

Neuroimaging

P 3184

Can intramedullary signal hyperintensity on magnetic resonance imaging predict the outcome of surgical treatment in cervical spondylotic myelopathy?

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Introduction There is no evidence as to whether the presence of magnetic resonance high signal intensity areas in the spinal cord can be a predictor for surgical results in patients with spondylotic cervical myelopathy.

Material and methods This is a prospective 3-year follow-up study comprising of 42 patients with cervical spondylotic myelopathy who underwent surgery. The clinical outcome was measured by means of the mJOA score, a timed 10-m walk and the patients' subjective evaluation of satisfaction with the surgery. Twenty-two patients showed high intensity areas in the spinal cord on the T2-weight image and twenty patients had normal intensity.

Results On average, no significant differences in mJOA score and in the timed 10-m walk test were observed over the 36 months of follow-up in comparison with the pre-treatment period. Subjective score improved in 58% of patients, remained identical in 20%, and deteriorated in 22% at the 6-month time point. However, at the 36th month the subjective state was declared as improved in 15%, identical in 41%, and deteriorated in 44% of patients. There were no differences between the group with the high intensity areas and those with normal findings on magnetic resonance imaging.

Conclusions The current study did not demonstrate significant changes in objective parameters over 36 months of follow-up in surgically treated patients with SCM. A significant number of patients deteriorated in subjective assessment. The presence or absence of high signal intensity areas in the spinal cord had no power to predict the outcome of the surgical treatment.

P 3185

Magnetization transfer analysis of multiple system atrophy

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Objective To determine whether magnetization transfer imaging (MTI) demonstrates characteristic abnormalities in the brain structures of patients with multiple system atrophy (MSA).

Patients and methods Twelve patients with clinically probable MSA and 11 control subjects were examined. From MTI, magnetization transfer ratios (MTRs) were calculated using region of interest analysis. Abnormal signal changes in the base of the pons, middle cerebellar peduncle, and putamen were assessed on T2-weighted images.

Results MTRs of the base of the pons, middle cerebellar peduncle, putamen, and white matter of the precentral gyrus were significantly lower in the MSA patients than in the controls. Abnormal signal changes on T2-weighted images were observed as follows: hyperintense signal changes in the base of the pons in 6 patients and in bilateral middle cerebellar peduncles in 7 patients, a combination of hyperintense and hypointense signal changes in the dorsolateral portions of bilateral putamen in 3 patients and of the unilateral putamen in 2 patients, and hypointense signal changes alone in the dorsolateral portions of bilateral putamen in 2 patients. MTRs of regions with abnormal signal changes were significantly lower than those of regions without abnormal signals and than those in the controls. Even the MTRs of the regions without abnormal signal changes were lower than those in the controls.

Conclusions MTI demonstrates characteristic abnormalities in the brain of patients with MSA that seem to reflect underlying pathological changes, and the abnormalities are detected more sensitively and over a larger area by MTI than by conventional magnetic resonance imaging.

P 3186

fMRI detects activation in the sensorimotor cortex before and after subsensory whole-hand afferent electrical stimulation in humans

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Introduction The aim of the study was to elaborate, whether changes in the motor cortex activation pattern can be demonstrated after electrical stimulation of the hand in volunteers.

Materials and methods All experiments were performed on a 1.5 Tesla MR-scanner. The motor-paradigm was self-paced finger-to-thumb-tapping of the left hand.

The experimental set-up consisted of a baseline fMRI examination using the above-mentioned motor-paradigm. Then, sub threshold electrical stimulation was applied for a duration of 20 minutes to the left hand using a mesh-glove, outside the magnet. This was followed by another fMRI run identical to the baseline examination. The entire experiment was performed twice at different days.

Post processing was done with SPM99.

Results The base-line fMRI examinations revealed activation of the primary and secondary motor cortex as previously described. After electric stimulation of the left hand, there was a quantitative increase of activated pixels in these areas. In addition, there was activation of regions not visible on the base-line studies. These involved the ipsilateral lobus parietalis inferior and the contra lateral gyrus precentralis, gyrus postcentralis and lobus parietalis superior. This pattern was observed in all volunteers and also when the experiments were repeated on another day.

Conclusions We have demonstrated, that afferent electrical whole-hand stimulation with a mesh-glove in fact leads to a lasting change in the responsiveness of the human brain to a motor paradigm. Nevertheless, the results of this initial study

could show in vivo that motor activation patterns can be successfully influenced by sensoric stimulation of afferent pathways.

P 3187

fMRI detects functional plasticity of the sensorimotor cortex after upper extremity amputation

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Purpose In this study, we looked for functional plasticity in the SM1 in a patient who sustained a right upper extremity amputation.

Methods The perioral region bilaterally, the stump on the right side on the location where the former (phantom) middle finger (PMF) was sensated and the existent middle finger (EMF) on the left side was stimulated with 2 Hz. Finally the patient imagined fist clenching of the amputated and the normal hand. All experiments were performed on a 1.5 Tesla MRI-Scanner. Post processing was done with SPM99.

Results Sensorimotor brain areas could be differentiated within both hemispheres.

Imagination of fist clenching led to a spatial difference of the activation foci in the primary motor cortex (M1) within the two hemispheres in the range of 4-12 mm.

The tactile task within the labial angle of the right perioral region lead to a cranial shift of the cortical representation of the perioral region within the contra lateral somatosensory cortex (S1) invading the former cortical representation of the amputated limb up to 15 mm.

The tactile task of the PMF within the stump showed a cranial shift on the convexity up to 8 mm in contrast to the SM1 activation focus of the EMF.

Conclusion In concordance with previous studies, we observed a clear reorganization phenomenon within SM1 of a patient with phantom limb pain after upper extremity amputation 29 years ago. The result of the current study can be interpreted as evidence for plasticity within the sensory cortex following traumatic limb amputation.

P 3188

Functional magnetic resonance imaging of the sensorimotor cortex of the lower limbs by means of a force controllable actuator

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Purpose The aim of the study was the implementation of a vibrotactile stimulation paradigm within the MR environment in healthy volunteers for further clinical application in patients with severe motor deficits.

Methods 10 healthy, male volunteers performed a foot-tapping paradigm with the right foot. In a second experimental run, the subject's sole was vibrated with a force controllable electromagnetic actuator. The vibration stimulus within a frequency range from 0–100 Hz in steps of 10 Hz was applied onto the sole of the right foot above the basic joints of the toes I–V.

All experiments were performed on a 1.5 Tesla MR-Scanner with T2*-weighted single shot echo-planar sequences. Post-processing was done with software SPM99.

Results Group analysis showed:

1. For the foot tapping paradigm (FTP) cortical brain activation within the contralateral hemisphere within the Gyrus precentralis (GPrC, MI), Gyrus postcentralis (GPOC, SI), Lobulus parietalis inferior (LPi, SII) and Gyrus cinguli (GC). Ipsilateral brain activation could be detected within the LPi, GPOC and LPs.

2. For the vibrotactile stimulation of the sole of the right foot (VPD) brain activation could be elicited contralaterally within the GPrC, GPOC, LPi, GC and Gyrus frontalis superior (GFs) and ipsilaterally within the LPi and the LPs.

Conclusion In our study, we implement an MR compatible moving coil actuator, which can easily be controlled and which can be applied for detailed functional maps of the sensorimotor cortex for the lower extremities especially for patients with spinal cord injury and damage of the long tracts.

P 3189

Thrombosis of dural sinuses: comparison of magnetic resonance imaging (MRI) and MR-angiography (MRA) with multislice (MS)-CT and CT-angiography (CTA)

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Purpose Comparison of unenhanced MS-CT combined with CTA and the “gold standard” MRI combined with MRA in the diagnosis of dural sinus thrombosis.

Material and methods In a prospective study 71 patients with the clinical suspicion of thrombosis of dural sinuses were examined with unenhanced cerebral MS-CT combined with CTA (coll. 1mm, pitch 3, 100 ml CM, flow velocity 4 ml/sec) and with cerebral MRI (TSE T2 axial, FLAIR axial, FFE coronal, TSE T1 sagittal) combined with MRA (TOF axial, PCA sagittal/axial with flow-velocity 30 sec, with MIP-reconstruction). Three-experienced radiologist evaluated all examinations for thrombosis in cerebral sinuses and graded the detectability of the concerned cerebral veins. All patients were followed either clinically or with CT or MRI to verify the diagnosis. Interobserver agreement was calculated with kappa-statistics. Examination time of CT and MRI was compared.

Results MS-CT and CTA revealed sinus venous thrombosis in 22 patients, MRI and MRA in 20 patients. Thromboses were detected with CT in 43 dural sinuses and 13 cerebral veins and with MRI in 38 sinuses and 6 cerebral veins. One patient showed dural venous fistulas with multiple venous collaterals as complication after thrombosis of dural sinuses in CTA and MRA in equal quality. CT and MRI showed in 48 patients no dural sinus thrombosis. In 2 patients, MRI could not differentiate between hypoplasia and thrombosis of transverse sinus. The interobserver agreement was 100% with CT and 94% with MRI. The average time that the examinations lasted were 10 minutes in CT and 35 minutes in MRI.

Conclusion Thrombosis is detected with CT more accurately and with higher interobserver-agreement than with MRI. Examination time is significantly shorter with CT than with MRI.

P 3190

Blood flow and acetazolamide vasoreactivity in post-hypoxic-ischaemic amnesia: a positron emission tomographic study

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Introduction Despite extensive research it still remains controversial as to what the precise location of the critical lesions underlying amnesia actually is. The amnesic syndrome is believed to be heterogenous and due to several distinct functional deficits.

Patients and methods Two patients, a 45 year-old woman and a 56 year-old man, respectively with sudden cardio-pulmonary arrest and successful reanimation, were left with a clear amnesic syndrome as main neurological sequela. During their revalidation period, they underwent a positron emission tomographic (PET) examination, utilizing the $^{13}\text{NH}_3$ bolus technique at rest and after intravenous acetazolamide administration.

Results Both PET studies showed more or less similar features with global decrease of regional cerebral blood flow (rCBF) in frontal, temporal and parietal lobes. In addition, rCBF was increased in both thalami of the 45 year-old patient and in the basal ganglia of the 56 year-old man. Acetazolamide vasoreactivity was most lost in the frontal lobes.

Conclusions In the present PET study we demonstrated that destruction of the inhibitory pathways to thalamus and basal ganglia by hypoxic-ischaemic frontal lesions could be one of the mechanisms leading to amnesia.

P 3191

Diffusion weighted MR findings in isolated angiitis of CNS (IACNS)

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Introduction The diagnosis of isolated angiitis of CNS (IACNS) has been problematic, mainly a process of exclusion, and requires biopsy for confirmation. However, brain biopsy has limited sensitivity due to the dependency on the site of the biopsy. The new non-invasive diagnostic test is required. Diffusion weighted imaging (DWI) findings in vasculitis are rarely reported. We report DWI findings of two cases with IACNS.

Methods A 31-year old woman and a 40-year-old woman with recurrent stroke-like episodes and seizures are reported. The diagnoses of these patients were made by the multiple lesions in the conventional brain MR and the typical cerebral angiographic findings with prominent changes over a short period, negative results of the extensive search for the risk factors of atherosclerosis, embolism, systemic vasculitis and other systemic diseases. The DWIs with ADC maps were performed within 3 days after the symptom onset.

Results DWIs obtained 2 or 3 days after the symptom onset showed bright hyper-intense lesions with some slightly hyper-intense lesions. ADC values in the bright hyper-intense lesions were 399 to 551 $\times 10^{-6} \text{mm}^2/\text{s}$ that indicate cytotoxic oedema and

slightly hyper-intense lesions were 948 to 1196 $\times 10^{-6} \text{mm}^2/\text{s}$ that indicate vasogenic oedema.

Conclusion DWI with ADC map in IACNS shows heterogeneous signal intensities that suggest the various stages of inflammatory process with ischemia and allow differentiation from usual arterial infarction. DWI with ADC map can be a useful non-invasive diagnostic test increasing specificity in the diagnosis of IACNS, combined with conventional MRI and cerebral angiography.

P 3192

A rare cause of stroke: left atrial myxoma. A report of two cases

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Introduction Myxoma is the most common primary cardiac tumour. In 50% of the cases, the first manifestation of the tumour is cerebral embolisation due to thrombus formation on its villous surface. A rare complication of myxoma can be cerebral metastases and formation of aneurysm.

Materials and methods We present two middle-aged patients; a female with ictal mild right-sided hemiparesis, and a male with ictal vertigo, nystagmus, internuclear ophthalmoplegia (INO) and gait disturbances. Neither of them had any symptoms referring to a cardiac disease.

Results CT and MR showed multiple cerebral infarcts, besides there were T2 hyperintense foci in periventricular white matter and in the thalami. Transthoracic and transoesophageal echocardiography revealed the left atrial myxoma, which was treated by surgical excision.

Conclusion In case of multiple cerebral infarcts, we should think of myxoma as well as a possible cause, even if there is not cardiac symptoms or history. Early diagnosis and surgical treatment can prevent further embolisation. When myxoma is justified a careful search for cerebral metastases and aneurysm is necessary.

P 3193

Transcranial Doppler evaluation of arterial occlusive disease in aphasic patients

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Background and purpose Aphasia is a sign of cortical involvement in stroke patients, affecting the dominant hemisphere supplied by the middle cerebral artery (MCA). The diagnosis of MCA occlusion is connected with transport to radiology. In order to evaluate the localization of arterial occlusive disease, we evaluated acute aphasic stroke patients by means of transcranial Doppler (TCD).

Patients and methods We investigated 30 ischemic stroke patients admitted within 24 hours from stroke onset. All patients were right handed, except one, and fulfilled the criteria for aphasia according to the Boston Diagnostic Examination of Aphasia. TCD was performed bedside with DWL Multi Dop XL, 2 MHz transducer. Thrombolysis in brain ischemia (TIBI) criteria was applied for localization of the MCA occlusion.

Results Out of 30 patients, 6 had left M1 MCA occlusion, one right M1 MCA occlusion, 4 left M1 MCA stenosis, and 6 left M2 or M3 occlusion, and 9 hypo-perfusion. Early ischemic signs in left MCA territory were visible in 27 patients. 9 patients had left internal carotid artery (ICA) subtotal stenosis

(3 intracranial, 6 extracranial), and 7 left ICA occlusion (1 intracranial, 6 extracranial) and one right ICA occlusion.

Conclusion TCD is a useful and non-invasive method for bedside evaluation of MCA occlusive disease in acute stroke patients with aphasia.

P 3194

Three-dimensional ultrasound of the Willis circle and the vertebrobasilar system

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Background and purpose Transcranial colour-coded sonography (TCCS) is used for evaluation of the Willis circle and vertebrobasilar system (VBS). Freehanded noncontrast three-dimensional ultrasound (3D US) enables reconstructions from transcranial power Doppler (PD) imaging of the Willis circle and VBS.

Patients and methods We displayed the 3D images of the Willis circle and VBS. Data acquisition was performed using 2.5 MHz sector transducer (Aloka Prosound SSD-5500), freehanded during 10 seconds, allowing PD sonography and post processed (Tom Tec imaging systems). The technique was applied in 10 patients.

Results One patient was excluded due to inadequate bone window. TCCS enabled visualization of only colour coded flow of all circle of Willis vessels simultaneously in one patient and all vessels of the VBS was not possible at all. Post processing and skilled rotation 3D PD data sets enabled visualization of the one side of the Willis circle in all patients but two, where only part of one arterial segment couldn't be displayed. Visualization of the communicating arteries or collateral flow in patients with occlusive disease was good. Hemodynamic analysis in TCCS was indispensable for occlusive disease evaluation and collateral pathways interpretation. 3D PD enabled visualization of all three vessels of the VBS simultaneously, allowing interpretation of the BA origin (neither patient had occlusive disease of that segment).

Conclusions Noncontrast 3D US enables display of one side of the Willis circle or VBS simultaneously in most patients. TCCS and hemodynamic analysis is needed for the evaluation of the occlusive disease and interpretation of the collateral pathways.

P 3195

Effect of laser acupuncture of the visual association cortex in humans: a functional magnetic resonance imaging study

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Purpose The use and efficacy of acupuncture treatment are not yet widely accepted in western medicine. Demonstration of specific acupuncture effects on relevant structures of the human brain would facilitate acceptance of this therapeutic modality

into the practice of modern medicine. The aim of this study was to investigate the effect of laser acupuncture on the cerebral cortex.

Methods With functional Magnetic resonance imaging (fMRI) cortical activations during laser acupuncture and dummy acupuncture were compared using a block design in 10 healthy male volunteers. Therefore, we used the acupoint BL 67 (VA1), which is located on the lateral aspect of the foot and acupuncture was applied to the left foot. All experiments were done on a 1.5 Tesla MR-scanner equipped with a circular polarised head coil. Post processing was done with SPM99.

Results During laser acupuncture we found activation in the cuneus corresponding to Brodman Area (BA) 18 and the medial occipital gyrus (BA 19) of the left visual cortex. Placebo stimulation did not show any activation.

Conclusion We could demonstrate, that laser acupuncture of a specific acupoint, empirically related to ophthalmic disorders, leads to activation of visual brain areas, whereas placebo acupuncture did not. Furthermore, we got similar activation pattern like a further needle acupuncture study by Cho et al. at the same acupoint. These results indicate, that laser acupuncture has a similar effect on the cerebral cortex like needle acupuncture and thus can give further evidence for the effectiveness and therapeutic potential of laser acupuncture.

P 3196

SPECT studies in vascular dementia

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Vascular dementia is a very difficult disease for diagnosis. Owing to the new methods in last time, the diagnosis of vascular dementia is easier.

The study was performed in 37 patients in age 48–85, mean 67. SPECT and CT were carried out in all patients. In CT, it was observed two and more ischemic lesions in brain. To the group with dementia patients were classified according to criteria of DSM-IV, ICD-10, MMS and Hachinsky Ischemia Scale. Apparatus APEX SP 6 HR firm Elscint using complex of 99m-Tc-ECD performed SPECT.

Results It was observed many hypo dense lesions in all patients with dementia, especially in temporal and frontal lobes. These results were compared with CT results. It was found conformability of lesions localisation in both examinations. However, the hypo dense lesions in SPECT were bigger than lesions in CT. It was observed many ischemic lesions in SPECT, invisible in CT.

Conclusions SPECT is more sensitive examination than CT in diagnosis of vascular dementia. SPECT should be the primary examinations in diagnosis of vascular dementia in the results of CT are negative.

P 3197

Usefulness of SPECT study in TIA

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The aim of the study was to evaluate the brain perfusion differences using Single Photon Emission Computed Tomography (SPECT) in patients with transient brain ischemia. Patients with transient ischemic attacks originating from the internal carotid artery and the basilar artery were qualified for the study.

Neurological focal symptoms retreated at all patients up to 24 hours. Obtained results were compared with a control group.

The study was based on data gained in total of 50 patients (24 male, 26 female, mean age 50 years, range 37–70). The brain perfusion was assessed by SPECT examination with gamma-camera device (Elscont type Apex SP-6 HR). All patients underwent Computed Tomography (CT) and Transcranial Doppler (TCD) sonography, where no significant pathology was found. Obtained results allowed to divide patients into three groups:

I – perfusion disturbances were found in temporal lobe (14 patients),

II – perfusion disturbances in occipital lobe (11 patients),

III – no pathology was found.

Results SPECT diagnosis is one of the most sensitive methods of the brain perfusion evaluation. The brain perfusion evaluation allows finding vascular originated pathology. Multidimensional microcirculation visualization of the existing symptoms correlates with patient's clinical status.