven to be accurate when compared to other diagnostic tests, but there are clinical situations known to lower duplex reliability, like carotid occlusions or haemodynamical changes in acute stroke. The aim of this study was to validate the results obtained with NVUE in our Stroke Unit (SU), focusing in detection of internal carotid occlusions in acute stroke. **Methods:** We performed a retrospective study of the patients admitted to the SU with

diagnosis of ischaemic stroke or TIA in which NVUE (TCD + CD performed by experienced neurologist according with standard protocols) showed occlusion of internal carotid artery (ICA) during acute phase of stroke (0 to 48 hours after symptoms onset). We analyzed the basal characteristics of these patients and the results of the control diagnostic test performed after acute phase (arteriography, angio-MRI or control duplex). To determine the agreement between both results we calculated usual accuracy parameters. Results: We studied 64 consecutive patients admitted to SU who met the criteria above detailed. A control test was performed to 53 of these patients (16% underwent angiography, 62% angio-MRI and 22% control duplex). In 81% of the patients occlusion of ICA was confirmed, and accuracy parameters were: 100% sensitivity, 85.25% specificity, 83.33% positive, and 100% negative predictive values. The value for kappa index was 0.83. **Conclusions:** The results obtained with bedside NVUSE during acute phase of stroke in our SU are in good correlation with other diagnostic tests performed during follow-up, and are validated for further examinations. However, there are some limitations in this study, mainly previous selection of patients by duplex (possible false negatives couldn't be determined) and the inability to perform angiography in all control studies.

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#### P49

##### EARLY ULTRASOUND IMAGING OF CAROTID ARTERIES IN THE ACUTE ISCHEMIC CEREBROVASCULAR PATIENT

M. F. Giannoni<sup>1</sup>; E. Vicenzini<sup>2</sup>; C. Zuco<sup>3</sup>; E. Sbarigia<sup>4</sup>; V. Di Piero<sup>5</sup>; G. L. Lenzi<sup>3</sup>; F. Speziale<sup>4</sup>

<sup>1</sup>Sapienza University of Rome, Paride Stefanini, Vascular Ultrasound Investigation, Policlinico Umberto I, Rome, Italy; <sup>2</sup>Sapienza University of Rome, Dept Nuerology and Psychiatry, Rome, Italy; <sup>3</sup>Sapienza University of Rome, Dept Neurology and Psychiatry, Rome, Italy; <sup>4</sup>Sapienza University of Rome, Paride Stefanini, Vascular Surgery, Policlinico Umberto I, Rome, Italy; <sup>5</sup>Sapienza University of Rome, Dept Neurology and Psychiatry, Stroke Unit, Rome Italy, Italy

**Background and Purpose:** The early identification of ischemic stroke pathophysiology may lead to different diagnostic and therapeutical strategies. In one third of patients, stroke is related to carotid disease, when a vulnerable atherosclerotic plaque evolves with surface rupture and local apposition of highly embolic thrombotic material. Being this a rapid evolving dynamic process, its early identification may be underestimated. With the diffusion of high-resolution ultrasound equipments, the possibility of identifying these features of plaque vulnerability has become easily available. These plaque characteristics have to be always considered in the patient management, in order to avoid further worsening of neurological conditions and to choose the appropriate prevention strategies. **Methods:** Early US was performed with high frequency probes (9-18 MHz) in patients admitted to emergency area for acute neurological deficit due to cerebral ischemic event from carotid stenosis. **Results:** in 8 patients, few hours after the onset of neurological symptoms, we detected peculiar plaque characteristics with local thrombosis, surface plaque rupture and carotid floating

thrombi. All these cases were successfully submitted to emergency carotid endarterectomy repair. **Conclusions:** Timing of carotid endarterectomy has always been debated in stroke patients' clinical management, depending from several factors, i.e. blood-brain-barrier breaking, neurological severity, entity of cerebral damage. All imaging techniques contribute to the identification of plaque morphology unstable features, but early US has a crucial leading role in detecting plaque rupture and dynamic changes in real-time, allowing the identification of those lesions at particularly high risk of further embolic events for their fragile characteristics and that may benefit of CEA.

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#### P50

##### US ASSESSMENT OF VERTEBROBASILAR SYSTEM WITH CEREBRAL INFARCTION OF POSTERIOR CIRCULATION

I. Kikule; G. Enina; Z. Kovaldina; I. Purina  
Riga East University Hospital, Hipokrata 2, Riga, Latvia

**Background:** To establish examination possibilities and frequency of stenotic changes of US indicators of different segments of cerebral posterior circulation territorial system. **Patients and methods:** Examinations were performed to 202 patients with acute vertebrobasilar system (VBS) infarction, who were treated in Stroke Unit. Radiologically the infarction was confirmed in 40% brainstem, 35.7% occipital lobe, 24.3% cerebellum. Examinations were performed by high resolution ultrasound equipment Philips iU22. **Results:** Inability to register US indicators of VBS arteries in different segments varied insignificantly. V0 segment failed to locate in 14.4%, V1, V2, V3 - 3.9% - 4.9%, V4 and BA 6.4% and 6.9% and P1-9.4%, P2-10.4% cases. The changes of US indicators which characterise atherosclerotic stenosis varied more significantly in different segments. Most often — 56.9% the changes were observed in P1 segments, V0, V1, V2- from 16.8% to 31.4% patients, V4 segment- 15.8%, BA 32.4%, and only P2 segments- 12.1%. **Conclusion:** Adapting individually the methodology of US location, VBS artery in all segments is possible to locate not least than 85.6%, even up to 96.1%. Atherosclerotic stenoses were found in different frequency in various extra- and intracranial segments of VBS.

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## VI Functional TCD, Vasomotor Reactivity 1

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P51

### MEASUREMENT OF CEREBROVASCULAR TIME CONSTANT USING TRANSCRANIAL DOPPLER ULTRASONOGRAPHY

M. Kasprowicz<sup>1</sup>; P. Smielewski<sup>2</sup>; P. J. Kirkpatrick<sup>2</sup>; J. D. Pickard<sup>2</sup>; M. Czosnyka<sup>2</sup>

<sup>1</sup>Wroclaw University of Technology, Institute of Biomedical Engineering and Instrumentation, Wroclaw, Poland;

<sup>2</sup>University of Cambridge, Academic Neurosurgery, Addenbrooke's Hospital, Cambridge, United Kingdom

**Background:** We proposed a novel ultrasound-based parameter, the time constant ( $\tau$ ), which estimates how fast the cerebrovascular arterial bed fills with blood volume load (CaBV) during one cardiac cycle. It can be calculated as a product of compliance of cerebral large arteries (Ca) and resistance of peripheral autoregulatory-modulated arterioles (CVR). **Methods:** We verified usefulness of  $\tau$  for quantitative assessment of cerebral haemodynamics in 2 groups: 1) 11 normal subjects 2) 16 patients with severe unilateral stenosis of internal carotid artery (ICA). Ca and CVR were calculated based on a mathematical model of the relationship between pulsatile arterial blood pressure (ABP) and Transcranial Doppler (TCD) cerebral blood flow velocity (CBFV). Simultaneous recordings of ABP and CBFV in MCA were performed during controlled changes in end-tidal CO<sub>2</sub> in ICA stenosis and normal subjects. Then, the  $\tau$  was compared between periods of 1) normocapnia vs. hypercapnia and 2) at baseline (normocapnia) in normal subjects and in patients with ICA stenosis. **Results:** The  $\tau$  was shorter during hypercapnia when compared with normocapnia in normal subjects ( $0.22 \pm 0.06$  s vs.  $0.19 \pm 0.04$  s,  $p < 0.02$ ), but such a relationship was not observed in ICA stenotic disease ( $0.18 \pm 0.04$  s vs.  $0.17 \pm 0.05$ ,  $p = 0.4$ ). The baseline  $\tau$  was shorter on ipsilateral side than on contralateral side in unilateral ICA stenosis ( $p = 0.001$ ) and also shorter when compared with normal subjects ( $p < 0.044$ ). The baseline  $\tau$  (at normocapnia) correlated with the degree of stenosis ( $R = -0.61$ ,  $p = 0.012$ ). **Conclusions:** Shortening of  $\tau$  during hypercapnia in normal subjects and shorter  $\tau$  at baseline in patients with carotid artery stenosis can be explained by decrease in CVR due to compensatory dilatation of the cerebrovascular bed distal from the point of ultrasound insonation. An important advantage of  $\tau$  is its independence of the cross-sectional area of the insonated vessel.

P52

### CEREBRAL HEMODYNAMIC EFFECT OF EXTERNAL COUNTERPULSATION IS A DIFFERENT MEASURE FROM VASOREACTIVITY

W. H. Lin; L. Xiong; J. H. Han; X. Y. Chen; T. W. Leung; K. S. Wong

The Chinese University of Hong Kong, Dept. Medicine and Therapeutics, Prince of Wales Hospital, The Chinese University of Hong Kong, Sha Tin, Hong Kong, China

**Background:** External counterpulsation (ECP) is a novel method to augment cerebral blood flow during diastole, which may benefit acute ischemic stroke patients. We aimed to explore the correlation between the augmented hemodynamic effect of ECP and cerebral vasomotor reactivity. **Methods:** We recruited 32 recent ischemic stroke patients with large artery occlusive disease and 20 healthy elderly controls. All underwent ECP treatment and breathholding test combined with transcranial Doppler monitoring on bilateral middle cerebral arteries (MCA). We designated the ipsilateral or contralateral MCA based on the side of the recent infarct, while we used the average of both sides in the controls. Cerebral augmentation index (CAI) was calculated based on the formula (mean velocity during ECP - baseline mean velocity) / baseline mean velocity  $\times 100\%$ . Vasomotor reactivity was assessed by using the breathholding index (BHI). **Results:** The MCA mean flow velocities in stroke group significantly increased after ECP (CAI ipsilateral  $9.856 \pm 9.057$ , contralateral  $9.235 \pm 7.624$ ) but not in the controls, (CAI  $-0.469 \pm 2.892$ ,  $p < 0.001$ ). BHIs were smaller in the stroke group, (ipsilateral  $0.723 \pm 0.437$ , contralateral  $0.864 \pm 0.470$ ) than that of the controls ( $1.405 \pm 0.455$ ,  $p = 0.011$ ). CAI did not correlate with BHI in the ipsilateral or contralateral side of stroke group as well as in controls. BHI was significantly lower on the ipsilateral side than the contralateral side,  $p = 0.049$ , but CAI showed no difference. **Conclusions:** Dynamic augmentation effects as measured by CAI were different from the well established vasomotor reactivity. CAI is a measure of how well the brain accommodates blood flow augmentation, independent of vasomotor reactivity.

P53

### VASOMOTOR REACTIVITY IN CEREBRAL SMALL VESSEL DISEASE

Y-S. Lee; B.-J. Kim, Beom-Joon

Seoul National University Boramae Medical Center, Neurology, Seoul, Republic of Korea

**Background:** Cerebral vasomotor reactivity (VMR) represents the capacity of the arterioles to dilate in response to CO<sub>2</sub> retention or acetazolamide. VMR has been reported to be reduced in cerebral small vessel disease (SVD). However, the difference between white matter lesion (WML) and lacunar infarct (LI) has not been studied well. **Methods:** We included consecutive patients with SVD confirmed on MRI whose VMR has been measured with TCD. Patients with acute stroke, cortical infarct, or underlying arterial stenosis were excluded. WML was graded by Fazekas scale and number of LI was counted. SVD was classified as WML-dominant ( $n = 12$ ), LI-dominant ( $n$

= 10) and mixed group (n = 8). VMR was measured by TCD with retention of CO<sub>2</sub> by semi-closed rebreathing method and calculated by % change of mean flow velocity. Results: Mean age was not different between groups (WML 70 years, LI 66 years, Mixed 68 years, p=0.35). VMR was significantly reduced in WML and Mixed group compared with LI group (45 ± 27 %, 42 ± 13%, 59 ± 16%, p<0.05). **Conclusion:** These preliminary results show that reduced VMR is more associated with WML than LI. Underlying pathophysiology and hemodynamic status may be different between WML and LI, which needs to be validated by further studies.

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**P54**  
**EVALUATION OF CEREBRAL VASOMOTOR REACTIVITY AND FLOW MEDIATED DILATION IN HEALTHY SUBJECTS**

*P. Palazzo<sup>1</sup>; P. Maggio<sup>1</sup>; F. Tibuzzi<sup>2</sup>; F. Passarelli<sup>2</sup>; C. Altamura<sup>1</sup>; R. Altavilla<sup>1</sup>; F. Vernieri<sup>1</sup>*

<sup>1</sup>Università Campus Bio-Medico, Department of Neurology, Rome, Italy; <sup>2</sup>Ospedale San Giovanni Calbita Fatebenefratelli, Isola Tiberina, Department of Neurology, Rome, Italy

**Background:** Endothelial function is fundamental in regulating vascular tone, cell growth, and platelet-leukocyte interactions. It is thought to be an important pathogenetic factor for atherosclerosis. Endothelium-dependent flow-mediated vasodilation (FMD), investigated by high-frequency ultrasonographic probes after 5-min brachial artery occlusion, represents a non-invasive method for assessing the endothelial function. Cerebral vasomotor reactivity (CVR) expresses the capability of dilation of cerebral vessels in response to hypercapnia, which can be induced by CO<sub>2</sub> inhalation or apnea. Impaired CVR is associated with an increased risk of ischemic events in subjects with carotid artery steno-occlusive disease. This study aims at evaluating both CVR and FMD in subjects without a history of cerebrovascular or cardiovascular disease in order to define a possible correlation between these two different modalities of vasomotor function evaluation. **Methods:** Thirty healthy volunteers were selected from consecutive subjects undergoing color coded duplex sonography of the neck vessels in our Neurosonology laboratory. FMD was measured as brachial artery blood flow and diameter changes induced by transient ischemia, according to guidelines. After undergoing FMD assessment, CVR to hypercapnia was assessed in all subjects by means of a breath-holding test and, in 20 subjects, by a CO<sub>2</sub> inhalation test as well. Breath-holding index (BHI) and CO<sub>2</sub>-induced CVR were obtained according to previously validated criteria. Results: CVR and FMD did not appear to correlate (p = 0.44). Strong association between CO<sub>2</sub>-induced CVR and BHI was observed (p < 0.001). **Conclusions:** CVR and FMD represent two different modalities evaluating the vasomotor function. According to our data, they did not appear to correlate, probably due to differences in the vascular district evaluated and vasodilatory stimulus used. CO<sub>2</sub>-induced CVR and apnea-induced CVR appeared to be significantly associated.

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**P55**  
**CEREBRAL HAEMODYNAMICS WITH NEUROVASCULAR COUPLING DURING ORTHOSTATIC CHALLENGE**

*P. Castro<sup>1</sup>; R. Santos<sup>2</sup>; J. Freitas<sup>3</sup>; B. Rosengarten<sup>4</sup>; R. Panerai<sup>5</sup>; E. Azevedo<sup>1</sup>*

<sup>1</sup>Hospital São João, Department of Neurology, Faculty of Medicine, University of Porto, Porto, Portugal; <sup>2</sup>Hospital São João, Department of Neurology, Porto, Portugal; <sup>3</sup>Hospital São João, Autonomic Unit, Faculty of Medicine, University of Porto, Porto, Portugal; <sup>4</sup>University of Giessen, Department of Neurology, Giessen, Germany; <sup>5</sup>University of Leicester, Department of Cardiovascular Sciences, University of Leicester, Leicester, United Kingdom

**Background:** Neurovascular coupling (NVC) adapts cerebral blood flow velocity (BFV) to cortical activity. It was shown to be unaffected by orthostatic challenge. Nevertheless, it is not known how different passive pressure-velocity models behave during functional transcranial Doppler (TCD) monitoring under different orthostatic conditions. Our aim was to evaluate cerebrovascular resistance index (CVRI), resistance-area product (RAP) and critical closing pressure (CrCP) during NVC, in different postural conditions. **Methods:** A visual reading test stimulation task was performed in 14 healthy volunteers in sitting, supine and head-up tilt (HUT) positions. We performed continuous monitoring of BFV with TCD in left posterior cerebral artery (PCA) and, as a reference, right middle cerebral artery (MCA), and of ABP and heart rate (HR) with Finapres. NVC was analysed by a control system method (parameters rate time, natural frequency, attenuation, gain). CVRI was compared to a two-parameter model: RAP and CrCP. **Results:** With visual stimulation, there were no differences in NVC control system parameters between the 3 positions. However, when upright, CrCP decreased significantly less compared to supine position (-13.9+/-6.5 and -28.7+/-13.0 %, p=0.0001). On the contrary, CVRI decrement was slightly higher (-24.9+/-4.3 and -20.9+/-5.3 %, p=0.007). **Conclusions:** Despite NVC, evaluated by a dynamic control system analysis, seemed to be unaffected by orthostatic challenge, cerebral haemodynamic response to visual stimulation showed differences from supine to upright positions, with lesser decrement in CrCP and little or no differences in CVRI and RAP following stimulation, perhaps because these parameters might be related to postural adaptation. Nevertheless, it remains to be investigated whether these changes in CrCP have diagnostic or prognostic value in different cerebrovascular conditions.

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**P56****THE EFFECT OF HELIUM ON CEREBRAL BLOOD FLOW; A N=1 TRIAL IN A HEALTHY YOUNG PERSON***D. Bertens<sup>1</sup>; S. Tromp<sup>2</sup>; S. Zinkstok<sup>3</sup>; J. de Kruijk<sup>1</sup>*

<sup>1</sup>Tergooi Hospital, Neurology, Blaricum, Netherlands; <sup>2</sup>St Antonius Hospital, Clinical Neurophysiology, Nieuwegein, Netherlands; <sup>3</sup>Academic Medical Center, Neurology, Amsterdam, Netherlands

**Background:** Several experimental studies have shown that noble gases can have neuroprotecting effects in cerebral ischemia. The possible mechanism of action is egression of nitrogen from neural mitochondria to facilitate oxygen reuptake during reperfusion. The noble gas helium meets criteria for practical use and is currently available for patients with acute pulmonary pathology. Before studying any neuroprotective effect of helium in acute ischemic stroke in humans, it is important to know if helium influences cerebral blood flow in healthy people. In this n=1 trial we measured cerebral blood flow velocities by means of transcranial Doppler (TCD) in a healthy young women inhaling air or helium. **Methods:** Using TCD, peak systolic velocity (PSV), mean velocity (Mean), and pulsatility index (PI) of the flow in the right middle cerebral artery were measured in a healthy women aged 26. Furthermore, oxygen saturation (O<sub>2</sub>sat) was measured with pulse oximetry. These measurements were performed during breathing of normal air (baseline), during a period of 5 minutes of inhaling heliox (80% helium, 20% oxygen) through an oral nasal mask, and a washout period of 3 minutes normal air. This was repeated 5 times. **Results:** Mean baseline values were: PSV 77 cm/s, Mean 47 cm/s, PI 0,94 and O<sub>2</sub>sat 99%. No significant changes were observed in the 5 periods that heliox was inhaled. No side effects other than temporary changes in voice pitch were observed. **Conclusions:** Inhalation of helium does not influence cerebral blood flow in a healthy young person. Any beneficial effects of helium in stroke patients are more likely due to neuroprotective effects then due to hemodynamic changes.

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**P57****BREATH HOLDING INDEX AND ARTERIAL STIFFNESS IN EVALUATION OF STROKE RISK IN DIABETIC PATIENTS***I. Zavoreo; V. Bašić Kes; S., Morovic; L. Coric; V. Demarin*

UH Sestre Milosrdnice, Neurology, Zagreb, Croatia

**The aim of the study** was to evaluate role of breath holding index (BHI) as functional parameter for intracranial subclinical atherosclerotic changes and arterial stiffness (AS) as marker for extracranial atherosclerosis changes in diabetic patients with well and poor controlled glucose blood values in correlation with healthy population. We included 60 volunteers divided into 3 aged standardized groups-healthy volunteers, well regulated diabetes, and poor controlled diabetes. We excluded individuals with moderate and severe carotid stenosis. There was decreasing trend in mean blood flow velocities of the intracranial blood vessels and increase of the arterial stiffness (BHI/AS correlation coefficient -0,7) due to poorly regulated

glucose levels ( $p < 0,05$ ). Results of our study show that BHI test and arterial stiffens could be subclinical markers in recognizing diabetic patients who are at increased risk for cerebrovascular disease.

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**P58****EFFECT OF NON-STEROID ANTI-INFLAMMATORY DRUG ON THE NEUROVASCULAR COUPLING***K. Szabó<sup>1</sup>; E. Lako<sup>1</sup>; B. Rosengarten<sup>2</sup>; L. Csiba<sup>1</sup>; L. Oláh<sup>1</sup>*

<sup>1</sup>University of Debrecen, Department of Neurology, Debrecen, Hungary;

<sup>2</sup>University of Giessen, Department of Neurology, Giessen, Germany

**Introduction:** Regional cerebral blood flow increase induced by neuronal activation was shown in animal experiments to require the presence of functioning cyclooxygenase. In the present study the effect of a widely used, non-selective non-steroid anti-inflammatory drug (NSAID), indomethacin, was examined. We thought the answer whether indomethacin, given in the usual dose, inhibits the neurovascular coupling in humans. **Methods:** By using a visual cortex stimulation paradigm, the flow velocity response was measured in both posterior cerebral arteries of 15 young healthy adults by TCD. The stimulation protocol consisted of 10 cycles with a resting phase of 20 s (baseline) and a stimulating phase of 40 s for each cycle. After the control examination, the same volunteers were given 3x25 mg indomethacin for 2 days, after that the investigation was repeated. Repeated-measures analysis of variance (ANOVA) was used to determine whether indomethacin influences the visually evoked flow velocity time course compared with the control phase. **Results:** The resting peak systolic flow velocities were 58±11 and 45±13 cm/s during the control phase and under indomethacin, respectively ( $p < 0.01$ ). To allow comparisons between volunteers, absolute data were transformed into relative changes of flow velocity in relation to baseline. Repeated measures ANOVA revealed significant difference in the relative flow velocity time courses when indomethacin was given compared to the control period ( $p = 0.03$ ). The maximum relative change of visually evoked flow velocities were 26±7% during the control phase and 20±5% under indomethacin ( $p = 0.01$ ). **Discussion:** Inhibition of cyclooxygenase by an usual dose of indomethacin resulted in decrease of the resting flow velocity in the posterior cerebral arteries. Furthermore, indomethacin decreased the measure of the visually evoked flow velocity changes, indicating that the cyclooxygenase has an effect on the mechanism of neurovascular coupling in humans as well.

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P59

**CEREBRAL AUTOREGULATION ASSESSMENT DURING ANESTHESIA IN NEUROSURGICAL PATIENTS**

V. Semenyutin<sup>1</sup>; V. Aliev<sup>1</sup>; A. Patzak<sup>2</sup>; A. Kozlov<sup>1</sup>; P. Ampata<sup>3</sup>

<sup>1</sup>Russian Polenov Neurosurgical Institute, Laboratory of brain circulation pathology, St. Petersburg, Russian Federation; <sup>2</sup>University Hospital Charité, Humboldt-University of Berlin, Johannes-Mueller Institute of Physiology, Berlin, Germany; <sup>3</sup>Russian Polenov Neurosurgical Institute, Department of anesthesiology-reanimatology, St. Petersburg, Russian Federation

**Background:** One of the main tasks is to maintain adequate state of cerebral autoregulation (CA) during anesthesia in neurosurgical patients. Results given in literature are very controversial which could be due to different methods of CA assessment. **Aim:** To evaluate usability of different methods of CA assessment during anesthesia in neurosurgical patients. **Material and Methods:** 20 patients with cerebral aneurysms underwent craniotomy in remote period of hemorrhage. CA was assessed prior to and after induction of intravenous anesthesia (propofol) with three methods: 1) cuff test (ARI); 2) cross-spectral analysis of blood flow velocity (BFV) and systemic blood pressure (BP) within the range of M-waves (phase shift – PS); 3) assessment of correlation coefficient (Mx) between BFV and BP within the range up to 0.1 Hz. BFV in both middle cerebral arteries was monitored with Multi Dop X (DWL), BP with Finapres-2300 (Ohmeda). **Results:** Prior to anesthesia BP was 88±18 mmHg, BFV 61±25 cm/s on the right and 58±14 cm/s on the left. ARI were 4.4±0.8 and 4.6±1.1; PS 0.74±0.33 rad and 0.83±0.31 rad; Mx 0.21±0.31 and 0.20±0.32, respectively. During anesthesia a reliable (p<0.05) decrease of the following parameters was detected: BP 62±9 mmHg, BFV 30±8 cm/s and 29±11 cm/s, respectively. ARI decreased up to 2.8±0.8 and 2.6±0.6 (p<0.05). This decrease of ARI could be due to decrease of BP (in some cases) outside the lower limit of CA. PS also decreased: 0.33±0.21 rad and 0.3±0.25 rad (p>0.05). Wide dispersion of data could be connected with suppression (significant in some cases) of M-waves. Mx decreased (p>0.05): 0.04±0.28 and 0.14±0.19. But these changes of Mx contradict the conventional conception of CA. **Conclusion:** The presented noninvasive methods do not always allow assessing CA during anesthesia. The cuff test is probably the more informative provided that cerebral perfusion pressure during anesthesia is being preserved within the limits of CA.

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P60

**WITHDRAW OF STATIN IMPROVES CEREBROVASCULAR RESERVE IN RADIATION VASCULOPATHY**

J. Volpi<sup>1</sup>; R. Kabir<sup>1</sup>; Z. Garami<sup>2</sup>; P. New<sup>3</sup>

<sup>1</sup>The Methodist Hospital, Neurology, Houston, United States; <sup>2</sup>The Methodist Hospital, Cardiovascular Surgery, Neurology, Houston, United States; <sup>3</sup>The Methodist Hospital, Neurosurgery, Houston, United States

**Background:** Radiation vasculopathy affects patients with primary brain tumor and causes significant morbidity from ischemia related to hemodynamic insufficiency. In these patients, medical management for secondary stroke prevention is used, including statins. Previous studies have shown that statin use improves cerebrovascular reactivity. We report a contradictory finding in a unique patient with radiation vasculopathy and suggest broader implications for patients with hemodynamic insufficiency. **Methods:** A 66 year old man who underwent surgery and radiation for glioblastoma multiforme presented 6 months post surgery with new onset left sided weakness. He was found with a right middle cerebral artery infarct and placed on simvastatin along with aspirin. He underwent a baseline transcranial Doppler (TCD) and then had his statin withdrawn. He was then brought back to the clinic 6 weeks later for follow-up study. **Results:** Initial TCD showed no significant stenoses by velocity criteria in the proximal vessels of the circle of Willis. Interestingly, however, there was flow diversion on the the right with ACA>MCA velocity, suggesting distal stenosis. The breath holding index was 0.42. 6 weeks later, after statin withdraw, TCD showed persistent flow diversion, but significant improvement in the BHI to 0.78. **Conclusions:** The data from this patient suggests small arteriolar disease from radiation vasculopathy causing poor hemodynamic flow to the right hemisphere. Statins have been show to inhibit small GTPases that cause arteriolar vasoconstriction; that is, by “turning off the off switch” statins promote vasodilation. This effect seems to exacerbate underlying hemodynamic insufficiency by causing a steal syndrome. We propose that contralateral vasodilation was overcoming the maximal vasodilation on the pathological hemisphere. By withdraw of statin, the pathological hemisphere was able to shunt more flow and improve.

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## VII Atherosclerotic Plaque 2

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P61

### DO PARAOXONASE HYDROLITIC RATE REFLECTS ATHEROSCLEROTIC PROCESS IN STROKE PATIENTS?

S. Shenhar-Tsarfaty<sup>1</sup>; N. Waiskopf<sup>2</sup>; K. Ofek<sup>3</sup>; L. Shopin<sup>1</sup>; S. Usher<sup>4</sup>; S. Berliner<sup>5</sup>; I. Shapira<sup>5</sup>; N. Bornstein<sup>5</sup>; H. Soreq<sup>2</sup>; E. Ben Assayag<sup>5</sup>

<sup>1</sup>Tel Aviv Sourasky Medical Center, Neurology, Tel Aviv, Israel; <sup>2</sup>The Hebrew University of Jerusalem, The Institute of Life Sciences and the Interdisciplinary Center of Neuronal Computation, Jerusalem, Israel; <sup>3</sup>The Institute of Life Sciences and the Interdisciplinary Center of Neuronal Computation, The Hebrew University of Jerusalem, Jerusalem, Israel; <sup>4</sup>Tel Aviv Sourasky Medical Center, Departments of Neurology and Internal Medicine, Tel Aviv, Israel; <sup>5</sup>Tel Aviv Sourasky Medical Center, Departments of Neurology and Internal Medicine "E, Tel Aviv, Israel

**Background/Aims:** Serum paraoxonase (PON)1 enzyme, an esterase/lactonase located on high density lipoprotein (HDL), was shown to prevent LDL and HDL oxidation, thus playing an important role in reducing the atherosclerosis risk. The importance of enzyme genotype and phenotype contribution to vascular disease was previously emphasized. We aimed to evaluate PON1 polymorphisms and PON, arylesterase (ARE) and acetylcholinesterase (AChE) activities as risk factors for atherosclerosis and cerebral arteriosclerosis in ischemic stroke. **Methods:** Carotid artery intima-media thickness (IMT), cerebral white matter lesions (WML), serum enzyme activities and PON1—108C/T, Q192R L55M polymorphisms were determined in 237 stroke patients. **Results:** Stroke patients with PON1 RR192 or MM55 genotype demonstrated significant lower PON and ARE activity at both Day 1 and 12 months post-stroke than non-carriers ( $p < 0.001$ ). However, the -108C/T SNP had no effect on PON and ARE activity. Patients with carotid atherosclerosis and/or cerebral arteriosclerosis had significantly lower 12 months PON1 activity than patients without, expressed as carotid IMT, carotid plaque/s and cerebral WML ( $p = 0.02$ ,  $p = 0.027$  and  $p = 0.001$ , respectively). Furthermore, patients carrying the PON1192Q allele had significantly higher correlation between PON and AChE hydrolysis rates than those with 192RR genotype, in a dose dependent manner ( $p < 0.001$ ). **Conclusions:** These data suggests significant association between carotid atherosclerosis, cerebral arteriosclerosis and PON1 activity in stroke patients: the lower the PON1 activity the progressed is the atherosclerotic process. Genetic variation at the PON1 locus has a strong influence on PON1 activity in ischemic stroke patients, but has no direct influence on carotid IMT. This study gives strength to previous PON1 genetic studies in stroke populations and emphasizes that the antioxidant activity of PON1 might serve as an antiatherogenic mediator.

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P62

### LACUNAR CEREBRAL INFARCTS PATIENTS HAVE RELATIVELY SPARE CAROTID ARTERY DISEASE

G. Struga

University Hospital "Mother Tereze", Tirane, Albania,  
University Service of Neurology, Tirana, Albania

**Background:** Lacunar stroke is more attributed to chronic hypertension, diabetes mellitus and alcohol abuse, while nonlacunar infarction to carotid artery stenosis and atrial fibrillation. **Methods:** A retrospective comparative study of 110 nonlacunar infarction and 178 lacunar cerebral infarction diagnosed by clinical examination and CT scanning and/or magnetic resonance imaging patients hospitalized in Service of Neurology University hospital "Mother Theresa", Tirana, ALBANIA and were examined with carotid ultrasound. Data analysis was performed using the statistical software for social science SPSS 15.0. Significant was consider the values of  $p < 0.05$ . **Results:** An important statistical difference between carotid artery atherosclerotic plaques in nonlacunar (55%, SD 17.83) versus lacunar infarction (35%, SD 14.57) ( $p < 0.001$ ) was observed. **Conclusion:** Lacunar cerebral infarcts patients have relatively spare carotid artery disease compare with those with nonlacunar cerebral infarcts

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P63

### ALCOHOL CONSUMPTION ROLE IN DEVELOPMENT OF ATHEROSCLEROTIC CAROTID ARTERY DISEASE

G. Struga

University Hospital "Mother Tereze", Tirane, Albania,  
University Service of Neurology, Tirana, Albania

**Background:** Alcohol consumption it is been described as a risk factor for lacunar small cerebral arteriopathy but not atherosclerotic carotid artery disease. The purpose of this study is to give our experience in studying our patient's data in our unit Neurosonography unit at UHC "Mother Tereza", Tirana, Albania **Methods** A retrospective case review study of patients that performed carotid ultrasound in our unit. The sample of data was retrieved from in hospital admitted patients and out patients Data are expressed in average mean value and standard deviation. Data analysis was performed using the statistical software for social science SPSS 15.0. Significant was considered the values of  $p < 0.05$ . **Result:** According to the coefficient of correlation Kendall, there is not a significant correlation between grade of carotid artery stenosis and alcohol consumption (N 512,  $P = 0.03$ ) **Conclusions:** Alcohol consumption has not significant correlation with grade of carotid artery stenosis.

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**P64**

**AGE AND GENDER ROLE IN ATHEROSCLEROTIC CAROTID ARTERY DISEASE**

G. Struga

University Hospital "Mother Tereze", Tirane, Albania,  
University Service of Neurology, Tirana, Albania

**Background:** Age and gender it is been defined as risk factor for atherosclerotic artery disease. The purpose of this study is to give our experience in studying our patient's data in our unit Neurosonography unit at UHC "Mother Tereza", Tirana, Albania Methods A retrospective case review study of patients that performed carotid ultrasound in our unit. The sample of data was retrieved from in hospital admitted patients and out patients Data are expressed in average mean value and standard deviation. To compare grade of stenosis (continue variable) was used "test of student" for two independent samples. Data analysis was performed using the statistical software for social science SPSS 15.0. Significant was considered the values of  $p < 0,05$ . **Results:** According the coefficient of correlation Pearson, there is a significant statistical connection between age and the grade of carotid artery stenosis ( $P = 0.001$ ) Test of student for two independent samples there is a significant statistical distinction between genders with male dominance in CAS ( $t = 3.825$ ,  $df = 510$ ,  $P = 0.001$ ) Age groups and the grade of carotid stenosis indicate sharp rise in CAS between 40 and 60 years old with the highest risk for stenosis and ischemic stroke **Conclusions:** Age and male gender are significant factor in development of atherosclerotic carotid disease. Monitoring the patients with vascular risk factors after their 40es with carotid ultrasound would be reasonable according our data

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**P65**

**CAROTID ATHEROSCLEROSIS IN EGYPT WHAT IS BEYOND?**

F. AbdAllah<sup>1</sup>; E. Baligh<sup>2</sup>

<sup>1</sup>Cairo-University Hospitals, Neurology, Cairo, Egypt; <sup>2</sup>Cairo-University Hospitals, Cardiovascular Medicine, Cairo, Egypt

**Background:** The incidence of stroke among Egyptians is not accurately known, due to lack of reliable survey results. Yet it is generally estimated to be 2.1 per 1000 inhabitants, 78% of which are ischemic. Atherosclerosis is a major cause of ischemic stroke, of which thrombo-embolic phenomena account for a significant proportion. In the past few years, the use of duplex ultrasound scans became well-established as an accurate and sensitive screening method. **Methodology:** We analyzed the data of 4733 Egyptian subjects, who underwent extracranial carotid duplex scanning at the vascular laboratories of Cairo-university hospitals from 1.1.2003 to 1.1.2008. Demographic, clinical data and causes of referral were correlated with ultrasound findings. **Results:** Atherosclerotic carotid disease was detected in 41 % of the study population, of which 17.6% in the form of intimal thickening, and 23.4% in the form of variable degrees of stenosis. Significant and clinically-relevant stenosis ( $\geq 50\%$ ) was found in only 2.5% of atherosclerotic cases. **Conclusion and Discussion:** This percentage of significant atherosclerotic carotid disease found in Egyptians is much

lower than that estimated in studies conducted in developed countries, despite the fact that risk factors are more or less the same. This raises a number of questions regarding the cause of this discrepancy. Are there any underlying unknown factors, whither nutritional, genetic environmental or life style? Is the rate of intra-cranial atherosclerosis higher than extra-cranial disease? The true answer is still obscure, and only more studies and surveys, with the additional efforts undertaken by health authorities, can help elucidating and clearing this issue.

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**P66**

**THE EUROPEAN UNSTABLE CAROTID PLAQUE STUDY (EUCAPS)**

O. M. Rønning<sup>1</sup>; A. Abbas<sup>2</sup>; M. Skjelland<sup>2</sup>; L. Thomassen<sup>3</sup>; A. H. Aamodt<sup>4</sup>; R. Salvesen<sup>5</sup>; D. Russell<sup>2</sup>

<sup>1</sup>Akershus University Hospital, Neurology, Lorenskog, Norway; <sup>2</sup>Oslo University Hospital, Neurology, Oslo, Norway; <sup>3</sup>Haukeland University Hospital, Neurology, Bergen, Norway; <sup>4</sup>St. Olavs University Hospital, Neurology, Trondheim, Norway; <sup>5</sup>Nordland Hospital, Neurology, Bodo, Norway

**Background:** A significant proportion of strokes are thromboembolic, arising from an atherosclerotic carotid plaque. In current clinical practice treatment primarily involves identification of the severity of luminal stenosis. It is increasingly clear, however, that this alone may not be the best predictor of risk. Strokes may occur as a result of non-stenotic carotid disease, and conversely, patients with significant carotid stenosis may remain asymptomatic throughout their life-time. Recent research has shown that inflammation plays a key role in plaque destabilization and increases the risk of artery to artery embolisation. The main goal of The European Unstable Carotid Artery Plaque Study (EUCAPS) is to register data which will enable the identification of new markers of plaque instability. EUCAPS has established a robust method for registering and storing patient data without the use of national identity numbers and with mechanisms to handle these conversions electronically with a high level of security **Methods:** EUCAPS is a prospective study which registers data regarding patients with symptomatic (unstable) and asymptomatic carotid artery plaques. It includes clinical details with a follow-up at 6 and 12 months, serum markers and mediators of plaque instability, carotid ultrasound findings, CT angiography and where available carotid 3-Tesla MRI with dedicated carotid coils, and imaging of metabolic activity using FDG-PET. Lastly, the histology and immunohistochemistry of plaques removed by endarterectomy will be examined. **Conclusion:** Results from this study may contribute to identification of new markers for plaque instability in atherosclerotic carotid stenosis. Better prediction of risk in carotid artery disease would result in more accurate selection of patients to different prophylactic treatments. Interested hospitals are invited to participate in EUCAPS.

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**P67****MIDDLE CEREBRAL ARTERY VELOCITY PROFILE IS CORRELATED WITH CAROTID INTERADVENTITIAL DIAMETER.**

J. Carneado-Ruiz; M. Gonzalez -Salaices; C. Prieto-Jurczynska; A. Diaz-Negrillo

Hospital Infanta Elena, Neurology, Madrid, Spain

**Objective:** To study the correlation between middle cerebral artery mean velocity and carotid artery atherosclerotic and remodeling markers. **Patients/Methods:** Fourteen patients consecutively studied in our neurosonology laboratory the main exclusion criteria were: Sectorial MCA territory cerebral infarction, central nervous system disease with space occupying effect, carotid artery territory hemodynamically significant arterial stenosis, insufficient transtemporal window, abnormal cardiac ejection fraction, atrial fibrillation, chronic renal failure with creatinine >2,3mg/dl, anemia, moderate cognitive impairment (MMSE < 20). Variables: Age, Sex, systolic (SBP) and diastolic (DBP) blood pressure, Middle Cerebral Artery mean velocity (MCAvm), vascular risk factors, clinical atherosclerosis markers, intima-media thickness (IMT), interadventitial diameter, carotid artery plaque area. **Results:** 28 carotid arteries were studied, sex male 50%, age 74,1 (Standard Deviation SD 6,4), SBP 141,5 (SD 11,2) mmHg, DBP 72,2 (SD 6,3) mmHg, MCAvm 42,3 (SD 10,6) cm/seg, IMT 1,176 (SD 0,175) mm, number of vascular risk factors/atherosclerotic markers 4 (SD 1), common carotid artery interadventitial diameter 8,6 (SD 1,2)mm. In the multiple linear regression analysis those variables with an independent association with MCA vm were: number of vascular risk factors/atherosclerotic markers 6,74 (1,23) p<0.001, age -0,95 (0,23) p<0,01, Common Carotid Artery interadventitial diameter -3,26 (1,21) p=0,013, DBP 0,52 (0,22) p=0,026. Determination coefficient 61,51% (p<0,001). **Conclusion:** Common Carotid Artery interadventitial diameter demonstrates an independent association with Middle Cerebral Artery velocity profile: (Coefficient: -3,26 (95% Confidence Interval: -5,76 to -0,75) p<0,05.

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**P68****SUBCLAVIAN STEAL PHENOMENON – CAN SONOGRAPHIC GRADING PREDICT SUBCLAVIAN ARTERY STENOSIS?**

S. Schreiber<sup>1</sup>; E. Siebert<sup>2</sup>; A. Tountopoulou<sup>3</sup>; J. M. Valdueza<sup>4</sup>; F. Doepp<sup>1</sup>

<sup>1</sup>University Hospital Charité, Neurology, Berlin, Germany;

<sup>2</sup>University Hospital Charité, Neuroradiology, Berlin, Germany; <sup>3</sup>Aeginition Hospital, Neurology, Athens, Greece;

<sup>4</sup>Segeberger Kliniken, Neurology, bad Segeberg, Germany

**Background:** The subclavian steal phenomenon (SSP) is a known indirect hemodynamic sign of proximal subclavian artery (ScIA) obstruction. We compare the magnitude of duplexsonographic SSP with CTangiographic (CTA) grades of ScIA obstruction. **Methods:** 47 consecutive patients (21 female) were recruited because of uni- (44) or bilateral (3) sonographic SSP. SSP was graded according to the observed vertebral artery (VA) flow pattern at the V2 and V4-VA segment. Three grades,

“systolic slowing=1”, “alternating flow=2” and “retrograde flow=3” were defined. CTA was used to determine presence and grade of ScIA obstruction or proximal vertebral artery pathology. **Results:** In 6 of 47 patients CTA yielded an additional contralateral pathology, leading to a total of 56 pathological and 38 physiological sides. Intraindividual SSP grades tended to be higher at the V4-level (V2/V4-grade 0:10/6, grade 1:17/11, grade 2:12/21, grade 3:17/18) suggesting a higher sensitivity. Analysing V4 results, all 6 sides without SSP yielded a “low-grade” ScIA stenosis between 9-37% (mean:24). 7 sides with sonographic SSP did not show ScIA stenosis but proximal VA stenosis/occlusion (4) or VA-hypoplasia (3). In the remaining 43 cases, the range of detected ScIA stenoses for the grades 1,2 and 3 was 26-60% (mean:46), 26-77% (mean:57) and 47-100% (mean:90), respectively. The diagnostic sensitivity, specificity, PPW and NPW for “indirect” detection of ScIA or proximal VA pathology is 0.94/0.86/0.87 and 0.93, p<0.0001 respectively. **Conclusions:** Our study confirms that ultrasound detection of SSP highly correlates with the presence of a ScIA or proximal VA obstruction. The SSP grade significantly correlates with the degree of the detected ScIA stenosis. Possible diagnostic pitfalls are a proximal VA stenosis without ScIA stenosis and a VA hypoplasia without VA- or ScIA-obstruction. Low-grade ScIA stenoses can be overlooked as they might not lead to a detectable SSP.

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**P69****ULTRASOUND FINDINGS IN A POPULATION WITH CEREBROVASCULAR SYMPTOMS**

P. Batista; V. Almeida; F. Soares; J. Alves; M. Moura; A. Gerardo; V. Oliveira

Hospital de Santa Maria, Neurology, Laboratório de Hemodinamica Cerebral, Lisboa, Portugal

**Introduction:** Cerebrovascular disease is the first cause of death and permanent disability in Portugal, being ischemic stroke responsible for about 85% of all strokes. Ultrasound is being increasingly accepted as a fundamental tool in the work-up of every cerebrovascular patient. We report the findings in the investigation of patients evaluated in our laboratory during one year - 2009. Patients and **Methods:** All adult patients (> 18y) evaluated at our cerebrovascular ultrasound laboratory during the year of 2009 with the diagnosis of cerebrovascular disease were included in our data-base. All of them were evaluated with Transcranial Doppler and Color-coded Duplex scan looking for extracranial and intracranial stenosis and Intima-Media Thickness (IMT). **Results:** 981 patients were evaluated (539 males and 422 females) with a mean age 67 years (18y-96y). 806 (83.9%) of them had the diagnosis of stroke and 155 (16.1%), TIA. Mean age for stroke patients was 68y and for TIA patients was 64y. Mean IMT was: 0,95±0,198 stroke patients and 0,90±0,196 for TIA patients. Hypertension was the main modifiable risk factor present in both groups. Smoking and dyslipidemia were more prevalent in TIA group. Stroke patients were older than TIA patients and presented more carotid and intracranial vessels stenosis. **Conclusion:** Cerebrovascular patients investigated in our laboratory with diagnosis of stroke and TIA had different profiles. Actions to

modify vascular risk factors may contribute decisively to reduce the burden of stroke.

P70

#### CAROTID ARTERIAL PLAQUE AND CLINICAL FACTORS IN ACUTE STROKE PATIENTS

J. H. Lee

National Health Insurance Corporation Ilsan Hospital, Neurology, Goyang-si., Republic of Korea

**Objectives:** Carotid arterial diseases become more common risk factor for stroke patients in Asian area. We reviewed stroke database to investigate clinical factors related to carotid arterial stenosis, including intracranial arterial stenosis and peripheral arterial disease. **Methods:** Acute stroke patients whose stroke onset were within 1 week when admitted at the National Health Insurance Corporation Ilsan Hospital from January 2005 to December 2010 with available carotid ultrasound study, transcranial Doppler(TCD) examination and ankle-brachial indexes(ABI) formed the analysis cohorts. Retrospective review was performed. **Results:** A total of 304 patients were included during that period. By duplex ultrasound, common/internal carotid arteries are examined and the greatest diameters of plaques are recorded. 3 groups of carotid arterial plaques are defined: diameter is less than 2mm (112 patients, 37%), 2-4mm(174 patients, 57%) and greater than 4mm(18 patients, 6%). As the size of carotid arterial plaques increased, ABI decreased ( $P=0.000$ ) and the number of intracranial arterial stenosis is increased ( $P=0.008$ ). Among the risk factors, Age, diabetes, male patients are increased ( $P=0.000$ ,  $P=0.047$ ,  $P=0.004$ ) and smoking history showed tendency of increase( $P=0.057$ ) as diameter of carotid arterial plaque increase. However hypertension, total cholesterol, LDL cholesterol, HDL cholesterol, triglyceride and past stroke history are not correlated with carotid arterial stenosis. **Conclusions:** Among the acute stroke patients, more than a half of them have carotid arterial plaque which diameters are greater than 2mm and these patients tend to have higher burden of advanced atherosclerosis as evidenced by a higher prevalence of diabetes, intracranial arterial stenosis and peripheral arterial occlusive disease.

## VIII Diagnostics in Stroke Management 2

P71

#### THE RETROBULBAR "SPOT SIGN" IN SUDDEN BLINDNESS - SUFFICIENT TO RULE OUT VASCULITIS?

M. Ertl<sup>1</sup>; M. Altmann<sup>2</sup>; F. Schlachetzki<sup>1</sup>; A. Gamulescu<sup>2</sup>; H. Helbig<sup>2</sup>; U. Bogdahn<sup>1</sup>

<sup>1</sup>University of Regensburg, Neurology Department, Regensburg, Germany; <sup>2</sup>University of Regensburg, Ophthalmology Department, Regensburg, Germany

**Background/Aims:** Sudden ocular blindness is a frequent disease of the elderly patient. Vascular pathology of the ophthalmic artery and its branches include thrombosis or embolic occlusion, vasospasm, vasculitis vessel wall alterations or internal carotid artery dissection. A challenge for the examiner is the discrimination between a vasculitic or embolic occlusion of the central retinal artery in elderly patients with signs of inflammation. Common imaging-techniques such as magnet-resonance-tomography or computer-tomography have their limitations in depicting the actual pathology. On the other hand mostly indirect and non-specific parameters as the erythrocyte sedimentation rate and the C-reactive protein are taken in account for the diagnosis of vasculitis. The most sensitive and specific instrument for the diagnosis is an invasive biopsy of the temporal artery, not without certain risks, respectively. B-mode-sonography might be a viable alternative to detect retinal thrombi or emboli. **Methods:** We conduct a prospective study with 50 patients having sudden monocular blindness to examine the incidence of retinal thrombi/emboli using transorbital ultrasound. A retrobulbar "spot sign" representing a fresh embolic occlusion might be a reliable finding to discriminate between a thrombo-embolic and a vasculitis cause. This will also have therapeutic consequences as vasculitic and embolic occlusions need to be treated thoroughly different. Results: pending **Conclusions:** pending

P72

#### ULTRASONOGRAPHY OF THE OPTIC NERVE SHEATH IN BRAIN DEATH

A. Lovrencic-Huzjan<sup>1</sup>; D. Sodec Simicevic<sup>1</sup>; I. Martinic Popovic<sup>1</sup>; M. Bosnar Puretic<sup>1</sup>; V. Vukovic Cvetkovic<sup>1</sup>; S. Gopcevic<sup>2</sup>; M. Vucic<sup>2</sup>; B. Rode<sup>2</sup>; V. Demarin<sup>1</sup>

<sup>1</sup>University Hospital "Sestre milosrdnice", University Department of Neurology, Zagreb, Croatia; <sup>2</sup>University Hospital "Sestre milosrdnice", Department of Anesthesiology, Zagreb, Croatia

**Background:** Evaluation of optic nerve sheath by means of optic nerve ultrasonography (ONUS) is a reliable tool for assessment of patients with increased intracranial pressure. The aim of this study was to present the usefulness of optic nerve sheath ultrasonography in patients with brain death. **Methods:** Ten patients with brain death as a result of traumatic or non-traumatic causes were evaluated by ONUS. Optic nerve

sheath diameter (ONSD) was measured with a 12 MHz linear ultrasound probe (Terason T3000, Teratech Corporation, USA). The probe was adjusted to give a suitable angle for displaying the entry of the optic nerve into the globe, at the depth of 3 mm behind the globe. For each optic nerve four measurements were made, twice in transversal and twice in the sagittal plane, by rotating the probe clockwise. Mean ONSD for brain death patients were compared with mean ONSD of 17 healthy controls. **Results:** Ten individuals (7 males) with confirmed brain death (5 due to neurotrauma, 2 due to subarachnoid hemorrhage, 2 as a result of ischemic strokes and one of parenchymal hemorrhage), were evaluated. On the left mean ONSD was 0.71±0.06 cm on transversal plane and 0.72±0.04 cm on sagittal plane. On the right mean ONSD was 0.73±0.05 cm on transversal plane and 0.73±0.06 cm on sagittal plane. In controls left mean ONSD was 0.51±0.05 cm on transversal plane and 0.55±0.06 cm on sagittal plane. On the right mean ONSD was 0.52±0.05 cm on transversal plane and 0.54±0.07 on sagittal plane. Mean ONSD in brain death was 0.72±0.05cm and 0.53±0.06 cm in controls (p<0.01). **Conclusion:** ONSD may be useful in distinguishing brain death persons from healthy controls.

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**P73**  
**SYMPTOMATIC INTRACRANIAL STENOSES: A UNIVERSITY HOSPITAL-BASED ULTRASOUND STUDY**

*F. Viaro; F. Farina; A. Onofri; G. Meneghetti; C. Baracchini*  
Clinica Neurologica I, Dept. of Neuroscience, University of Padua School of Medicine, Padua, Italy

**Background:** Stenoses of intracranial arteries are responsible for 11 % of strokes in Hispanics, 6 % in Blacks, 30-50 % in Orientals and only 1 % in Caucasians. However, the clinical importance of intracranial stenoses in Whites may have been underestimated. **Methods:** We examined our database registry of all TIA/ischemic stroke Caucasian patients over a two-year period, from January 1st 2009 to December 31st 2010. All patients underwent a complete extra- and transcranial echo-color Doppler sonography and MRA/CTA/DSA. **Results:** Among 292 patients, we found 59 (20.2%) subjects harbouring at least one intracranial stenosis and 20 (33.9%) with 2 stenoses; the total number of intracranial stenoses was 96. The patients were mainly males (79.7%); mean age was 71.0±12.8 years (range 33-96). With regards to risk factors, hypertension was present in 67.8% of patients, diabetes in 27.1%, smoking in 30.5%, obesity in 10.2%, dyslipidemia in 37.3%, previous TIA/stroke in 23.7%, heart disease in 18.6%. Forty-six (77.9%) presented with stroke, while 13 (22.1%) with TIA. Concerning the site of stenoses, 56 (58.3%) were located in the anterior circulation [MCA 52 (54.1%), ACA 4 (4.2%)], 40 (41.6%) in the posterior circulation: [PCA 24 (25.0%), BA 11(11.6%), VA 5(5.2%)]; 44 (51.7%) on the right, 41 (48.3%) on the left. **Conclusions:** In this university hospital-based study among Caucasian patients with acute cerebral ischemia, ultrasound disclosed a higher prevalence of intracranial stenoses than previously thought, suggesting the clinical importance of this condition in White European TIA/stroke patients.

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**P74**  
**THE IMPACT OF RECANALIZATION ON ISCHEMIC STROKE OUTCOME- CLINICAL CASE PRESENTATION**

*S. Andonova<sup>1</sup>; F. Kirov<sup>2</sup>; C. Bachvarov<sup>3</sup>*  
<sup>1</sup>University Hospital "St. Maria" – Varna, Second Clinic of Neurology, Varna, Bulgaria; <sup>2</sup>University Hospital "St Marina"- Varna, Second Clinic of Neurology, Varna, Bulgaria; <sup>3</sup>University Hospital "St Marina"- Varna, department of Radiology, Varna, Bulgaria

**Background:** Intravenous thrombolysis with recombinant tissue plasminogen activator (rtPA) for the treatment of acute ischemic stroke within 3 hours of onset become, a worldwide conventional standard of care. However, intravenous thrombolysis is successful in approximately one third of patients. Thromboaspiration through either a microcatheter, or a guiding catheter may be an option for a fresh nonadhesive clot. The use of mechanical thrombectomy devices in patients experiencing ischemic stroke and reocclusion after intravenous thrombolysis can be now gain approval on the basis of recanalization, demonstrating better recanalization rates. **Methods - Case Description:** We describe a case of a 51-year-old man who presented with ischemic stroke (right-sided hemiparesis and sensorimotor aphasia) and sudden onset on 06.50h. He was hospitalised in Neuro Intensive Care Unit on 08.10h with NIHSS 8 points. The CT of the head was normal and on 8.40h began an intravenous rtPa by protocol: 0.9mg/kg body weight, with 10% of the dose given as a bolus followed by a 60-min infusion. **Results:** After beginning of treatment it was a significant improvement with neurological deficit NIHSS 5 points. After the end of the fibrinolysis the patient was with severe deterioration of the symptoms (right-sided hemiplegia and aphasia) - NIHSS 15 points. The patient underwent control CT of the head to exclude intracerebral haemorrhage - was normal. On the digital subtraction angiography there was total thrombosis of the left internal carotid artery. Through a guiding catheter was done thromboaspiration with effective reperfusion with reversal of neurological deficits - NIHSS 3 points. **Conclusions:** This case represents a valuable example of two recanalization therapies in acute ischemic stroke to improve clinical outcome by restoring antegrade perfusion and salvaging ischemic brain.

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**P75**  
**STUDIES ON VASOSPASM DUE TO SUBARACHNOID HAEMORRHAGE (SAH)**

*A. M. Schenk<sup>1</sup>; J. Woudsma<sup>1</sup>; N. M. Maurits<sup>1</sup>; R. J. M. Groen<sup>2</sup>; J. H. van der Hoeven<sup>1</sup>*

<sup>1</sup>University Medical Center Groningen, Department of Neurology, Groningen, Netherlands; <sup>2</sup>University Medical Center Groningen, Department of Neurosurgery, Groningen, Netherlands

**Background/Aims:** Transcranial Doppler (TCD) has become commonly used to detect vasospasm after subarachnoid haemorrhage (SAH). We defined vasospasm as the relative increase in flow velocity between the MCA or

ACA and the ipsilateral internal carotid artery (Lindegaard ratio (LR)). An LR of 3 is taken as evidence for spasm. Based on this definition, we retrospectively analysed TCD measurements in SAH to define characteristic patterns in the natural course of vasospasm. **Methods:** We analysed all SAH patients diagnosed between 1997 and 2010 in which at least 4 TCD measurements were performed. In all patients vasospasm was diagnosed. Parameters: presence and location of aneurysm, number of spastic vessels, spacial relation between aneurysm and spasm, and the time course of spasm. Patients with multiple aneurysms were excluded. **Results:** We included in 369 patients. SAH was more frequent in women (66%). SAH in anterior regions (ACA, coA) was relatively more frequent in men. We did not find significant age differences between men and women regarding spasm in a specific vascular territory or between MCA and ACA spasm regarding peak time. Location of spasm was related to site of bleeding. Mean time to maximal spasm 11.2 SD 6.6 days. However, the course and duration of spasm proved highly variable. Most severe spasm was found in the younger age groups. **Conclusions:** Although mean peak time was not significantly different between sexes, age groups and vascular territory, we found a highly variable pattern in vasospasm between patients. Prediction of the various patterns will be important to estimate possible effects of therapeutic interventions to reduce vasospasm.

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#### P76

#### EXTRA-INTRACRANIAL SONOGRAPHY-DIAGNOSTIC AND PROGNOSTIC TOOL IN VERTEBROBASILAR INSUFFICIENCY

*M. Alpaidze<sup>1</sup>; M. Janelidze<sup>2</sup>*

<sup>1</sup>DKC Medical Centre, University Clinic, Neurology and Neurosurgery, Tbilisi, Georgia; <sup>2</sup>S. Khechinashvili University Clinic, Neurology and Neurosurgery, Tbilisi, Georgia

**Background:** Vertebrobasilar insufficiency (VBI) has a wide clinical manifestation such as vestibulocerebellar syndrome, cephalalgia, cochlear syndrome, vegetovascular dystonia, visual disturbances, "syndrome of vertebral artery compression" etc.caused by blood flow insufficiency in vertebral, basilar and posterior cerebral arteries (PCA). **Aim:** evaluation of role of extracranial duplex-sonography (EDS), transcranial color-coded sonography (TCCS) and rotational functional tests (RFT) in VBI. **Methods:** 98 patients (age range 18-62) with VBI were examined using EDS, TCCS and RFT with measurement of vertebral and basilar arteries diameter, mean flow velocities (MFV) and pulsatility index (PI). **Results:** in 48 patients revealed unilateral narrowing (less than 2.5 mm in diameter) and deformation of vertebral artery associated with osteochondrosis or primary hypoplasia. Ultrasound investigation showed a decrease of MFV (20±1,4) in the intracranial length of vertebral artery and an increase of PI (3,2 ±0,3) (p=0,002) in the extracranial segments (V2, V3). In 11 patients revealed bilateral narrowing (less than 2.8 mm in diameter) and deformation of vertebral arteries. Among these patients in 52 cases revealed decrease of MFV in basilar artery and in 28 cases decrease of MFV in both PCA. In 21 cases of general contingent revealed concurrent development of

vertebrogenic reflex vasoconstriction. In 18 patients exposed only deformation of vertebral arteries with local increase of MFV and normal intracranial values. Rotational tests were positive in 47% of patients and manifested high correlation with clinical data. **Conclusion:** EDS and TCCS are important tools for estimation of high hemodynamic risk in VBI patients. Rotational vertebrobasilar ischemia with temporary impairment of cerebral blood flow to the brainstem, thalamus, and occipital lobes predicts possible posterior circulation stroke and helps with proper selection of patients for further surgical decompression.

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#### P77

#### POST STROKE EPILEPSY AND DEPRESSION EXECUTIVE DYSFUNCTION SYNDROME

*N. Radojkovic Gligic<sup>1</sup>; M. Petric<sup>2</sup>*

<sup>1</sup>Hospital for Cerebrovascular Disease, Stroke Unit, Belgrade, Serbia; <sup>2</sup>Hospital for Cerebrovascular Diseases, Neuropsychological Investigation, Belgrade, Serbia

**Background:** Depression executive dysfunction and post-stroke epilepsy are independent sequels of stroke. Their coexistence influence on post-stroke cognitive decline is not well established yet. **Methods:** Perspective study of 577 post stroke patients performed (age 65 ± 5,2 men/women ratio 381/196) all of them are diagnosed CT/MRI at acute stage. Patients were evaluated at 6 months and 1 year post stroke. Cognitive function are daily activity evaluated by MMSE, WB-sp, Benton TVP, Test Bender;-pictures test. Depressive symptoms assessed by Hamilton depression rating scale (ZUNG) and scale D from MMPi-201. According to test data patients were divided in 5 groups: 1. With DES 2. Without DES 3. With PSE 4. Without PSE 5. With PSE and DES. Groups did not differ due to vascular risk factors clinical demographic and radiological variables. **Results** from 577 patients DES was diagnosed in 92 cases(16.67%), PSE in 105(18,19%) coexistence of PSE and DES in 97 cases(16,95%). All patients with PSE and DSE had right hemisphere stroke. Comparison of these 3 groups revealed that patients with coexistence of DES and PSE had lower MMSE, worse ADL index Conclusion: Coexistence of DSE and PSE may have higher risk for developing post stroke dementia. Definite treatment options should be necessary to prevent development of this sequel to stroke.

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#### P78

#### TRANSCRANIAL DUPLEX ULTRASOUND IN INTRACEREBRAL HAEMORRHAGE - USE OF DIFFERENT PROBE ANGLING

*B. Malojcic; L. Unusic; S. Juren Mejaski*

University Hospital Zagreb, Neurology, Zagreb, Croatia

Imaging of intracerebral haemorrhage (ICH) patients by means of transcranial duplex ultrasound (TDUS) is a useful adjunct to CT scanning. Its major advantage in neurological intensive care units (NICU) is its ability to be performed by bedside. Hematoma expansion is closely related to poor outcome and surgical treatment might be indicated in some cases. CT scan is the golden standard and almost all admitted patients are scanned before they enter into NICU. Comparison of CT

and TDUS images is sometimes difficult because longitudinal CT cross sectional slices present hematoma in different angles than TDUS images if performed through transtemporal approach. We performed TDUS within 1 h after admission in 12 consecutive patients with primary ICH through temporal and parietal bone levels in planes similar to CT scans, i.e. parallel to skull base. All visualized hematomas were measured in two maximal diameters and then they were compared to the diameters obtained by CT. We found good correlation between the two methods ( $r= 0,72$ ,  $p=0,04$ ). Artefacts from patient's hair did not influence the results. Suboptimal bone windows prevented visualisation of ICH in 2 patients. We suggest that in selected patients this modified insonation method might be useful when comparing CT and TDUS findings.

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**P79**  
**IRANIAN EXPERTS' EXPERIENCE OF REHABILITATION SERVICES FOR STROKE SURVIVORS**

A. Dalvand<sup>1</sup>; S.-L. Ekman<sup>1</sup>; S. S. B. Maddah<sup>2</sup>; H. R. Khankeh<sup>3</sup>; K. Heikkilä<sup>1</sup>

<sup>1</sup>Karolinska Institutet, Neurobiology, Care Sciences and Society, Stockholm, Sweden; <sup>2</sup>Uni& Rehabilitation Sciences University of Social Welfare, Nursing, Tehran, Islamic Republic of Iran; <sup>3</sup>University of Social Welfare & Rehabilitation Sciences University of Social Welfare, Nursing, Tehran, Islamic Republic of Iran

**Background/Aim:** Stroke is a global burden that can cause significant health care problems. Stroke sufferers and their family caregivers experience that the rehabilitation care in Iran needs to be developed. In order to understand the broader picture of stroke rehabilitation, even the experiences of stroke rehabilitation experts is needed. The aim of this study was to explore the experiences of Iranian rehabilitation experts about rehabilitation services in community for stroke survivors and their points of view on how to develop these services. **Methods:** A qualitative research using grounded theory approach with purposive and theoretical sampling was used. Data were gathered through two focus group discussions and four individual interviews with ten Iranian rehabilitation experts. Constant comparative analysis method was used. **Results:** Non-integrated rehabilitation service emerged as core concept of the study. The explored concepts were identified as 'deficiently allocated budget', 'inadequate social insurance', 'lack of availability of rehabilitative care', 'public views', 'lack of consistency of care', 'split services and professional separation', 'need for changing policymakers' attitudes', 'needs for re-defining rehabilitation in health care system', 'needs for establishing a registration system', 'needs for providing information and skills' and 'needs for seeing family as a whole'. **Conclusions:** The experts experienced that the rehabilitation services are not profoundly integrated within the health system in Iran and refinements need to be done. Adequate budgets for implicating discharge plan should be allocated to make opportunities for rehabilitation team working. These efforts could bring opportunities for stroke survivors and their family caregivers to gain knowledge and skills and to participate in

rehabilitation teams and also to help reduce their problems.

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**P80**  
**COLOR DUPLEX SCANNING IN THE DIAGNOSIS OF BRAIN DEATH.**

D. Solonskiy<sup>1</sup>; M. Sinkin<sup>2</sup>; I. Stulin<sup>1</sup>

<sup>1</sup>Moscow State University for Medicine and Dentistry, Neurology, Moscow, Russian Federation; <sup>2</sup>Moscow Municipal Hospital #11, Diagnostic Department, Moscow, Russian Federation

**Aims:** To investigate the cerebral blood flow in brain death.

**Materials:** The sonographic study of 20 patients with brain death (BD) due to traumatic brain injury and subarachnoid hemorrhage was performed and included TCD and ICA and VA duplex scanning. All patients were untrepanized. The study was conducted on a portable device Sonosite Micromaxx twice: at baseline after clinical signs of BD examination and 6 hours later. **Results:** At baseline TCD revealed both MCA in all patients. Both ACA in 17, both PCA in 18 patients, and the BA in 15 patients. Oscillating flow with Vmax -  $32\pm 12$  sm/s in all arteries and accelerated flow up to  $24.0\pm 6.0$  sm/s in basal veins was found. A midline shift in B-mode in 13 patients we noted. Reverberating flow in the proximal segment of ICA and in the V2 segment of VA was found in all patients. Vmax ranges were  $96\pm 27$  sm/s in ICA and  $58\pm 17$  sm/s in VA respectively. After 6 hours TCD was successful in 16 patients. In all of 16 cases blood flow in the MCA as a systolic peak or reverberating flow was detected. Basilar system study was successful in 12 cases. BA was recorded in 5 patients and PCA only in 1. In all vessels blood flow was as systolic peaks. In BV Vmax was 15 sm/s. Extracranial ICA and VA was visualized in all cases. In the ICA and V2, V3 segments of the VA reverberating flow was detected. Vmax was  $47\pm 25$  sm/s in ICA and  $35\pm 17$  sm/s in VA. Spontaneous in ICA and bulb was observed in 14 cases. **Conclusion:** Color duplex scanning reveals oscillating flow or systolic spikes in ICA, VA and intracranial vessels in BD and spontaneous echo contrast enhancement in extracranial ICA. In TCD, the most common finding is MCA with reverberating flow. There are some difficulties in detection of basilar system and they depend on the time of the study. The optimum combination is extracranial and intracranial scanning in the early stages of BD.

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## IX US in Surgery and Angioplasty

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P81

### SURVEILLANCE OF CEREBRAL PERFUSION REDUCES INCIDENCE AND SEVERITY OF STROKE RELATED TO CABG SURGERY

A. Van Sonderen<sup>1</sup>; A. Falsafi<sup>2</sup>; B. De Bruijn<sup>1</sup>; R. W. M. Keunen<sup>1</sup>

<sup>1</sup>Haga Teaching Hospitals, Neurology, The Hague, Netherlands; <sup>2</sup>Haga Teaching Hospitals, Cardiac surgery, The Hague, Netherlands

**Background:** Ischemic stroke is a serious complication of cardiac surgery with often adverse outcome. Preoperative cerebral hemodynamic impairment is an independent risk factor for stroke of both embolic and hemodynamic origin. The aim of the study was to determine whether a more detailed preoperative examination of cerebral hemodynamics and perioperative monitoring of cerebral oxygenation reduces stroke incidence and severity related to cardiac surgery. **Methods:** A historical cohort of 2494 patients was analyzed. A study group of patients who underwent coronary artery bypass graft (CABG) surgery after implementation of the Haga Brain Care Strategy was compared to a control group who had CABG surgery before implementation. The strategy consists of an extended cerebral examination by preoperative transcranial Doppler (Delica 9 series, Shenzhen Delicate Electronics Co. LTD, China) and perioperative cerebral oximetry (Invos, Somanetics, USA). Stroke rate and stroke severity measured with National Institutes of Health Stroke Scale (NIHSS) were collected from archived patient files. **Results:** Stroke had occurred in 0.77% of the patients in the study group, compared to 1.67% in the control group. These data show a significant decline in stroke rate, with an odds ratio of 0.390 favoring the study group (95% confidence interval: 0.177 to 0.859;  $p=0.019$ ). There was a significant decline in stroke severity as well, with a mean NIHSS of 4.67 in the study group compared to 9.50 in the control group ( $p=0.006$ ). **Conclusions:** These retrospective data suggest that a more careful neurologic examination and monitoring, consisting of preoperative TCD and perioperative cerebral oximetry, can reduce both incidence and severity of stroke related to coronary bypass surgery. Confirmation by a prospective randomized trial is warranted.

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P82

### STENTING IMPROVES CEREBRAL AUTOREGULATION IN STROKE PATIENTS WITH INTRACRANIAL LARGE ARTERY STENOSIS

W. H. Lin; T. W. Leung; Y. O. Y. Soo; V. H. L. Ip; L. W. C. Au; L. C. Chan; K. S. Wong

The Chinese University of Hong Kong, Dept. of Medicine and Therapeutics, Prince of Wales Hospital, The Chinese University of Hong Kong, Sha Tin, Hong Kong, China

**Background:** Intracranial stenting is an adjunctive treatment option in symptomatic intracranial large artery stenosis. External counterpulsation (ECP) is a non-invasive

technique to augment diastolic cerebral blood flow by inflation of pneumatic cuffs placed on the lower extremities, and could be used to assess cerebral autoregulation. We aimed to explore the intermediate-term effects of stenting on cerebral autoregulation. **Methods:** In this subgroup study of a randomized controlled study of intracranial stenting, we assessed 14 ischemic stroke patients (8 patients received stenting) 2 years after randomization, who had symptomatic high-grade ( $\geq 70\%$ ) intracranial internal carotid artery or middle cerebral artery (MCA) stenosis. We performed ECP and transcranial Doppler monitoring of both MCAs. MCA mean blood flow velocities before and during ECP were recorded for 3 minutes. The increase in mean blood flow velocity induced by ECP (cerebral augmentation index [CAI]) was evaluated and compared based on the presence of infarction (symptomatic vs asymptomatic side). **Results:** Baseline NIHSS and demographics were comparable between 2 groups. All patients had no stroke recurrence after randomization. MCA mean flow velocities significantly increased during ECP in both groups (stenting group: symptomatic side baseline 57.65 vs ECP 59.85, asymptomatic side 55.90 vs 57.20; non-stenting group: symptomatic 47.90 vs 53.05, asymptomatic 46.15 vs 49.4; all  $p<0.05$ ). CAI on the symptomatic and asymptomatic sides of stenting group was significantly lower than that of non-stenting group ( $3.35\pm 3.37$  vs  $8.43\pm 3.43$ ,  $p=0.028$ ;  $2.22\pm 1.97$  vs  $7.38\pm 3.25$ ,  $p=0.01$  respectively). CAI was not different between symptomatic and asymptomatic sides in both groups. **Conclusions:** Stenting of intracranial atherosclerosis may improve the cerebral autoregulation and ability for the ischemic brain to accommodate flow augmentation in long term.

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P83

### CEREBRAL ANGIOSPASM IN ENDOVASCULAR CEREBRAL VESSEL PROCEDURES

Y. Sagildina; S. Kucherenko; N. Bolomatov; V.

Germanovich; O. Vinogradov; A. Kuznetsov

National Pirogov Center of Therapy and Surgery, Moscow, Russian Federation

Cerebral angiospasm (CA) was supposed as one of the complications after endovascular treatment (ET). **Purpose of the study:** to estimate incidence of CA during ET, to reveal possible causes of its development and its role in postoperative complications. **Material and methods:** 59 patients were investigated (32 men and 27 women) for ET: internal carotid transluminal balloon angioplasty with stenting (TBAS) in symptomatic stenosis more or equal 70% -17 patients (the first group), selective embolization of afferents and stroma in arteriovenous cerebral malformation (AVM) with glue mix -12 patients (the second group), endovascular "exclusion" of cerebral arterial aneurysms -30 patients (the third group). **Results:** CA detected with the use of cerebral angiography and transcranial Doppler sonography was revealed in 16 (27,1%) patients. In most cases (93,8%) CA had mild and moderate severity and transient nature (no more than 15 minutes). CA developed in conditions of active and durable procedures in different segments of cerebral arteries by technical difficulties. Persistent residual neurologic deficiency was noted in 2 (3,4%)

patients, however, without CA. In the first group CA was revealed in 29,4% of the cases, thereby 1 patient developed ischemic stroke (IS) of embolic origin. In patients of the second group CA was detected in 16,7% of the cases. In the third group CA rate was 30,0%, and 1 patient had an IS as a result of acute thrombosis. **Conclusions:** CA was an often event during endovascular treatment and did not followed by persistent residual neurologic deficiency.

#### P84

##### **Intravascular coiling of an STA aneurysm with an assist of intraoperative sonography -Case Report-**

*T. Saguchi; Y. Kondo; T. Mizokami; I. Suzuki*

Japanese Red Cross Medical Center, Neurosurgery, Tokyo, Japan

**Patient profile:** A 69-year-old man presented with a 2-year history of a left temporal subcutaneous mass existing anterior to the left ear. No apparent traumatic events were noted. The mass began to enlarge from August in 2009. CT angiography and MRI revealed a left superficial temporal artery (STA) aneurysm. An intravascular occlusion of the left STA aneurysm was planned. Intraoperative sonography of the left STA was used to confirm a presence of a blood flow to the aneurysm and to confirm a complete occlusion of the aneurysm after the procedure. **Methods:** Under a local anesthesia, a 6-French sheath was introduced into the right femoral artery. A 6-French guiding catheter was advanced into the left external carotid artery. A micro catheter was advanced to the STA aneurysm. However, it was difficult to set the tip of the catheter beyond the aneurysm because of a sclerotic change of the artery. A micro balloon catheter was set into the left maxillary artery for a temporally occlusion of the parent artery of the left STA aneurysm. Intraoperative sonography of the STA aneurysm during the proximal parent artery occlusion revealed a collateral blood flow into the aneurysm. This finding meant a necessity of occlusion of the parent artery of the STA aneurysm at the distal and proximal part. After several trials the tip of the micro catheter was set beyond the aneurysm. Intravascular occlusion of the distal and the proximal part of the parent artery of the STA aneurysm with coils was performed. **Results:** A sonography after coiling revealed a complete disappearance of a blood flow to the STA aneurysm. The aneurysm became not pulsatile after the procedure. The left temporal mass was gradually reduced, then disappeared after several months. **Conclusions:** Intravascular coiling of an STA aneurysm with an assist of intraoperative sonography was useful and reliable method from the less invasive point of view.

#### P85

##### **COGNITIVE PERFORMANCE AFTER CAROTID ARTERY STENTING**

*P. Maggio<sup>1</sup>; C. Altamura<sup>1</sup>; F. Tibuzzi<sup>2</sup>; P. Palazzo<sup>1</sup>; F. Moffa<sup>2</sup>; S. Migliore<sup>2</sup>; L. Quintiliani<sup>1</sup>; F. Passarelli<sup>2</sup>; R. Arpesani<sup>2</sup>; G. Di Giambattista<sup>2</sup>; Y. Errante<sup>1</sup>; P. M. Rossini<sup>1</sup>; F. Vernieri<sup>1</sup>*

<sup>1</sup>University Campus Bio-medico, Neurology, Rome, Italy;

<sup>2</sup>Ospedale Fatebenefratelli, Neurology, Rome, Italy

**Aims:** The role of carotid artery stenting (CAS) on cognitive function is still debated. Although CAS carries a high risk of cerebral microembolism that could negatively affect cognitive status, many studies reported a cognitive performances improvement after CAS. However, the influence of confounding factors does not allow to draw definitive conclusions. We aimed at evaluating if a preliminary assessment of cerebrovascular risk profile, detailed neurological and neuropsychological examination and brain MRI performed before and after stenting procedure could more accurately predict patients' cognitive status following CAS. **Methods:** We studied 22 patients (mean age 72.2±7.8, 4 female) with severe internal carotid stenosis, who underwent neurological examination (including NIHSS), neuropsychological evaluation and brain MRI with diffusion-weighted imaging (DWI) and ADC maps before CAS. The day after CAS, a NIHSS assessment and a brain DWI-MRI were repeated. The neuropsychological evaluation was repeated with a mean follow-up of 18.9 months. **Results:** Basal NIHSS was 0 in 72.7%, 1 in 22.7%, 2 in 4.5% of cases. None had positive DWI scan on the basal evaluation and no patient had complication during the procedure. Eight patients (36.4%) had positive DWI scan after CAS, without NIHSS impairment. Considering the whole group, we did not found a global modification of neuropsychological performance after CAS. Instead, the subgroup of patients with a positive DWI scan after CAS had a significant worse cognitive performance than negative ones, as indicated by Mini-Mental State Examination and long term memory tests impairment ( $p<0.05$ ). These findings were independent from time of follow-up ( $R^2$  linear=0.004). Among cerebrovascular risk factors, diabetes predicted an impairment of short and long-term memory functions ( $p<0.05$ ). **Conclusions:** In our study cerebral microembolism during CAS was associated with significant worse cognitive performance in neuropsychological evaluation

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**P86**

**INTRAOPERATIVE COLOR-CODED DUPLEX SONOGRAPHY OF SUPERIOR SAGITTAL SINUS IN PARASAGITTAL MENINGIOMAS**

V. Semenyutin<sup>1</sup>; V. Olyushin<sup>2</sup>; V. Aliev<sup>1</sup>; D. Pechiborsch<sup>2</sup>; A. Kozlov<sup>1</sup>

<sup>1</sup>Russian Polenov Neurosurgical Institute, Laboratory of brain circulation pathology, St. Petersburg, Russian Federation;

<sup>2</sup>Russian Polenov Neurosurgical Institute, Department of Neurooncology, St. Petersburg, Russian Federation

**Background:** Patency of the superior sagittal sinus (SSS) is a key factor in surgery of parasagittal meningiomas. Magnetic resonance venography (MRV) is presently the main method of evaluation of SSS patency in patients with parasagittal meningiomas. However, the informativeness of this method is significantly limited in low blood flow velocities that occur in substantial invasion and/or compression of the SSS by meningioma. Method of direct-contact (placing transducer on the superior wall of the SSS) color-coded duplex sonography (CCDS) can be applied intraoperatively for a more reliable evaluation of SSS patency. **Aim:** To determine potentials of CCDS for intraoperative evaluation of SSS patency in parasagittal meningiomas. **Methods:** 20 patients (20-67 years, mean age 55) with parasagittal meningiomas were studied. Intraoperative CCDS (anterior third of the SSS-30%, middle third-65%, posterior third-5%) was conducted with linear probe i12L-RS (Vivid e, GE, USA). Intraoperative CCDS findings were compared with 2D time-of-flight MRV (Signa INFINITY, GE, USA). **Results:** MRV showed absence of blood flow in the SSS in 9 out of 20 cases, which were confirmed by intraoperative CCDS in 5 cases only (complete invasion in 4 cases, thrombosis in 1 case). In the remaining 4 cases the SSS was patent (blood flow velocity in the SSS was 5-16 cm/s and flow index reached 30-45 ml/min). False-positive results of complete occlusion of the SSS according to MRV in our series were obtained in 45% of cases. In 11 cases both CCDS and MRV revealed SSS patency but CCDS additionally evaluated the degree of SSS invasion/compression with its hemodynamics and differentiated invasion from compression of the SSS. **Conclusion:** Thus, CCDS allows evaluating SSS patency intraoperatively and being more informative than MRV it can be used to determine surgical tactics, further prognosis and will help in planning radiosurgery.

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**P87**

**SURGICAL TREATMENT FOR VERTEBROBASILAR INSUFFICIENCY: ADVANTAGES AND DRAWBACKS**

S. Volkov; A. Shurakova

Vishnevsky Institute of Surgery, Moscow, Russian Federation

**Background:** Due to the necessity of diagnostics and treatment of cerebrovascular diseases, the application of the new measures of treatment and methods of evaluation are important. There is thoroughly investigated data of the relative stroke risks and cognitive impairment for patients with significant carotid stenosis, but much lesser for patients with vertebrobasilar insufficiency. **Aims:** Our purposes are to

evaluate the comparative risks for cognitive dysfunction and other immediate and delayed complications in cases of different types of revascularization of extracranial arteries. **Methods:** To obtain immediate and delayed results of surgical treatment we evaluate complaints, neurological status, concomitant diseases, cognitive impairment, presence of depression and anxiety disorders, ultrasound data (evaluation of the site, degree and extension of the stenosis), magnetic resonance imaging of the brain to assess the presence of vascular encephalopathy, X-ray computed tomography of brachycephalic arteries. We are going to compare 30 patients possessed significant carotid stenosis (underwent carotid endarterectomy) with 30 patients possessed subclavian steal-syndrome (underwent transluminal balloon angioplasty with stenting or carotid-subclavian bypass, or revascularization of innominate artery). **Results:** The complaints being expressed significantly differ in both groups due to the topical-specific prevalence of transient ischaemic events. The brain lesions and the degree of cognitive impairment do not considerably differ in both groups if cases with disabling strokes are excluded. The site and degree of stenosis correlate with the probability of transient ischaemic attacks and strokes in the appropriate sites. **Conclusions:** The significant stenoses of precerebral arteries are linked with the high risk of ischaemic stroke, focal neurological deficit and cognitive impairment, and the presence of concomitant stenoses increases the probability of its occurrence.

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**P88**

**PERIPROCEDURAL INFLAMMATION AS A PREDICTOR FOR CAROTID ARTERY IN-STENT RESTENOSIS**

C. Schmidt; K. Wasser; J. Wohlfahrt; S. Schnaudigel; K. Gröschel

Georg August University Goettingen, Neurology, Goettingen, Germany

**Background:** Carotid angioplasty and stenting (CAS) may currently be recommended especially in younger patients with a high-grade carotid artery stenosis. However, evidence is accumulating that in-stent restenosis (ISR) could be an important factor endangering the long-term efficacy of CAS and an inflammatory process may play an important role for ISR. The aim of this study was to investigate periprocedural inflammatory markers and their influence on ISR as diagnosed with duplex sonography. **Methods:** 214 patients treated with CAS were prospectively analyzed. Periprocedural C-reactive protein (CRP) and leukocyte count were analyzed and serial carotid duplex ultrasound investigations were obtained during long term follow-up. ISR  $\geq 70\%$  as assessed during duplexsonography was defined as peak systolic velocity of  $>300$  cm/s within the stent. **Results:** Over a median of 32 months follow-up (IQR: 14 - 54) of 214 patients (71.6% male, mean age  $68 \pm 9.7$ , 154 symptomatic) a total of 12 ISRs of  $\geq 70\%$  (5.6%) were found after a median of 8.6 months (IQR: 3.4 - 17.3). Elevated CRP levels (2.1 mg/dl IQR: 0 - 6.7 vs. 10.4 mg/dl IQR: 1.5 - 23.7;  $p = 0.038$ ) before and leukocyte count after CAS-intervention ( $8973 \pm 2630$  vs.  $10433 \pm 4177$ ;  $p=0.028$ ) were significantly associated with an increased risk of ISR during follow up.

**Conclusions:** ISR during the long-term follow-up after CAS is associated with elevated pre-interventional levels of CRP and postprocedural leukocyte count. Our findings support the assumption that periprocedural inflammation plays a pivotal role in the development of carotid artery ISR.

**P89**

**VALUE OF THE SECOND POSTOPERATIVE SIPHON EXAMINATION IN OPERATED UNILATERAL, BILATERAL AND HIGH GRADE STENOSIS WITH CONTRALATERAL OCCLUSION**

*V. Zbornikova*

University of Health Science, Department of Neurology, Lindköping, Sweden

In a previous period of evaluation of hemodynamic changes after carotid endarterectomy(CE) an increase of mean velocity (MV) in antegrade flow direction in the siphon was seen on both sides. **Aim** of the study was to estimate a possible normalization of MV in siphon at second postoperative examination after several weeks. **Patients / Methods:** 26 patients, aged 66±7,4 years with 10 TIAs and 16 minor stroke, had symptomatic ICA stenosis >70% (16 unilateral and 10 bilateral high grade lesions comprising 5 stenoses >70% and 5 occlusions in the ICA) underwent CE. Operations were performed with patch angioplasty and using a shunt. All patients were examined by duplex-scanning pre- and postoperatively within one week after CE. 3-D TCD was performed before operation and 1-2 days after operation. In 19 patients was 3-D TCD repeated as the third examination after 4 weeks including 10 patients with bilateral and 9 patients with unilateral high grade lesion. **Results:** No occlusion or restenosis >50% was found at postoperative duplex examination. All retrograde flow in the ophthalmic artery on operated side turned to normal direction. MV in the siphon ipsilateral to unilateral high grade stenosis were significantly slower ( $p<0,02$ ) preoperatively, than those on the contralateral side and compared to normals ( $p<0,05$ ). MV in siphon were augmented after operation bilaterally, but increase was more pronounced ( $p<0,01$ ) on the operated side, where the highest MV of 56,4±17,4 cm/s were measured in Patients with contralateral occlusion. At the third examination MV decreased, but only in patients with unilateral stenosis >70%, values on both sides were nearly those, as normals of 42,35±13,23 cm/s. In patients with contralateral occlusion increase the MV (49,0±9,7 cm/s) in siphon was lasting. **Conclusion:** Results imply to perform operation on both side in patients with bilateral stenoses >70% in order to hinder a development of contralateral occlusion. Haemodynamic state, initially influenced by hyperkinetic circulation, is stabilized after 4 weeks in successfully operated patients with unilateral high grade stenosis.

**X Functional TCD,  
Vasomotor Reactivity 2**

**P90**

**THE PROGNOSTIC VALUE OF MCA BLOOD FLOW PARAMETERS IN ACUTE ISCHEMIC STROKE**

*M. Baydemir; N. Uzuner*

Eskisehir Osmangazi University, Neurology, Eskisehir, Turkey

**Aims:** We aimed to investigate whether there is an association between blood flow parameters of middle cerebral artery measured with transcranial Doppler and prognosis during acute, subacute and chronic periods in patients with acute ischemia on MCA territory. **Methods:** Twenty-six patients with acute ischemia on MCA territory, applied within first 12 hours after start of symptom were included. The MCA blood flow parameters were measured with TCD during acute period. Stroke severity and prognosis were determined on detailed neurologic examination with GCS, NIHSS and mRANKIN values during acute, subacute and chronic periods. **Results:** TCD was performed within mean 6.0±2.9 hours during acute period. When we look at blood flow velocity parameters with TCD during acute period, pulsatility index (PI) on the lesion side was 1.5±0.8. Based on the detailed neurologic examination during acute period, mean arrival GCS was 13.2±2.4 and mean arrival NIHSS was 10.9±6.3. Mean NIHSS and mRS were found 11.5±10.1 and 3.1±2.0 on neurological examination during subacute period, respectively. Mean NIHSS and mRS were found 9.9±12.2 and 2.4±2.4 on neurological examination during chronic period, respectively. There were significantly negative association between PI measured at the side of lesion during acute period and arrival GCS ( $p=0.009$ ) and significantly positive association between PI and arrival NIHSS ( $p=0.001$ ). In addition, significant positive associations were found between the PI on the side of lesion during acute period with NIHSS ( $p=0,009$  ve  $p=0,013$ , respectively) and mRANKIN ( $P=0,035$  ve  $p=0,049$ , respectively) values measured during subacute and chronic periods **Conclusions:** In this study, we concluded that important information about prognosis on acute, subacute and chronic periods can be obtained with PI measurement which is not affected by measuring fondness among the blood flow parameters measured with TCD that as a simple examination method on acute stroke.

**P91**

**THE BLOOD FLOW VELOCITY CHANGES TO SIMPLE AND COMPLEX VISUAL STIMULATION**

*G. Tekgöl Uzuner<sup>1</sup>; N. Çınar<sup>1</sup>; N. Uzuner<sup>2</sup>*

<sup>1</sup>Eskisehir Osmangazi University, Neurology, Eskisehir, Turkey; <sup>2</sup>Neurology, Faculty of Medicine, Meselik Kampus, 26480, Eskisehir, Turkey

**Aims:** The metabolic requirement that necessary for the function of neurons is provided by increase of regional cerebral blood flow. The most frequently, visual stimulation is used for measurement of reactivity. In the present study, we assessed the change of blood flow velocities during simple and complex

stimulation at posterior cerebral arteries coupling to neuronal activity at occipital cortex. **Methods:** The 12 healthy individual were included study. A long term TCD monitoring device was used for simultaneous recording of both PCA's using bilateral 2-MHz probes. All subjects were monitored during 10 cycles of 20 seconds eyes open looking at checker board and 20 seconds eyes close, afterward 10 cycles of 20 seconds eyes open reading a basic pragraphy, and 20 seconds eyes close. Individual reactivity was defined with a relative increase of blood flow velocities as a percentage change of baseline values. **Results:** The blood flow velocity changes acquired by TCD to complex visual stimulations ( $44,8\pm 13,3$  cm/s) were significantly higher than those of simple visual stimulation ( $30,0\pm 10,3$  cm/s) ( $p<0,001$ ). **Conclusions:** Transcranial Doppler Sonography is noninvasive and low-priced cerebral hemodynamic assessment method, and gives information about cerebral perfusion with recording blood flow velocites of cerebral arteries.

### P92

#### DUPLEXSONOGRAPHY OF CEREBRAL BLOOD FLOW VOLUME (CBF) AFTER CARDIAC ARREST - A PROSPECTIVE STUDY

*F. Doepp<sup>1</sup>; C. Storm<sup>2</sup>; S. Schreiber<sup>1</sup>; J. Reitemeier<sup>1</sup>*

<sup>1</sup>University Hospital Charité, Neurology, Berlin, Germany;

<sup>2</sup>University Hospital Charité, Internal Medicine, Berlin, Germany

**Background:** Despite therapeutic hypothermia, the prognosis after cardiac arrest (CA) remains poor. An early and reliable assessment of the neurological outcome is of enormous value with regard to therapeutic strategies or the patient's relatives. Beside the clinical status different diagnostic tools exist to assess the outcome, however its sensitivity remains low. We analyzed the CBF by duplex ultrasound in the acute phase after CA to evaluate its prognostic potential. **Methods:** 54 comatose survivors (17-85 years, mean age:  $63 \pm 17$  years, 37 men) of CA were prospectively enrolled. All patients received hypothermia during the first 24 hours. The global CBF (sum of blood volume flow [BVF] in both ICAs and VAs) the blood flow velocity (Vmean) of both MCA and basal veins of Rosenthal (BVR) as well as the pulsatility index (PI) of the MCA were assessed at disease onset and follow-up (total number: 99). The first measurement was performed within 48 h (<24h in 30 patients). Hypoperfusion (CBF < 535 ml/min) - and hyperperfusion (CBF > 931 ml/min) were defined as >2 SD below or above the CBF of a control group ( $733 \pm 99$  ml/min). For the clinical outcome in hospital the Cerebral Performance Categories (CPC 1: full recovery; CPC 2 and 3: moderate and severe disability; CPC 4: vegetative state CPC 5: dead) were used. **Results:** The CBF differed between 210-1100 ml/min but showed no significant changes within the first 10 days ( $p = 0.3$ ). 27 patients attained a CPC 1-3 and 26 patients a CPC 4-5. No correlation between CBF and CPC was found ( $p=0.4$ ). Hypoperfusion was found in 25 and hyperperfusion in 6 patients. CBF correlated with the Vmean of both MCAs ( $p<0.0001$ ) and BVRs (right  $p=0.0002$ ; left  $p<0.0001$ ) and inversely with the PI of both MCAs ( $p<0.0001$ ). The PI (MCA) was similar in patients with CPC 1-3 and CPC 4-5. **Conclusions:** CBF varies widely

within the acute stage after CA. However, neither distinct hypoperfusion nor hyperperfusion seems to predict the clinical outcome.

### P93

#### CEREBRAL PRESSURE-VELOCITY HEMODYNAMICS EVALUATION IN AUTONOMIC FAILURE DURING ORTHOSTATIC CHALLENGE

*P. Castro<sup>1</sup>; J. Freitas<sup>2</sup>; R. Santos<sup>3</sup>; R. Panera<sup>4</sup>; E. Azevedo<sup>1</sup>*

<sup>1</sup>Hospital São João, Department of Neurology, Faculty of Medicine, University of Porto, Porto, Portugal; <sup>2</sup>Hospital São João, Autonomic Unit, Faculty of Medicine, University of Porto, Porto, Portugal; <sup>3</sup>Hospital São João, Department of Neurology, Porto, Portugal; <sup>4</sup>University of Leicester, Department of Cardiovascular Sciences, Leicester, United Kingdom

**Background:** Autonomic failure (AF) patients often develop symptoms when standing, despite reports of intact cerebral autoregulation. Little is known about cerebrovascular behavior to orthostatic challenge in AF. We aimed to compare cerebral hemodynamic changes as accessed by classic pulsatility index (PI) and cerebrovascular resistance index (CVRI) with evaluation by critical closing pressure (CrCP) and resistance-area product (RAP) model, between AF patients and healthy subjects during HUT. **Methods:** Groups of familial amyloidotic polyneuropathy (FAP) patients with mild and severe AF were compared to control subjects in supine and initial HUT. Bilateral middle cerebral artery cerebral blood flow (CBF) velocities were measured with transcranial Doppler, along with noninvasive continuous measurement of arterial blood pressure (BP). We calculated PI, CVRI, CrCP and RAP. **Results:** Data was obtained from 7 mild and 10 severe AF patients, and 10 controls. The severe AF group showed significant decrease in RAP (variation:  $-0.2\pm 0.2$  vs  $0.1\pm 0.1$  mmHg/cm/s;  $p=0.001$ ) and increased PI (variation:  $0.4\pm 0.2$  vs  $-0.1\pm 0.1$ ;  $p=0.001$ ) compared to controls. Variation of CVRI and CrCP in the severe AF and of all the parameters in the mild AF group did not differ significantly compared to the control group. **Conclusion:** Our data suggest that in FAP patients with severe AF, initial orthostatic challenge promoted a cerebral vasodilatory response that could be better described with RAP than with classical CVRI. This study also suggests that PI is not a good parameter for estimation of cerebrovascular resistance with orthostatic challenge.

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**P94****CEREBRAL AND SYSTEMIC ENDOTHELIAL FUNCTION IN MIGRAINE PATIENTS WITHOUT COMORBIDITIES***M. Zaletel<sup>1</sup>; B. Žvan<sup>1</sup>; J. Pretnar-Oblak<sup>1</sup>; D. Perko<sup>2</sup>*<sup>1</sup>University Medical Center Ljubljana, Department of Neurology, Ljubljana, Slovenia; <sup>2</sup>Department of Neurology, Zaloška cesta 2, 1000, Ljubljana, Slovenia

**Background:** A relationship between cerebral and systemic endothelial function in migraine patients is not known. **Aims:** To compare cerebral and systemic endothelial function through post-hoc analysis of cerebrovascular reactivity (CVR) to L-arginine in the anterior and posterior cerebral circulation, flow mediated vasodilatation (FMD) and intima-media thickness (IMT) in migraine patients without comorbidities. **Methods:** CVR to L-arginine in the middle and posterior cerebral artery, brachial artery FMD and IMT were measured according to the standard protocols in forty migraine patients (20 migraine with and 20 without aura) and twenty healthy subjects without cardiovascular risk factors. Correlations analyses were made between CVR to L-arginine, FMD and IMT. **Results:** We did not find any significant correlation between CVR to L-arginine in the cerebral arteries (middle, posterior) and FMD in migraine patients with aura ( $p = 0.880$  vs.  $p = 0.682$ ), without aura ( $p = 0.153$  vs.  $p = 0.179$ ) and healthy subjects ( $p = 0.869$  vs.  $p = 0.662$ ). Analysis of correlations also revealed that IMT did not correlate with CVR to L-arginine in migraine patients with aura ( $p = 0.596$ ), without aura ( $p = 0.414$ ) and healthy subjects ( $p = 0.791$ ). We only found a significant correlation in CVR to L-arginine between the middle and posterior cerebral artery in migraine patients with aura ( $p = 0.004$ ), without aura ( $p = 0.001$ ) and healthy subjects ( $p = 0.002$ ). **Conclusions:** We could conclude that cerebral and systemic endothelial function is not associated in migraine patients without comorbidities, neither with nor without aura. Endothelial function of the anterior and posterior cerebral circulation is associated. Regarding to the present data, the regulation of regional cerebral blood flow in the territory of posterior cerebral artery in migraine patients seems to be altered.

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**P95****CEREBRAL BLOOD FLOW IN THE CHRONIC HEART FAILURE PATIENTS***T. Lepic<sup>1</sup>; G. Loncar<sup>2</sup>; B. Bozic<sup>3</sup>; D. Veljancic<sup>4</sup>; B. Labovic<sup>1</sup>; Z. Krsmanovic<sup>1</sup>; M. Lepic<sup>1</sup>; R. Raicevic<sup>1</sup>*<sup>1</sup>Military Medical Academy, Neurology, Belgrade, Serbia; <sup>2</sup>Clinical Medical Center Zvezdara, Cardiology, Belgrade, Serbia; <sup>3</sup>University of Belgrade, Institute for Physiology and Biochemistry, Belgrade, Serbia; <sup>4</sup>Military Medical Academy, Neurology, 11000, Belgrade, Serbia

**Background:** Global cerebral blood flow (CBF), as a measure of cerebral perfusion, can be non-invasive studied using Doppler sonography. Chronic heart failure (CHF) increases the risk of stroke and dementia. One of the possible causes may be cerebral hypoperfusion in CHF patients. Therefore, we aimed to investigate the relationship between CBF and CHF

severity. **Methods:** Study was performed in 76 ischemic or idiopathic dilatative cardiomyopathy patients, left ventricular ejection fraction (LVEF) <40%, with no clinical evidence of decompensation and 20 healthy volunteers. Each CHF patient was categorized according to the New NYHA criteria. All patients underwent Doppler echocardiography examination (GE Vivid 7). The LVEF was quantified using the Simpson method. CBF was estimated by a 7.0-MHz linear transducer of a computed sonography system (Toshiba Power vision 6000). CBF volume was determined as the sum of the flow volumes of the ICA and the VA of both sides. **Results:** Atrial fibrillation was noted in 30%, left bundle branch block in 26%, while pacemaker was implanted in 9% of patients with CHF. History of myocardial infarction was presented in 64% of patients. No differences in age, waist/hip ratio, body mass index and lipid profile were found between CHF patients and healthy subjects. CBF was calculated in 71 of 76 patients. Three patients had occlusion of ICA, while VA was occluded in another two patients. Others did not have hemodynamically significant ICA and VA stenosis. CBF volume was decreased in CHF patients, ( $677 \pm 170$ ) according to control ( $783 \pm 128$ ). **Conclusion:** Our results of noninvasive sonographic measurement of CBF according to LVE

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**P96****INTRACRANIAL ARTERIAL AND VENOUS VELOCITIES IN PATIENTS WITH DIFFERENT CAUSES OF BRAIN INJURY***A. Catalán Valadés; R. Sierra Camerino; R. Diaz Sese; S. Pedraza López; A. Catalán Valadés*

Hospital Universitario Puerta del Mar, Medicina Intensiva, Cádiz, Spain

**Aims:** The aim was to analyze cerebral hemodynamics estimated by intracranial arterial and venous velocities in patients suffering brain injury, with either head trauma (TBI) or intracranial hemorrhages (ICH). **Methods:** Middle cerebral artery (MCA) and basal cerebral venous (BV) velocities (vel) were measured by TCD ultrasound. Intracranial pressure (ICP) was continuously recorded using Camino transducers. Intracranial hypertension (ECH) was defined by an ICP  $\geq 20$  mm Hg. Data were collected during the first 48 hours of ICU admission. Data are expressed as mean values with confidence intervals (CI95). **Results:** Eighty-six patients were included. Two groups were studied: (I) traumatic brain injury ( $n=61$ ), and (II) intracranial bleeding ( $n=25$ ). The later group included cases of intra-axial ( $n=11$ ) and subarachnoid hemorrhage ( $n=14$ ). 21 (34%) and 8 (32%) patients had ECH in the TBI and ICH group, respectively. Values of mean arterial pressure (mm Hg), ICP (mm Hg), MCA vel (cm/s), and BV vel (cm/s) were (I) 86 (82.8-89.2), 16.2 (14-18.4), 69.1 (62.7-75.4), and 14.3 (13-15.5), respectively in TBI group, and (II) 92.1 (85.6-98.5), 17.5 (14.2-20.9), 70.9 (55.9-85.9), and 14.4 (11.8-17.1), respectively in ICH group. TBI subgroup with ECH showed higher BV vel (cm/s) than that without ECH (16.7 (14.1-19.3) vs 13 (11.7-14.3)) with similar values of MCA vel. MCA vel and BV vel values of ICH patients who had or not ECH were not significantly different. IPC and BV vel values from TBI and ICH groups were positively correlated ( $\rho=0.46$  and  $0.44$ ,  $p<0.05$ ,

respectively). Logistic regression analysis showed BV vel to be an independent predictor of ECH in TBI patients (OR, 1.18 (1.03-1.31),  $p=0.02$ ) with 71% sensitivity and 70% specificity for a threshold value of 13.5 cm/s (area under ROC curve, 0.75 (0.63-0.88)). **Conclusion:** TCD BV vel values appear to be associated to ICP in patients with TBI and ICH. Furthermore, TCD BV vel demonstrates to be a predictor of ECH presence in head injury.

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#### P97

##### SHORT-TERM MODERATE HYPOCAPNIA AUGMENTS DETECTION OF OPTIMAL CEREBRAL PERFUSION PRESSURE

C. Haubrich<sup>1</sup>; L. Steiner<sup>2</sup>; M. Kasprovicz<sup>3</sup>; J. Diedler<sup>4</sup>; E. Carrera<sup>5</sup>; R. R. Diehl<sup>6</sup>; P. Smielewski<sup>7</sup>; M. Czosnyka<sup>8</sup>

<sup>1</sup>University of Aachen, Neurology, Aachen, Germany;

<sup>2</sup>University Hospital Lousanne, Department of Anaesthesia, Lousanne, Switzerland; <sup>3</sup>Wroclaw University of Technology, Institute of Biomedical Engineering and Instrumentation, Wroclaw, Poland; <sup>4</sup>University of Heidelberg, Department of Neurology, Heidelberg, Germany; <sup>5</sup>University Hospital Lousanne, Neurology, Lousanne, Switzerland; <sup>6</sup>Alfried-Krupp-Krankenhaus, Department of Neurology, Essen, Germany; <sup>7</sup>Addenbrooke's Hospital, Cambridge, Department of Academic Neurosurgery, Cambridge, United Kingdom; <sup>8</sup>Addenbrooke's Hospital, University of Cambridge, Department of Academic Neurosurgery, Cambridge, United Kingdom

An autoregulation-oriented strategy has been proposed to guide neurocritical therapy towards an optimal cerebral perfusion pressure (CPPOPT). The influence of ventilation changes is however unclear. We sought to find out whether short-term moderate hypocapnia (HC) shifts the CPPOPT or affects its detection. Thirty head injured patients requiring sedation and mechanical ventilation were studied during 20 min of normocapnia ( $5.1 \pm 0.4$  kPa) and 30 min of moderate hypocapnia ( $4.4 \pm 3.0$  kPa). Monitoring included bilateral transcranial Doppler of the middle cerebral arteries (MCA), invasive arterial blood pressure (ABP), and intracranial pressure (ICP). Mx -autoregulatory index provided a measure for the CPP responsiveness of MCA flow velocity. CPPOPT was assessed as the CPP at which autoregulation (Mx) was working with the maximal efficiency. During normocapnia, CPPOPT (left:  $80.65 \pm 6.18$ ; right:  $79.11 \pm 5.84$  mmHg) was detectable in 12 of 30 patients. Moderate HC did not shift this CPPOPT but enabled its detection in another 17 patients (CPPOPT left:  $83.94 \pm 14.82$ ; right:  $85.28 \pm 14.73$  mmHg). The detection of CPPOPT was achieved via significantly improved Mx-autoregulatory index and an increase of CPP mean. Short-term moderate HC augments the detection of an optimum CPP and may therefore usefully support the CPP guided therapy in patients with head injury.

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#### P98

##### PRES (POSTERIOR REVERSIBLE ENCEPHALOPATHY SYNDROME) IS ASSOCIATED WITH IMPAIRED AUTOREGULATION AND HYPERPERFUSION STATE

J. Heuckmann, T. Mark, M. Eicke

Department of Neurology, Klinikum Idar-Oberstein, Germany

**Background:** The etiology of PRES is unknown. Clinically predominantly young patients present with excessive blood pressure, headache, seizures, visual disturbances (hemianopia or cortical blindness), brainstem involvement, and cognitive dysfunctions. An association with several drugs such as ciclosporine or illegal drugs has been described. It remains uncertain, if the clinical presentation is due to a hypo or hyperperfusion state. **Methods:** We report two cases of PRES (1 male 28 yrs. and 1 female 17 yrs.) with typical clinical and radiological (MRI) presentation. We studied the volume flow in the carotid system (Common and Internal carotid arteries) at the onset of disease and two weeks later by means of grey scale duplex imaging. **Results:** Extracranial volume flow in the carotid arteries and TCD flow velocities were considerably higher at the onset of disease (2-3 days after symptoms started) (CCA volume flow 480 and 320 ml/min) compared to 'baseline' data two weeks and 6-12 months later (360 and 250 ml/min). **Conclusion:** PRES is associated with a hyperperfusion state with impaired autoregulation.

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#### P99

##### COMPARISON OF THE LONG-TERM EFFECTS OF HYPOBARIC CONDITION OF PILOTS VERSUS HYPERBARIC CONDITION OF DIVERS ON BLOOD FLOW VELOCITY OF MIDDLE CEREBRAL, BASILAR AND CAROTID ARTERIES USING TRANSCRANIAL DOPPLER AND DUPLEX ULTRASONOGRAPHY

S.-M. Fereshtehnejad; B. Dormaneh; M. R. Motamed; P. Basir; S.-M. Hossein Mahmoudi; M. Mehrpour

Firoozgar Clinical Research Development Center (FCRDC), Medical Student Research Committee (MSRC), Tehran University of Medical Sciences, Tehran, Iran  
AJA University of Medical Sciences, Tehran, Iran

**Background & Aim:** Nowadays, cerebrovascular events including stroke are one of the most common causes of mortality and morbidity worldwide. More attentions are paid to the potential risk factors of such events. Meanwhile, some environmental conditions that could affect blood flow velocities of brain arteries are considered as possible occupational risk factors. Therefore, this study was aimed to compare the long-term effects of hypobaric condition of pilots versus hyperbaric condition of divers as two possible occupational risk factors on blood flow velocity of middle cerebral, basilar and carotid arteries using transcranial Doppler and Duplex ultrasonography. **Methods:** This historical cohort study was performed in Firoozgar Hospital, Tehran, Iran between March 2009 and June 2010. A final number of 15 pilots and 16 divers were snow-bally selected and referred to the Neurology Laboratory of Firoozgar Hospital. Afterward, Transcranial Doppler ultrasonography was performed to evaluate blood flow velocity of middle cerebral

(MCA) and basilar arteries and Duplex ultrasonography was also used to assess flow velocity and intima media thickness (IMT) of carotid arteries. Moreover, baseline and laboratory variables and occupational indexes were also recorded for each individual. Finally, data were analyzed by SPSS software using Partial Correlation, ANCOVA and Linear Regression Model. **Results:** All 31 enrolled cases were male with the mean age of 42.94 (SD=11.16) yr and the mean working history of 21.00 (SD=12.53) yr. Comparison of the TCD findings between these two groups showed that resistance index was significantly higher in divers [0.57 (SD=0.03) vs. 0.52 (SD=0.06),  $P=0.008$ ]. A significant inverse correlation was also found between total working index of the pilots and end-diastolic ( $R= -0.480$ ,  $P=0.014$ ) and mean velocities ( $R= -0.433$ ,  $P=0.026$ ) of right MCR even after eliminating the confounding effect of age. Additionally, a significant direct correlation was observed between working history of divers and IMT of right internal carotid artery ( $R= +0.402$ ,  $P=0.044$ ). **Conclusion:** For the first time, some considerable associations were found in regard to the long-term effects of hypobaric condition of pilots and hyperbaric condition of divers on blood flow velocity of middle cerebral and carotid arteries using transcranial Doppler and Duplex ultrasonography in our study. Although considering the hypobaric and hyperbaric conditions of pilots and divers as potential occupational risk factors for altering blood flow velocities of cerebral arteries needs to be more assessed by further large sample size studies, it seems that both conditions may affect cerebral hemodynamic which could lead to ischemic events in brain parenchyma.

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## XI Novel Technologies

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### P100 ULTRASOUND CHARACTERISTICS OF TWELVE SERBIAN PATIENTS WITH TEMPORAL ARTERITIS

*M. Mirkovic<sup>1</sup>; M. Mijajlovic<sup>2</sup>*

<sup>1</sup>Health Center Valjevo., Department of Neurology, Valjevo, Serbia; <sup>2</sup>Clinical Center of Serbia, Institute of Neurology, Belgrade, Serbia

**Background:** Although a temporal artery biopsy is the gold standard, color Doppler sonography (CDS) is useful diagnostic tool in temporal arteritis (TA). Characteristic CDS signs of the temporal arteries may be of diagnostic importance. We describe ultrasound characteristics of twelve Serbian patients with TA. **Methods:** We investigated twelve consecutive patients (nine women, mean age 67.4 years), with at least 3 positive American College of Rheumatology (ACR) criteria for TA. CDS of the common-, superficial- temporal artery (STA), and frontal and parietal rami were examined with ultrasound system Aloka Prosound Alpha 6. Internal diameters, presence of arterial wall edema (halo) and flow velocities were measured at defined points. Inflammatory markers (ESR, CRP) and platelet count were measured also in all patients and controls. **Results:** Main feature in all patients was headache (mean intensity 5,0). Temporal artery tenderness was present in nine and jaw claudication in five patients. We noticed visual loss in all

patients. All had polymyalgia rheumatica and positive laboratory markers for TA with the exception of two who fulfilled the ACR criteria, and had typical CDS signs. Mean ESR was 59.5, CRP 22.3 and platelet count 292.1. All had a hypo echoic halo of variable size (0.7–1.9 mm) around the temporal vessels lumen (bilateral in ten). Two patients had total occlusion of at least one of the STA. The artery wall was thicker, average internal lumen was smaller, and mean velocities in temporal arteries lower in patients with TA in comparison with 20 age- and sex- matched healthy controls. The halo size correlated with the intensity of headache and the number of ACR criteria for TA. **Conclusions:** CDS of the temporal arteries is useful, reliable, easy-to-perform and non- invasive diagnostic method for TA.

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### P101 NON-INVASIVE ASSESSMENT OF VASCULAR PHYSIOLOGY IN PATIENTS WITH DEMENTIA

*I. Martinic Popovic; A. Lovrencic-Huzjan; D. Sodec Simicevic; M. Bosnar Puretic; V. Demarin*  
"Sestre milosrdnice" University Hospital, University  
Department of Neurology, Zagreb, Croatia

**Background:** Vascular risk factors (VRFs) are recognized as important contributors in the pathogenesis of both vascular and Alzheimer's dementia. The same VRFs influence arterial mechanics and consequently cerebrovascular perfusion, thus predisposing to evolution of cerebral vascular incidents. Our aim was to further investigate vascular function in patients with cognitive decline, using non-invasive neurosonology techniques. **Methods:** In all, 15 patients diagnosed with Alzheimer's disease (AD), 15 patients with vascular dementia (VAD) and 20 patients diagnosed with mild cognitive impairment (MCI) were recruited. E-tracking was performed using Aloka ProSound Alpha 10 with 13 MHz linear probe. Parameters of arterial stiffness (beta stiffness index, augmentation index [AI] and pulse wave velocity [PWV]) were analysed, and IMT was measured. Inter-group comparison was performed. **Results:** When compared to patients with VAD, patients with AD showed statistically significant difference ( $p<0,05$ ) in the mean beta stiffness ( $9,14\pm 4,3$ ) and AI ( $6,4\pm 8,3$ ), but not in the mean PWV and IMT. Patients with MCI also differ significantly in the AI ( $5,6\pm 6,5$ ) and IMT ( $0,9\pm 0,25$ ) when compared to patients with VAD, but not with AD patients. No significant differences were found among groups regarding age and VRFs profile, except for diabetes which was present more often in patients with VAD. **Conclusions:** Our results pointed towards some differences in vascular function among patients diagnosed with AD, VAD and with subtle cognitive decline. We propose the neurosonological non-invasive assessment of vascular function parameters to be performed as a part of clinical evaluation and monitoring in patients with cognitive decline.

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**P102****ULTRASOUND-MEDIATED ACOUSTIC CAVITATION, GLIAL AND NEURAL SPECIFIC ANTIBODY IN BRAIN TUMORS***D. Labunskiy*

Biomedical Engineering, Longhorn Circle, Santa Rosa, United States

Ultrasound in medicine plays a dual role first as a diagnostic tool in a number of internal medical conditions, and second for medications and gene vectors delivery. Ultrasound mediated acoustic cavitation UMAC - especially transient cavitation helps to provide delivery of big and small molecules, including DNA, proteins, and antibodies. The aim of our research was study of specific antibodies to nervous tissue glial GFAP and neuronal NSE in rats with experimental brain tumors were treated by focused ultrasound beam delivery into brains of experimental animals, rats with induced glioblastomas multiforme (GM) obtained by inoculation of specific tumor's cell line inside the experimental rat's skull. We applied rituximab and trastuzumab as monoclonal antibodies (MAB) for treatment of rats developed brain tumor after 6 consecutive injections of GM cells. Experimental group consisted of 28 rats Wistar with induced Control group included also 28 rats, without induction of any tumors. After 2 month of everyday MAB delivery we studied the level of anti-GFAP and anti-NSE antibodies in blood of this animals. Cell permeability increased and viability decreased with increasing peak negative pressure, pulse repetition frequency, pulse duration and insonation time and with decreasing pulse center frequency. The highest therapeutic ratio achieved was 9.7 with 34 +/- 4% permeabilization and 93 +/- 1% viability at 567 kPa peak negative pressure, 7.5 microsec pulse duration, 4 kHz pulse repetition frequency, 548 kHz center frequency. In comparison with untreated and control rats level of glial and neuronal antibodies considerably increased in rats with induced tumors. After UMAC concentration of anti-GFAP decreased in 18 animals and anti-NSE in 21 rats. In control group the level of glial and neuronal AB remained the same before and after UMAC. In conclusion, we can state that MAB transfection via UMAC plays a certain role specific antibodies changing in experimental treatment of GM.

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**P103****INVESTIGATION OF NON-INVASIVE ULTRASONIC CEREBROVASCULAR AUTOREGULATION MONITOR WITHOUT ABP LINE***A. Ragauskas<sup>1</sup>; E. Kalvaitis<sup>1</sup>; V. Petkus<sup>1</sup>; V. Chomskis<sup>1</sup>; A. Kalasauskienė<sup>2</sup>; L. Kalasauskas<sup>3</sup>*<sup>1</sup>Kaunas University of Technology, Telematics (biomedical) Scientific Laboratory, Kaunas, Lithuania; <sup>2</sup>Lithuanian Academy of Physical Education, Kaunas, Lithuania; <sup>3</sup>Hospital of Lithuanian University of Health Sciences Kaunas Clinics, Kaunas, Lithuania

**Background:** An innovative ultrasonic monitor "Vittamed" can be used for continuous non-invasive intracranial wave and cerebrovascular autoregulation (CA) state monitoring. The objective of study is an in vivo assessment of this monitor by

comparative study of CA monitoring on healthy volunteers and sportsmen as well as comparison of "Vittamed" CA estimation method with other known methods. **Methods:** Fully non-invasive "Vittamed" monitor is based on ultrasonic volumetric measurements of pulsations of intracranial blood, brain tissue, cerebrospinal fluid, extraction of slow, respiratory and pulse waves and calculation of CA indices without using any additional arterial blood pressure (ABP) measurements. **Results:** The steady CA status was observed in 20 amateur sportsmen after physical load, while instability of CA status was observed in 7-10 min after physical load in 10 professional bodybuilders. New CA calculation method and "Vittamed" software which does not need ABP reference signal data, was compared with existing ABP and ICP slow wave correlation method (ICM+, Cambridge, UK). Comparative analysis of "Vittamed" and "ICM+" software performance on ICP data measured invasively in traumatic brain injury patients (up to 120 h of continuous monitoring) showed significant agreement ( $r = 0.655$ ) between these two methods. **Conclusions:** "Vittamed" non-invasive monitor is available for continuous real-time CA monitoring during sportsmen training and can be used for optimization of sportsmen training methodology. Comparative study of "Vittamed" and "ICM+" methods showed at first time that it is enough to analyze ICP dynamics only and it is not necessary to monitor ABP dynamics in order to monitor CA status.

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**P104****ASYMMETRY OF CEREBRAL AUTOREGULATION CANNOT BE EXPLAINED BY ASYMMETRY OF CEREBROVASCULAR REACTIVITY***B. Schmidt<sup>1</sup>; M. Czosnyka<sup>2</sup>; J. Klingelhöfer<sup>1</sup>*<sup>1</sup>Medical Center Chemnitz, Neurology, Chemnitz, Germany; <sup>2</sup>Addenbrooke's Hospital, Neurosurgery, Cambridge, United Kingdom

**Background:** Asymmetry of cerebral autoregulation (CA) during increase and decrease of arterial blood pressure (ABP) was first described by Aaslid (2007), a weaker asymmetry was observed by Schmidt et al. (2009). Aim of this study was to investigate CA during increase and decrease of cerebral perfusion pressure (CPP) and to clarify whether asymmetries may be explained by differences in vasoreactivity. **Methods:** 727 data recordings of CPP and cerebral blood flow velocity (FV) of 210 patients with severe traumatic brain injuries (age ( $\pm$ SD): 37 $\pm$ 17 y) were analysed. During spontaneous CPP oscillations periods of CPP increase and decrease were separately correlated to corresponding FV in order to assess CA responses to upward (upMx) and downward (downMx) changes of CPP. This calculation was similar to the calculation of Mx index, which was introduced by Czosnyka et al. (1996). The correlation indices range from -1 to +1, negative values indicate intact CA, positive values indicate impaired CA. Only data with defined strong CPP variations were evaluated. For assessment of the cerebral vasoreactivity ABP was correlated to intracranial pressure (ICP) (PRx index; Czosnyka et al., 1997). Similar to the calculation of MX indices periods of increasing decreasing ABP were separately correlated to ICP in order to assess vascular reactivity in upward and downward

changes of ABP. **Results:** Strong CPP variations were found in 84 recordings. On average ( $\pm$ SD) upMx was significantly lower than downMx ( $0.05\pm 0.49$  vers.  $0.14\pm 0.54$ ;  $P<0.005$ ) The difference upMx-downMx did not correlate with ICP or CPP significantly. No significant differences could be found between upPRx and downPRx ( $0.42\pm 0.45$  vers.  $0.39\pm 0.48$ ;  $P>0.3$ ). **Conclusions.** During increasing CPP the CA response was slightly but significantly stronger than during decreasing CPP. The asymmetry of CA could not be explained by changes in cerebrovascular reactivity. Further studies are needed to clarify the reasons of CA asymmetry.

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**P105**  
**THREEDIMENSIONAL IMAGING OF CAROTID ARTERIES: ADVANTAGES AND PITFALLS OF ULTRASOUND INVESTIGATIONS.**

*E. Vicenzini<sup>1</sup>; S. Pro<sup>1</sup>; G. Sirimarco<sup>1</sup>; M. C. Ricciardi<sup>1</sup>; C. Zuco<sup>2</sup>; P. Pulitano<sup>3</sup>; O. Mecarelli<sup>2</sup>; V. Di Piero<sup>3</sup>; G. L. Lenzi<sup>2</sup>*  
<sup>1</sup>Sapienza Università di Roma, Dept Neurology and Psychiatry, Rome, Italy; <sup>2</sup>Sapienza University of Rome, Dept Neurology and Psychiatry, Rome, Italy; <sup>3</sup>Dept Neurology and Psychiatry, Viale dell'Università, Rome, Italy

**Objectives:** threedimensional-ultrasound is nowadays commonly applied as adjuvant imaging technique in several fields of clinical practice. In carotid arteries investigations, it has been used to better define plaque morphology, surface and volume during atherosclerosis progression, to monitor, for example, plaque structural changes. Nonetheless, no papers described the use of this technique in conditions different than carotid stenosis, such as bifurcation anatomy changes of the caliber and vessels course modifications. **Methods:** we investigated patients admitted to our ultrasound laboratory for vascular screening. Patients were submitted to standard carotid duplex and to 3D ultrasound reconstruction of the carotid bifurcation. **Results:** Forty normal subjects, 7 patients with caliber alterations (4 carotid bulb ectasia and 3 internal carotid lumen narrowing), 45 patients with course variations (tortuosities and kinkings) and 35 patients with internal carotid artery stenosis of various degrees have been investigated. **Conclusions:** 3D ultrasound is a feasible technique, rapidly executable as part of the standard routine investigation. It can improve carotid axis imaging through a better presentation of caliber variations and vessels course "at a glance". Stenosis can be visualized with the 3D ultrasound reconstruction from inward flow, but quantification should always take into account the assessment of plaque morphology and of the vessels wall.

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**P106**  
**PULSATILITY INDEX AND CEREBRAL AUTOREGULATION IN PATIENTS WITH HYDROCEPHALY**

*V. Semenyutin<sup>1</sup>; V. Aliev<sup>1</sup>; V. Bersnev<sup>2</sup>; A. Patzak<sup>3</sup>; L. Rozhchenko<sup>4</sup>; A. Kozlov<sup>1</sup>; S. Ramazanov<sup>2</sup>*

<sup>1</sup>Russian Polenov Neurosurgical Institute, Laboratory of brain circulation pathology, St. Petersburg, Russian Federation; <sup>2</sup>Russian Polenov Neurosurgical Institute, Department of Head injury and Epilepsy, St. Petersburg, Russian Federation; <sup>3</sup>University Hospital Charite, Humboldt-University of Berlin, Johannes-Mueller Institute of Physiology, Berlin, Germany; <sup>4</sup>Russian Polenov Neurosurgical Institute, Department of Neurovascular Surgery, St. Petersburg, Russian Federation

**Background:** A high correlation between transcranial Doppler pulsatility index (PI) increase and intracranial hypertension has been recently demonstrated in most neurosurgical patients. But in patients with hydrocephaly PI is sometimes controversial. This may be due to a different degree of cerebral autoregulation (CA) impairment during cerebral perfusion pressure decrease. **Aim:** To compare results of PI and CA assessment in operated and non-operated patients with hydrocephaly. **Material and Methods:** There were 18 cases (aged 20-52) with hydrocephaly which was diagnosed by CT of brain. Indications for operation (shunting or endoscopic fenestration) were determined on the basis of clinical examination and lumbar infusion test. We monitored blood flow velocity in middle cerebral arteries with Multi Dop X (DWL) and systemic blood pressure with Finapres-2300 (Ohmeda). CA was assessed with cuff test (evaluation of ARI) and cross-spectral analysis of spontaneous oscillations of cerebral and systemic hemodynamics within the range of Mayer's waves (evaluation of phase shift in radians – PS). **Results:** Operation was performed in 9 cases with clinical signs of hydrocephaly. Preoperative values of PI were within the normal range ( $0.83\pm 0.16$ ), but ARI ( $4.3\pm 1.5$ ) and PS ( $0.65\pm 0.27$  rad) were considerably lower than normal indices ( $p<0.01$ ). As for other 9 non-operated patients without any clinical signs of hydrocephaly mean values of PI were also within the normal range ( $0.82\pm 0.17$ ), but ARI ( $6.6\pm 1.5$ ) and PS ( $1.03\pm 0.15$  rad) were considerably higher than in operated patients ( $p<0.01$ ). This indicated the normal statue of CA. **Conclusion:** Preoperative CA assessment being more informative than PI evaluation can increase transcranial Doppler valuability in noninvasive diagnostics of cerebral spinal fluid dynamics and may be helpful in clarifying indications for operation in patients with hydrocephaly.

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**P107****CHANGES OF LEFT ATRIAL VOLUMES AND CONTRACTILE PROPERTIES IN ISCHEMIC STROKE PATIENTS***Y.-T. Chen<sup>1</sup>; H.-Y. Hsu<sup>2</sup>*

<sup>1</sup>Tungsi Taichung Metrohabor Hospital Taichung, Section of Cardiology, Taichung County, Taiwan; <sup>2</sup>School of Medicine, Chung-Shan Medical University, Section of Neurology, Taichung, Taiwan

**Background:** Increased left atrial (LA) size has been proposed as a predictor of multiple adverse cardiovascular events including stroke, death, new atrial fibrillation and new heart failure. The relationship between stroke and an enlarged LA are not completely understood. **Methods:** Patients with acute ischemic stroke and controls from subjects receiving physical check-ups were enrolled prospectively. All study subjects received echocardiography examination. Conventional echocardiographic parameters were calculated and cardiac contractile characteristics of left atrium and left ventricle were analyzed by using speckle-tracking techniques (STE). **Results:** Totally, 20 control subjects and 87 patients with acute ischemic stroke were enrolled recruited in this study. The end-diastolic and end-systolic volumes of left ventricle measured by using STE were significantly higher in the stroke patients ( $p=0.002$  and  $0.004$  respectively). The mitral inflow E-wave velocities were lower and A-wave velocities were higher in the stroke patients ( $0.76\pm 0.19$  vs  $0.84\pm 0.16$ ,  $p=0.048$ ; and  $0.97\pm 0.20$  vs  $0.76\pm 0.11$ ,  $p<0.01$  respectively). The diastolic emptying index of left atrium measured by STE was significantly lower in the stroke patients ( $61.4\pm 14.6$  vs  $70.2\pm 11.0$ ,  $p=0.016$ ). The longitudinal velocities of left atrium were significantly different between controls and stroke patients. **Discussion and conclusion:** The patients with acute ischemic stroke had altered mitral inflow velocities, morphology and pumping function of left heart chambers. Speckle-tracking echocardiography is convenient for quantitative assessment of left atrial deformation and contractile characteristics.

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**P108****VIRTUAL NAVIGATOR STUDY. SUBSET OF PRELIMINARY DATA ABOUT ARTERIAL CIRCULATION.***G. Malferrari<sup>1</sup>; M. Zedde<sup>1</sup>; G. De Berti<sup>2</sup>; M. Maggi<sup>2</sup>; L. Lodigiani<sup>3</sup>; N. Marcello<sup>4</sup>*

<sup>1</sup>ASMN, Neurology, Stroke Unit, Reggio Emilia, Italy; <sup>2</sup>ASMN, Neuroradiology, Reggio Emilia, Italy; <sup>3</sup>Esaote, Ultrasound Operational Marketing, Genova, Italy; <sup>4</sup>ASMN, Neurology, Reggio Emilia, Italy

**Background:** Neuroradiological techniques are known for their high spatial resolution, but neurosonological techniques (TCCS) are known for their high temporal resolution. An ideal study of intracranial circulation should combine the high temporal resolution of ultrasound with the high spatial resolution of MR. Therefore, we implemented for the intracranial ultrasound examination a real time imaging fusion between the neurosonological technique and the neuroradiological

examination (Brain MR and MR angiography) into the ultrasound machine, similarly similar to what is already done for the study of focal liver lesions, known as Virtual Navigator. **Patients and Methods:** 16 consecutive subjects (11 men and 5 women, mean age 55.7 years) were chosen among patients who underwent standard TCCS examinations at our lab, because of known and accepted indications. The selection criteria were: age > 18 years, a sufficient temporal acoustic window and a recently performed brain MR and MRA. Therefore these patients underwent to Virtual Navigator exploration, after the uploading of the neuroradiological examination in the ultrasound machine. The matching between ultrasound examination and MR was achieved by using a magnetic tracking system, solidary with the probe, and a reference plane for the alignment of the main bone and parenchymal landmarks. Standard TCCS examination was compared with the Virtual Navigator examination for parenchymal correspondence in mesencephalic, diencephalic and ventricular plane and for the rate of single segment vessel insonation. **Results:** The parenchymal correspondence between ultrasound examination and brain MR was achieved for all the chosen landmarks, but one in the ventricular plane in one subject. The vessel identification rate (flow waveform in the corresponding segment) was increased from 76.4% to 91.7%. **Conclusions:** The Virtual Navigator protocol can help to improve the vessel identification in suboptimal temporal acoustic window patients.

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**P109****CLINICAL APPLICATION OF LASER DOPPLER FLOWMETRY IN NEUROLOGY***Z. Stoyneva*

St. Ivan Rilsky University Hospital, Department of Neurology, Sofia, Bulgaria

Laser Doppler flowmetry is a contemporary method for monitoring microcirculation used in different medical fields including neurology. **Aim:** To present principles and clinical application of laser-Doppler method in neurology and related pathologies. **Methods:** The diagnostic value was studied by evaluating systematic literature and personal experience. It is based on Doppler principle and uses a laser-generated monochromatic light beam, a fiber-optic probe and sensitive photodetectors. The tissue perfusion of a sample volume is calculated by multiplying the number of moving blood cells and their velocity and is presented in perfusion units. **Results:** A high diagnostic value was established in studying microcirculation and its autoregulation using a battery of different functional tests with relative specificity for evaluation of microcirculatory vasomotor response mediated by sympathetic neural, axon-reflex, receptor or endothelial mechanisms. It has clinical significance in assessment of Raynaud's phenomenon, distal autonomic neuropathy of the small C fibers due to diabetes mellitus, peripheral arterial occlusive disease, systemic autoimmune diseases, chronic venous insufficiency, peripheral neuropathies, for medical expertise of occupational diseases as hand-arm vibration syndrome, neurovascular syndromes, toxic neuropathies, etc. By iontophoretic transducer different drugs or substances might be applied locally to test either an effect

or some physiological or pathophysiological mechanisms. Unlike the contemporary ultrasound investigations it studies the blinded sphere for neurosonology - microcirculation and its autoregulation. **Conclusions:** Laser Doppler flowmetry is a valuable and reliable method for diagnostics of microcirculation and perfusion, for assessment of autoregulation and effect of treatment, for experimental studies and research. In combination with ultrasound sonography it gives a thorough information for both macro- and microcirculation.

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## XII Various Stroke Etiologies

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### P110 HIGH PREVALENCE OF RIGHT-TO-LEFT SHUNT IN PATIENTS WITH CHRONIC HYPERVENTILATION SYNDROME.

*J. Staszewski<sup>1</sup>; K. Tomczykiewicz<sup>1</sup>; A. Stepień<sup>2</sup>; B. Brodacki<sup>2</sup>; Z. Podgajny<sup>3</sup>; P. Smurzyński<sup>3,4</sup>*

<sup>1</sup>Military Medical Institute, Clinic of Neurology, Warsaw, Poland; <sup>2</sup>Clinic of Neurology, Szaserow 128, 04-141, Warsaw, Poland; <sup>3</sup>Clinic of Endocrinology, Szaserow 128, 04-141, Warsaw, Poland; <sup>4</sup>Clinic of Cardiology, Szaserow 128, 04-141, Warsaw, Poland

**Background:** Chronic hyperventilation syndrome (CHVS) can present with a myriad of respiratory, neurologic or cardiac symptoms however, the underlying pathophysiology has not been clearly elucidated. The pathogenetic role of cardiac right-to-left (R-L) shunt is unknown and its relation with CHVS has not been reported so far. **Patients and methods:** Patients with established CHVS, presenting with neurological symptoms (dizziness, weakness, paresthesias or near syncope) and 25 healthy subjects from control group (CG; 70% females, mean age 39 years) were prospectively recruited into the study. All patients with CHVS had documented spontaneous EMG activity during hyperventilation. R-L vascular shunt was diagnosed using transcranial Doppler of the middle cerebral artery to detect the presence of bubble emboli following an injection agitated saline/blood/air mixture as a contrast at rest and with Valsalva. **Results:** Of 25 subjects with CHVS tested (82% females, mean age 37 years), 16 (64%) were positive for R-L shunt vs 3 from CG (12%,  $p < 0.05$ ). The transoesophageal echocardiography confirmed patent foramen ovale in 10 patients with CHVS (40%) and 2 from CG (8%,  $p < 0.05$ ). Basing on chest CT examination, pulmonary arteriovenous malformation was found in 2 patients (10%) with CHVS and none from CG. **Conclusions:** The prevalence of R-L shunt and PFO in patients with CHVS were significantly higher than in healthy subjects from control group. A link between R-L shunt and CHVS is new and whether etiological or functional may improve the understanding of both conditions.

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### P111 INTERVENTIONAL CLOSURE OF PFO IS RELATED WITH LOW RISK OF PROCEDURE-RELATED CEREBRAL EMBOLIC EVENTS.

*J. Staszewski<sup>1</sup>; E. Skrobowska<sup>2</sup>; A. Stepień<sup>3</sup>; M. Zarebinski<sup>4</sup>; M. Zienkiewicz<sup>4</sup>*

<sup>1</sup>Military Medical Institute, Clinic of Neurology, Warsaw, Poland; <sup>2</sup>Department of Radiology, Szaserow 128, 04-141, Warsaw, Poland; <sup>3</sup>Clinic of Neurology, Szaserow 128, 04-141, Warsaw, Poland; <sup>4</sup>Specjalistyczny Szpital Zachodni, Interventional Cardiology Department, Grodzisk Mazowiecki, Poland

**Background:** Paradoxical embolism via patent foramen ovale (PFO) is an important cause of stroke in young patients. Embolisation of small-sized venous thrombus or platelet aggregate was proposed to be the leading mechanism precipitating migraine with aura (MWA) or ischemic stroke (IS) in patients with PFO. Transcatheter PFO closure is considered to carry a low procedural risk and to be technically feasible with a high primary success rate. There are however no data for the rate of procedure-associated silent embolic events. **Aim:** The present study was aimed to analyze the total number of cerebral ischemic complications with interventional PFO closure. **Results:** 21 symptomatic PFO patients (70% female, mean age 40 years): 12 with history of past IS, 9 with MWA and documented by the diffusion-weighted imaging (DWI) MRI presence of white matter lesions were qualified for the transcatheter closure of PFO using intrasept occluder. All of the patients had DWI MRI performed before and after PFO closure and received aspirin (75mg/daily) and clopidogrel (75mg/daily) after the procedure. In the MRI examinations following the intervention, new microembolic lesions were found in only 2 of 21 (9.5%) patients. These lesions were clinically unapparent and were found in the right frontoparietal white matter in two patients (aged 56 and 59), who were qualified for the PFO closure due to past stroke. No symptomatic microembolic events were noticed among the studied patients. **Conclusions:** Although this study was based on a small number of patients it provides first evidence of low frequency of closure associated silent cerebral embolisms after interventional PFO closure in patients with IS or MWA.

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### P112 SPONTANEOUS CERVICAL ARTERY DISSECTION: AN ANALYSIS OF SEASONAL VARIABILITY

*S. Evers; R. U. Milz; E. Akova-Oeztuerk; E. B. Ringelstein*  
University Hospital Muenster, Department of Neurology, Muenster, Germany

**Background:** There is an evidence for seasonal variability in spontaneous cervical artery dissection (sCAD) with a significant peak in wintertime. **Methods:** We analysed the seasonal variability of 223 patients between 16 and 72 years with sCAD. 155 of them had consecutive ischaemic stroke. Vascular risk factors were also recorded. We analysed the seasonality of all patients and compared the seasonal variability of patients with arterial hypertension to these without

arterial hypertension. **Results:** We found a significant seasonal peak of sCAD in winter (November 1st until January 31st). The highest number of sCAD was found in January. The analysis of patients with arterial hypertension was significant ( $p=0.022$ ). The analysis of patients without arterial hypertension was not. Other vascular risk factors, such as cigarette smoking, diabetes mellitus, and hyperlipidaemia, investigated in our study failed to show any significant influence on the seasonal variability of sCAD. **Conclusion:** We conclude that sCAD shows a seasonal variability with a peak in wintertime and that the only conventional risk factor associated with this observation is arterial hypertension. There might be a pathophysiological connection between hypertension and sCAD. Temperature- and air pressure-related changes in blood-pressure, coagulation parameters, rheological factors, physical activity, diet, and air pollution have been considered as the underlying mechanism. Further studies are warranted to clarify these issues.

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### P113

#### SPONTANEOUS CERVICAL ARTERY DISSECTION AND VASCULAR RISK FACTORS: A CASE-CONTROL STUDY

S. Evers; R. U. Milz; E. Akova-Oeztuerk; E. B. Ringelstein  
University Hospital Muenster, Department of Neurology, Muenster, Germany

**Background:** Although the aetiology of spontaneous cervical artery dissection remains unclear, several constitutional and environmental risk factors have been discovered to be associated with spontaneous carotid or vertebral artery dissection (sCAD and sVAD). However, conventional vascular risk factors in patients with sCAD or sVAD have not been studied in a case-control design. **Methods:** We analysed the incidence of conventional vascular risk factors in patients with sCAD or sVAD. The data were compared in a case-control design to 358 sex and age matched healthy control subjects. **Results:** The analysis of all patients compared to the healthy control group showed arterial hypertension ( $p<0.001$ ), smoking ( $p=0.039$ ), hyperlipidaemia ( $p<0.001$ ), and fibromuscular dysplasia ( $p<0.001$ ) to be significantly more prevalent in patients with sCAD or sVAD. The occurrence of venous disease in patients themselves ( $p<0.001$ ) or in any first degree relative ( $p<0.001$ ) and the use of oral contraceptives ( $p=0.002$ ) turned out to be significantly more prevalent in the healthy control group. All subgroup analyses showed similar results. **Conclusions:** We found arterial hypertension, smoking, hyperlipidaemia, and fibromuscular dysplasia to be significant risk factors for sCAD and sVAD. All subgroup analyses showed similar results suggesting that these risk factors are relevant for the development of sCAD or sVAD and not for the infarction. Venous diseases in patients themselves or in their family members are possibly protective factors for sCAD or sVAD. Oral contraceptive use also seems to be protective.

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### P114

#### ULTRASONOGRAPHIC MONITORING OF CEREBRAL CIRCULATION IN MOYAMOYA-SYNDROME- A REPORT OF TWO CASES

J. Albers; S. Suntrup; E. B. Ringelstein; R. Dziewas; M. A. Ritter

University Hospital of Muenster, Department of Neurology, Muenster, Germany

**Introduction:** Moyamoya-syndrome in Caucasians is extremely rare. Diagnosis and therapy are challenging and require multidisciplinary involvement. The risk of recurring hemodynamic strokes makes an ultrasonographic monitoring of cerebral circulation seem to be useful. Case 1: A 51-year-old female was admitted to our department with complaints of headache and double vision. She was an active smoker (35py), had arterial hypertension and a history of hypercholesterolemia which was treated with statins. On clinical exam she had paresis of the left abducens nerve and hemianopia to the right. Magnetic resonance imaging (MRI) showed watershed infarctions in the territory of the left middle and posterior cerebral arteries. Transcranial - Doppler - sonography (TCD) revealed reduced blood flow in both middle cerebral arteries. Cerebral angiography (DSA) showed a moyamoya-syndrome. Because of recurring hemodynamic stroke symptoms and insufficient cerebral collateralization, monitored by TCD, the patient underwent EC-IC bypass surgery. Case 2: A 59-year-old male was referred to our department because of impaired vision. He had a history of diabetes mellitus, hypertension and hypercholesterolemia and was active smoker (80py). On clinical exam he had hemianopia to the left, memory disturbances and mild aphasia. MRI showed watershed infarctions in the territory of right middle and posterior cerebral arteries. TCD revealed reduced blood flow in both middle cerebral arteries and DSA showed a moyamoya-syndrome. In the following course cerebral blood flow increased, monitored by TCD and the patient remained stable. Therefore we recommended best medical practice and abstained from surgical intervention. **Conclusion:** Moyamoya-syndrome is a severe and potentially lethal cerebral vasculopathy. During the clinical course monitoring of cerebral circulation by TCD might be useful to estimate the risk of recurrent cerebral ischemia and to ensure the indication for EC-IC bypass surgery.

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### P115

#### TRANSIENT BRAINSTEM ISCHEMIA AND DURAL ARTERIOVENOUS MALFORMATION

J. Valaikiene<sup>1</sup>; J. Dementaviciene<sup>2</sup>; M. Mataciunas<sup>2</sup>; D. Jatuzis<sup>1</sup>

<sup>1</sup>Centre of Neurology, Vilnius University, Santariskiu 2, Vilnius, Lithuania; <sup>2</sup>Centre of Radiology, Vilnius University, Santariskiu 2, Vilnius, Lithuania

**Background:** High cervical dural arteriovenous fistulas are extremely rare and usually manifest with progressive myelopathy. We present neurovascular imaging in a patient suffering from a cervical intradural extramedullary and intracranial arteriovenous malformation who presented with

repeated transient ischemic brainstem attacks. **Case Report:** A 40 yrs old woman was admitted due to repeated short lasting episodes of dysarthria and left hemiplegia. Neurological examination after these episodes revealed no pathological signs. Unenhanced cerebral CT excluded ischemia or haemorrhagia but was suspicious of aneurysms of the basilar artery and left middle cerebral artery. Extracranial color-Duplex ultrasound was unremarkable. Transcranial color-coded sonography showed normal basal arteries, but detected an enlarged vein of Rosenthal and deep middle cerebral vein with pathologically increased blood flow velocities. A large vein found at the mesencephalic brainstem level adjacent to the basilar artery. Transforaminal examination revealed increased blood flow velocity of anterior spinal artery in conjunction with venous enlargement. MRI disclosed a large intradural extramedullary cervical and intracranial arteriovenous malformation. The cervical spinal cord was deformed by the enlarged draining vein running cranially into posterior fossa draining into the straight sinus. Conventional angiography confirmed multiple arteriovenous junctions with feeding arteries arising from V2-V3 segments of both vertebral arteries. **Conclusions:** This case illustrates the hemodynamic and anatomical informations derived from multimodal neuroimaging procedures. Therapy for these AVM with multiple feeders is preferably using interventional closure of the primary fistula. Given the absence of a congestive edema, the hemodynamic situation and any myelopathy and the rather benign TIA clinic, prevented urgent and risky intervention and allowed for thorough planning of the interventional procedure.

#### P116

##### EVALUATION OF BRAIN BLOOD FLOW PARAMETERS IN CHILDREN WITH SICKLE CELL DISEASE AND ARABIAN HAPLOTYPE

R. Bavarsad Shahripour<sup>1</sup>; S. A. Sajedi<sup>2</sup>; M. Pourjafar<sup>3</sup>; K. Ghandhari<sup>4</sup>

<sup>1</sup>Neurology, Golestan Hospital - Neurology Ward-, Ahwaz, Islamic Republic of Iran; <sup>2</sup>Joundishapour University, Golestan Hospital - Neurology Ward-, Ahwaz, Islamic Republic of Iran; <sup>3</sup>Shiraz Medical University, - Neurology ward-, Ahwaz, Islamic Republic of Iran; <sup>4</sup>Mashhad Medical University, - Neurology ward-, Mashhad, Islamic Republic of Iran

In The province of Khuzestan in IRAN, There is high prevalence of Sickle cell among the Arab people. The low prevalence of stroke among the these patients, is the most important issue about them. However, Cerebral Blood Flow Changes in these patients, isn't inconsistent for intracranial stenosis criteria, even in cases with acute symptoms with acceptable Neurological Criteria. **OBJECTIVE:** To evaluate brain haemodynamic profile of children with SCA in Khuzestan-Iran **METHODS:** Cross sectional study (group1: SCA patients aged 3-16; group2: age and sex matched healthy individuals). Baseline brain flow was evaluated. **RESULTS:** Group1=32 patients; group 2=80 controls. SCA patients had mean velocity (MV)=120.96 cm/s±23.40; pulsatility index (PI)=0.85±0.10; right anterior cerebral artery/right middle cerebral artery=0.85.8±0.20; left anterior cerebral artery/left middle

cerebral artery=0.78±0.20. Controls had MV=79.44±15.54; PI=0.82±0.11; MCAr=13.19±13.77; right anterior cerebral artery/right middle cerebral artery=0.87±0.16; left anterior cerebral artery/left middle cerebral artery=0.88±0.18. MV and PI differences were statistically significant between groups. **Conclusion:** Cerebral blood flow profile in children with SCD showed higher cerebral speed flow and lower pulsatility index than in health children. Relation between MCAs and ACAs/MCAs were not different when both groups were compared showing that the hiperdynamic effect of chronic anaemia is homogenous for these arteries. According to the Ultrasound tissue and comparing with control group, it seems In a special type of sickle cell "Arabic haplotype\_ that in these study had been reveiwed" a significant difference has been observed and evaluate other haplotype is necessary and required

#### P117

##### TRANSCRANIAL DOPPLER SONOGRAPHY IN CHILDREN WITH SICKLE CELL DISEASE AND SILENT ISCHEMIC LESIONS

F. M. Farina<sup>1</sup>; P. Rampazzo<sup>1</sup>; L. Sainati<sup>2</sup>; R. Manara<sup>3</sup>; A. Onorfi<sup>1</sup>; R. Colombatti<sup>2</sup>; C. Baracchini<sup>1</sup>; G. Meneghetti<sup>1</sup>

<sup>1</sup>University Hospital of Padua, Department of Neurology, Padova, Italy; <sup>2</sup>University Hospital of Padua, Department of Pediatrics, Padova., Italy; <sup>3</sup>University Hospital of Padua, Department of Neuroradiology, Padova, Italy

**Background:** Sickle Cell Disease (SCD) is considered the most frequent cause of stroke in childhood and children with HbSS have a 300-fold increased risk for stroke. According to the STOP protocol criteria (Stroke Prevention Trial in Sickle Cell Anemia study) only patients with abnormal values (>200cm/s) of Time Averaged Mean velocities of Maximum blood flow (TAMM), detected by Transcranial Doppler Sonography (TCD), undergo blood transfusion in order to reduce the risk of ischemic stroke. However, patients with normal TAMM can reveal silent strokes on MRI scan. Our aim was to verify whether a significant asymmetry in TAMM values (>20% and <30%), could identify subjects more prone to develop silent strokes, although presenting normal blood flow velocities. **Methods:** Thirty one consecutive SCD patients, (16 males, 15 females; mean age: 9,23±3,66 years), categorized as normal according to the STOP protocol, who never received blood transfusions, and did not have a history of TIA/stroke underwent a complete TCD evaluation in order to detect significant asymmetries in the main intracranial arteries and a cerebral MRI scan. We subdivided this cohort into two groups according to the detection of TAMM asymmetry: normal and symmetric (NS), normal and asymmetric (NA). **Results:** With regards to the TCD study, we found 13/31 patients (41.9%) harbouring a significant TAMM asymmetry (NA Group). Overall, brain MRI detected the presence of silent ischemic lesions in 13/31 (41,9%) patients. However, no significant differences were found in silent strokes frequencies (Chi-Square test with continuity correction,  $\chi^2=0.598$ ), in lesion number (t-Student test,  $p=0.09$ ) and in lesion burden (t-Student test,  $p=0.227$ ) between NA and NS. **Conclusion:** According to our study, TAMM asymmetry does not seem to be a significant indicator of silent cerebral ischemia.

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**INTELLECTUAL IMPAIRMENT AND TCD EVALUATION  
IN CHILDREN WITH SICKLE CELL DISEASE AND  
SILENT STROKE**

*A. Onorfi<sup>1</sup>; M. Montanaro<sup>2</sup>; P. Rampazzo<sup>1</sup>; R. Colombatti<sup>2</sup>;  
F. M. Farina<sup>1</sup>; R. Manara<sup>3</sup>; L. Sainati<sup>2</sup>; M. Ermani<sup>1</sup>; C.  
Baracchini<sup>1</sup>; G. Meneghetti<sup>1</sup>*

<sup>1</sup>University Hospital of Padua, Department of Neurology,  
Padova, Italy; <sup>2</sup>University Hospital of Padua, Department  
of Pediatrics, Padova, Italy; <sup>3</sup>University Hospital of Padua,  
Department of Neuroradiology, Padova, Italy

**Background:** Sickle cell disease (SCD) may impair intellectual activity and 25% of SCD patients have a significant cognitive deficit. Our aim was to verify in a cohort of children with HbSS if the presence of silent strokes or altered Time Averaged Mean velocities of Maximum blood flow (TAMM) detected by Transcranial Doppler Sonography (TCD) are indicators of impaired intellectual ability. **Methods** Thirty-five consecutive SCD patients (17 males, 18 females; mean age: 8.6±3.22;) were subdivided into two groups according to the detection of neuropsychological deficits by means of a neuropsychological evaluation (WISC III for the children aged 6-16 years, WPPSI test for the children aged 4-6 years). All patients underwent a TCD assessment of the main intracranial arteries, in order to detect any increase of TAMM velocities (normal < 170 cm/s; altered >170cm/s) and a cerebral MRI to reveal any silent strokes. **Results:** According to the neuropsychological evaluation, 29/35 (82.8%) patients (Group 1) had a normal (> 70) Total Intelligence Quotient (TIQ), while 6/35 (17.2%) patients (Group 2) were defined intellectually impaired (TIQ <69). TCD detected altered velocities in 8/35 (22.8%) patients. No significant differences were found in the percentage of altered TAMM velocities between the two groups (Fisher Exact test: p=0.42). MRI detected silent ischemic lesions in 14/35 patients (40.0%). No significant differences were found in silent stroke frequencies (Fisher Exact test: p=0.25) between Group 1 and Group 2. **Conclusion:** With the limitations of the study sample, according to our results, altered TAMM values and silent strokes do not seem to be indicators of impaired intellectual ability in SCD patients.

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