Traditional Posters: Neuroimaging

Imaging of Dementia & Neurodegeneration

Hall B Tuesday 13:30-15:30

1938. **Degeneration of Subcortical White Matter in Alzheimer's Disease: Atlas-Based Automated Mapping and Its Diagnostic Utility Based on Multi-Variate Model**

Takashi Yoshiura[1], Akio Hiwatashi[1], Koji Yamashita[1], Hironori Kamano[1], Yukihisa Takayama[1], Eiki Nagao[1], Tuvshinjargal Dashjamts[1], Hiroshi Honda[1]
[1]Department of Clinical Radiology, Kyushu University, Fukuoka, Japan

We measured mean diffusivities (MD) in subcortical white matter (WM) in 78 different cortical regions using an atlas-based mapping method in 33 patients with Alzheimer□fs disease (AD) and 28 healthy control subjects to determine whether the topographical pattern of the diffusion abnormalities can be used to diagnose AD. Uni-variate analysis in which discrimination was attempted based on MD in the single region resulted in the accuracy of 88.5 %. Multi-variate analysis in which a linear discriminant function based on MDs from multiple cortical regions increased the accuracy up to 96.7 %.

1939. **Deterioration of Abstract Reasoning Ability in MCI and Alzheimer's Disease: Correlation with Local Gray Matter Volume Loss Using DARTEL VBM Analysis**

Takashi Yoshiura[1], Akio Hiwatashi[1], Koji Yamashita[1], Hironori Kamano[1], Yukihisa Takayama[1], Eiki Nagao[1], Tuvshinjargal Dashjamts[1], Hiroshi Honda[1]
[1]Department of Clinical Radiology, Kyushu University, Fukuoka, Japan

We estimated brain regions whose damages are responsible for the deterioration in abstract reasoning ability measured by Raven□fs colored progressive matrices (CPM) in 37 patients with Alzheimer□fs disease (AD) (n=19) and mild cognitive impairment (MCI) (n=18) using VBM with non-linear registration based on DARTEL algorithm. A multiple regression analysis was used to map the regions where gray matter volumes were correlated with CPM scores. Significant correlations were seen in 14 regions with the strongest correlation in the left middle frontal gyrus. Results suggested that damages of multiple regions are responsible for deterioration of abstract reasoning ability in AD and MCI.

1940. **MRI Shape Analysis Predicts Progression from Mild Cognitive Impairment to Alzheimer's Disease**

Donald Louis Collins[1], Vladimir Fonov[1], Simon Duchesne[2,3]
[1]McConnell Brain Imaging Center, Montreal Neurological Institute, Montreal, QC, Canada; [2]Centre de Recherche Université Laval - Robert Giffard, Quebec, Canada; [3]Dépt. de Radiologie, Faculté de Médecine, Université Laval, Quebec, Canada

A method is presented to predict conversion from mild cognitive impairment to Alzheimer's disease using shape analysis of baseline T1w MRI data. Using 100 MCI subjects from the ADNI database, PCA analysis of deformation fields required to register to a minimum deformation template is used to build a shape model of the aging brain. LDA of the eigenvalues is used to build a classifier to identify converters and non-converters. Testing with 100 additional MCI subjects demonstrates accuracies of 65% at 12 months and 64% at 24 months. Adding baseline HC volume increases accuracy to 73% and 69%, respectively.

1941. **Ultra-High Field MRS in Healthy Aging and Early Cognitive Impairment**

Mary Charlotte Stephenson[1], Mirjam I. Schubert[2], Maryam Abaei[2], Antonio Napolitano[2], Rob G. Jones[3], Peter G. Morris[1], Dorothee P. Auer[2]
[1]SPMMRC, School of Physics and Astronomy, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Academic Radiology, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [3]School of Community Healthy Sciences, University of Nottingham, Nottingham, Nottinghamshire

Metabolic profiles in the posterior cingulate cortex (PCC) have been found to be altered due to healthy aging and in many neurodegenerative diseases. The purpose of this study was to use increased spectral resolution and signal, available at higher field, to measure changes in the PCC metabolic profile due to healthy aging and cognitive impairment. Atrophy corrected levels of N-acetyl aspartate, glutamate and aspartate were found to significantly decrease with healthy aging. Levels of phosphocreatine were greatly reduced in patients with cognitive impairment, supporting a crucial role for Creatine Kinase dysfunction in dementia.

1942. **Cerebral Blood Flow in Alzheimer's Disease by Arterial Spin Labeling QUASAR**

HKF Mak[1], Queenie Chan[2], Zhipeng Zhang[1], Esben Petersen[3], Deqiang Qiu[1], Xavier Golay[4], Leung-Wing Chu[5]
[1]Diagnostic Radiology, University of Hong Kong, Hong Kong, Hong Kong; [2]Philips Healthcare; [3]Clinical Imaging Research Centre, National University of Singapore, Singapore, Singapore; [4]UCL Institute of Neurology, Univeristy College of London, United Kingdom; [5]Medicine, University of Hong Kong, Hong Kong

Arterial Spin Labeling MRI is a non-invasive method in studying cerebral blood flow, which can be used as an indirect marker of glucose metabolism. In our local Chinese cohort of 13 Alzheimer's disease (mean age- 76.3, MMSE- 16.3) and 15 cognitively normal

elderly adults (mean age- 70.8, MMSE- 28.4), QUASAR sequence showed impaired cerebral blood flow in middle & posterior cingulate, bilateral inferior frontal, bilateral superior frontal, right inferior parietal and left superior temporal gyri in AD as compared to controls. This distribution of perfusion impairment is characteristic of moderate Alzheimer's disease, analogous to regional hypometabolism in Positron Emission Tomography.

1943. Co-Analysis of Structural Imaging and DTI in Alzheimer's Disease

Valerie A. Cardenas[1,2], Duygu Tosun[1,2], Kristine Yaffe,[2,3], Bruce Miller[4], Norbert Schuff[1,2], Michael W. Weiner[1,2]

[1]Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States; [2]San Francisco VA, San Francisco, CA, United States; [3]Neurology and Psychiatry, UCSF, San Francisco, CA, United States; [4]Memory and Aging Clinic, UCSF, San Francisco, CA, United States

A voxel-wise co-analysis of structural imaging and DTI is presented and compared to analyses with a single modality only, to determine whether a multi-modality analysis detects effects due to Alzheimer's disease with greater sensitivity. Results show that co-analysis with FA does not detect greater AD-related disease than structural analysis alone.

1944. Parental History of Alzheimer Disease Predicts Abnormal White Matter in Cognitively Normal Elderly Individuals

Joseph Mettenburg[1], David N. Daniels[1], Beau Ances[2], Huiling Peng[2], Joshua Shimony[1], Abraham Z. Snyder[1], John C. Morris[2], Mark A. Mintun[1], Tammie L.S. Benzinger[3]

[1]Mallinckrodt Institute of Radiology, Washington University in Saint Louis; [2]Neurology, Washington University in Saint Louis; [3]Mallinckrodt Institute of Radiology, Washington University in Saint Louis, St. Louis, MO, United States

DT-MRI was performed on cognitively normal adults with and without a family history of dementia of the Alzheimer's type (DAT). Regional differences were identified in the corpus callosum and parietal white matter in those individuals with confirmed parental history of DAT. These findings support the hypothesis that white matter abnormalities precede the clinically apparent onset of dementia, representing either early pathophysiological changes or fundamental differences in white matter integrity which may place individuals at risk for subsequent development of Alzheimer Disease.

1945. Discrimination of Alzheimer's Disease from Cognitively Healthy Individuals: An Arterial Spin Labeling MRI Study

Mike P. Wattjes[1], Nelleke Tolboom[2], Menno Schoonheim[1], Jose Maria Garcia-Santos[1], Joost P. Kuijer[1], Bart N. M. van Berckel[3], Philip Scheltens[2], Frederik Barkhof[1], Ernesto J. Sanz-Arigita[1]

[1]Dept. of Radiology, VU University Medical Center, Amsterdam, Netherlands; [2]Dept. of Neurology, VU University Medical Center; [3]Dept. of Nuclear Medicine, VU University Medical Center

These specific perfusion patterns measured by ASL-MRI suggest fundamental differences in the brain perfusion between AD patients and cognitively healthy subjects and could contribution to the diagnoses of AD-related dementia.

1946. Resting State Functional Patterns in AD and Their Correlation with Regional Amyloid-β Distribution.

Ernesto Sanz-Arigita[1], Nelleke Tolboom[2], Jolanda Boverhoff[2], A.A. Lammertsma[2], R. Boellaard[2], M. Yaqub[2], A.D. Windhorst[2], Cornelius S. Stam[3], Philip Scheltens[4], Frederik Barkhof[5], Bart van Berckel[2]

[1]Radiology, VUmc, Amsterdam, North Holland, Netherlands; [2]Nuclear Medicine and PET Research, VUmc, Amsterdam, Netherlands; [3]Neurophysiology, VUmc, Amsterdam, Netherlands; [4]Neurology, VUmc, Amsterdam, Netherlands; [5]Radiology, VUmc, Amsterdam, Netherlands

Alzheimer-related differences in basal functional brain networks are likely be related to the regional distribution of neuropathology. To explore this relationship, we have scanned the same population of AD patients and age-matched controls both with fMRI in resting state condition and PET, employing two different amyloid-b tracers: 11C-PIB reveals the distribution of neurofibrillary tangles and 18F-FDDNP binds predominantly to amyloid plaques. The functional networks affected in AD, and the distribution of neuropathology largely overlaps. We will demonstrate the specific relationship between either type of amyloid pathology and particular functional networks.

1947. Pulsed Arterial Spin Labeling Perfusion in Healthy Aging and Early Dementia

Christine Preibisch[1], Annette Förschler[1], Afra Wohlschläger[1], Christian Sorg[2], Timo Grimmer[2], Hans Förstl[2], Alexander Kurz[2], Claus Zimmer[1], Panagiotis Alexopoulos[2]

[1]Abteilung für Neuroradiologie, Klinikum rechts der Isar der Technischen Universität München, Munich, Germany; [2]Klinik und Poliklinik für Psychiatrie und Psychotherapie, Klinikum rechts der Isar der Technischen Universität München, Munich, Germany

Problem: PASL was used to study cerebral perfusion changes in patients with MCI and AD. Methods: Resting CBF maps were obtained from 16 young (30±10a) and 15 elderly (65±5a) cognitively normal controls, 13 patients with MCI (69±9a) and 7 patients with mild dementia in AD (70.9±11.2a). Results: Hypoperfusion was detected in parietal cortex and right angular gyrus when patients were compared to controls. A significant perfusion decrease in parietal cortex and left caudate was also detected in elderly compared to young controls. Conclusion: This suggests that PASL is capable to investigate the transition from normal ageing to dementia.

***1948*. Fully-Automated MRI Quantification of Lateral-Ventricle Volume and Volume-Change in Patients with Alzheimer's Disease**

Zografos Caramanos[1,2], Vladimir S. Fonov[3], Jacqueline T. Chen,[2,3], Simon J. Francis,[2,3], Alexandre Carmel-Veilleux[3,4], Sridar Narayanan,[2,3], D Louis Collins[3], Douglas L. Arnold,[2,3]

[1]McConnell Brain Imaging Centre, Montreal Neurological Institute, McGill University, Montreal, Quebec , Canada; [2]NeuroRx Research, Montreal, Quebec, Canada; [3]McConnell Brain Imaging Centre, Montreal Neurological Institute, McGill University, Montreal, Quebec, Canada; [4]NeuroRx Research, Montreal, Quebec , Canada

Precise and accurate quantification of the volume, and longitudinal change in volume, of the lateral ventricles (LV) based on MRI data is an important goal in understanding the natural progression of neurodegenerative disorders such as Alzheimer's disease (AD) and multiple sclerosis. In the present study, we provide evidence from 270 AD patients for the accuracy of a novel, fully-automated, MRI-based technique for LV segmentation. Furthermore, we provide preliminary evidence (from a subset of 33 of these patients) for the validity and precision of two novel, fully-automated, MRI-based techniques for the estimation of longitudinal change in LV volume.

***1949*. A Study of APOE and Cerebral Perfusion in Adult Offspring of Patients with Alzheimer's Dementia Using Dynamic Susceptibility Contrast MRI**

Rachel DiAnne McKinsey[1], Zhifei Wen[1], Alan McMillian[1], Beth Meyerand[1], Sterling Johnson[2], Sean Fain[1,3], Cindy Carlsson[2]

[1]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States; [2]GRECC, Veteran Administration Hospital, Madison, WI, United States; [3]Radiology, University of Wisconsin-Madison, Madison, WI, United States

APOE and vascular dysfunction are associated with increased risk of AD. Changes in perfusion have been identified in APOE carriers verse non-carriers. The application of DSC perfusion with intravenous gadolinium contrast injection to investigate perfusion changes in AD has the ability to provide CBF, CBV, and MTT perfusion maps. We investigated the ability of DSC MRI to measure CBV, CBF, and MTT changes in non-demented children with increased risk for AD due to one or more risk factors: APOE and/or family history.

***1950*. Alteration of Integrity and Patterns of the Memory Modules in Mild Cognitive Impairment and Alzheimer's Disease**

Guangyu Chen[1], Piero Antuono[2], Shi-Jiang Li[1]

[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Neurology, Medical College of Wisconsin, Milwaukee, WI, United States

We tested a hypothesis that the integrity and organization patterns of specific modules (HIP-TP) responsible for memory processing are altered in Mild Cognitive Impairment (MCI) and Alzheimer's disease (AD) subjects, in comparison with cognitively normal (CN) subjects. HIP-TP in CN is very well organized and has highly directed connected bilateral symmetric regions, but the MCI and AD HIP-TP module have fewer directed left and right connections, and the modules are hardly symmetric and organized. There is a potential that patterns of the HIP-TP modules could be employed to distinguish MCI subjects from CN subjects.

***1951*. Dynamic Changes in Causal Strength in Memory Encoding Networks in Alzheimer's Disease Detected by Granger Causality Analysis**

Guangyu Chen[1], B. Douglas Ward[1], Shi-Jiang Li[1]

[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States

A quantitative Granger causality analysis, which can measure the causal strength among different time series, was employed to identify and quantify the directional hippocampus and default model network in cognitively normal subjects, and detect the changes in the directional network in AD patients. Interestingly in AD subjects, the functional afferents of parahippocampal gyrus is significantly decreased but the efferents of that are increased. And the abnormal network are correlated with abnormal behaviors.

***1952*. Diffusion Tensor Imaging in Patients with Alzheimer's Disease and Mild Cognitive Impairment**

Sidy Fall[1], Souraya El Sankari[2], Roger Bouzerar[3], Bertille Perin[4], Marc-Etienne Meyer[5], Olivier Baledent[3]

[1]Imaging and Biophysics, University Hospital , Amiens, Picardie, France; [2]Institute of Neuroscience, Cliniques Universitaires Saint-Luc, Brussels, Belgium; [3]Imaging and Biophysics, University Hospital, Amiens, Picardie, France; [4]Neurology , University Hospital, Amiens, Picardie, France; [5]Nuclear Medicine, University Hospital, Amiens, Picardie, France

We used DTI to investigate inferior fronto-occipital fasciculus (IFO) alterations in patients with Alzheimer's disease and Mild Cognitive Impairment (MCI). Within each group, we compared DTI parameters between the two hemispheres in IFO. We found no differences in DTI parameters between the two patients groups. Our results reveal that the longitudinal and radial diffusivities,

fractional anisotropy and apparent diffusion coefficient were significantly higher on the right lobe than on the left lobe in AD group. While, Within the MCI group, only FA and radial diffusivity were higher on the right lobe than on the left lobe.

***1953*. Association of White Matter Hyperintensities with White Matter Changes in Alzheimer's Disease as Studied by DTI**

Liya Wang[1], Felicia C. Goldstein[2], Hui Mao[1]

[1]Radiology and Emory Center for Systems Imaging, Emory University School of Medicine, Atlanta, GA, United States; [2]Neurology, Emory University School of Medicine, Atlanta, GA, United States

White matter hyperintensities (WMH) provide an additive effect is considered to be a risk factor of Alzheimer¡¯s disease (AD). We investigated which DTI indices: fractional anisotropy (FA), mean diffusivity (MD), radial diffusivity (DR) and axial diffusivity (DX) values were more sensitive to differentiate AD from normal control and how different levels of WMH may contribute to AD in specific areas of the white matter. FA and DR were helpful to discriminate AD with different grade of WMH. Different level WMH contributed AD in different regions and extent. The increased DR may provide measurement of demyelination of AD in pathology.

***1954*. Reduced Regional Fractional Anisotropy in Cognitively Normal Individuals with Biochemical and Imaging Evidence of Cerebral Amyloid Deposition**

Joseph Mettenburg[1], David N. Daniels[1], Yvette I. Sheline,[12], Beau Ances[3], Huiling Peng[3], Abraham Z. Snyder[1], John C. Morris[3], Mark A. Mintun[1], Tammie L.S. Benzinger[4]

[1]Mallinckrodt Institute of Radiology, Washington University in Saint Louis; [2]Psychiatry, Washington University in Saint Louis; [3]Neurology, Washington University in Saint Louis; [4]Mallinckrodt Institute of Radiology, Washington University in Saint Louis, St. Louis, MO, United States

Amyloid plaque deposition in the brain is one of the key pathological hallmarks of Alzheimer's disease. Recently, CSF amyloid beta42 peptide levels and PET scans using C-11 Pittsburgh Compound B (PIB) have been established as potential biomarkers for dementia of the Alzheimer's type (DAT). Using DTI, we evaluated white matter microstructure in subjects with and without established DAT and identified differences in both the corpus callosum and precuneus. The same white matter findings were identified in non-demented subjects with positive CSF and PIB-PET, suggesting that microstructural abnormalities in white matter integrity may precede cognitive changes in DAT.

***1955*. White Matter Disruption and Its Relationship with Cognitive Function and Cortical Atrophy in Alzheimer's Disease**

Hao Huang[1], Xin Fan[1], Kristin Martin-Cook[2], Guanghua Xiao[3], Laura Lacritz[4], Myron Weiner[4], Roger Rosenberg[2]

[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Department of Neurology, University of Texas Southwestern Medical Center, Dallas, TX, United States; [3]Department of Clinical Sciences, University of Texas Southwestern Medical Center, Dallas, TX, United States; [4]Department of Psychiatry, University of Texas Southwestern Medical Center, Dallas, TX, United States

The purpose of this study is to find an effective white matter biomarker of Alzheimer's disease (AD) which may indicate disease severity and progression. In this study, DTI and T1 weighted images were acquired from 38 subjects (20 AD, 18 controls). We surveyed all white matter tracts by labeling of the ICBM-DTI-81 digital atlas and correlated FA values of individual white matter tracts with cognitive testing score and cortical atrophy map respectively. The correlation analyses show that tracts in the limbic system, namely fornix and cingulum, are the most sensitive tract to cognitive testing scores and cortical atrophy.

***1956*. Quantitative 7T Relaxographic, Volumetric and DCE Assessment of Thalamic Changes in Early Alzheimer's Disease**

Valerie C. Anderson[1], David P. Lenar[1], Joseph F. Quinn[2], William J. Woodward[3], Jeffrey A. Kaye[2], William D. Rooney[3]

[1]Neurological Surgery, Oregon Health & Science University, Portland, OR, United States; [2]Neurology, Oregon Health & Science University, Portland, OR, United States; [3]Advanced Imaging Research Center, Oregon Health & Science University, Portland, OR, United States

Longitudinal water proton (^1H_2O) relaxation time constants (T_1) are strongly associated with macromolecular volume fraction. Here, we report that ^1H_2O T_1 values are increased in the thalamus of subjects with early AD compared to age-matched, cognitively normal controls. Further, we find that the increased ^1H_2O T_1 values in early AD reflect, at least in part, neurodegenerative (macromolecular loss) processes and that contributions to the increased ^1H_2O T_1 values from altered blood water content (via dilation or increased vessel density) are small.

***1957*. Dementia Induces Correlated Reductions in White Matter Integrity and Cortical Thickness: A Multivariate Neuroimaging Study with Sparse Canonical Correlation Analysis**

Brian Avants[1], Phil Cook[1], Lyle Ungar[1], James Gee[1], Murray Grossman[1]

[1]University of Pennsylvania, philadelphia, PA, United States

We present a novel, unsupervised method, sparse canonical correlation analysis for neuroimaging (SCCAN), that automatically locates correlated sets of voxels in complementary imaging modalities. The method reveals significant and syndrome-specific cortical thickness-diffusion tensor imaging networks in two neurodegenerative diseases, AD and FTD. Subject diagnosis was confirmed by autopsy or CSF-biomarker ratios. The SCCAN summary correlates, in AD, with MMSE reduction and, in FTD, with reduced verbal fluency. Thus, SCCAN identifies disease-specific networks of effects in white matter and cortical thickness that appear in anatomy suspected to be involved in these diseases and that relate specifically to impaired cognitive processes.

1958. Resting-State FMRI Contributes to Differentiate Patients with Dementia with Lewy Bodies from Those with Alzheimer's Disease

Barbara Basile[1], Mara Cercignani[1], Laura Serra[2], Roberta Perri[3], Camillo Marra[4], Lucia Fadda[3], Carlo Caltagirone[3,5], Marco Bozzali[2]

[1]Neuroimaging Laboratory, Santa Lucia Foundation, Rome , Italy, Italy; [2]Neuroimaging Laboratory, Santa Lucia Foundation, Rome, Italy, Italy; [3]Clinical and Behavioural Neurology Laboratory, Santa Lucia Foundation, Rome, Italy, Italy; [4]Department of Neurosciences, Catholic University of Rome, Roma, Italy, Italy; [5]Department of Neurosciences , University of Torvergata, Rome, Italy, Italy

Resting-state fMRI was used to investigate changes of functional connectivity (FC) within specific resting-state networks (RSNs) in the presence of Alzheimer's disease (AD) and dementia with Lewy Bodies (DLB) as compared to normal aging. Using ICA analysis, we identified 10 RSNs across subjects. AD patients revealed reduced FC in the posterior cingulate, within the default-mode-network. Conversely, DLB patients showed reduced FC in occipital areas, within the visual network. These findings respectively account for brain disconnection between medial temporal lobes and other association cortexes in the development of AD symptoms, and for occipital abnormalities potentially responsible for visual hallucinations in DLB.

1959. On Using Optimized MRS Acquisitions for Improved Mild Cognitive Impairment Diagnosis

Ileana Hancu[1], John Cowan[2], Earl Zimmerman[2]

[1]GE Global Research Center, Niskayuna, NY, United States; [2]Albany Medical Center, Albany, NY, United States

Accurate and repeatable mI measurements may offer a simple means for diagnosing or monitoring treatment in mild cognitive impairment (MCI) patients. Unfortunately, such repeatable measurements are difficult to obtain in vivo. The current report investigates the capability of CPRESS to better separate MCI subjects from normal controls (NC's). With only 12 subjects in each of the MCI and NC categories, p-values separating the two classes decrease from 0.03 to 0.002 when using CPRESS instead of a short TE PRESS sequence. The impact of more repeatable mI concentration measurements in diagnosing or monitoring MCI evolution or treatment is discussed.

1960. Classification of AD, MCI and Controls Using Large-Scale Network Analysis

Gang Chen[1], Barney Douglas Ward[1], Chunming Xie[1], Zhilin Wu[1], Wenjun Li[1], Jennifer Jones[2], Malgorzata Franczak[2], Piero Antuono[2], Shi-Jiang Li[1]

[1]Department of Biophysics,, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Department of Neurology, Medical College of Wisconsin, Milwaukee, WI, United States

There has been great interest in developing objective biologically based markers that can be used to predict risk, diagnose, stage, or track the course and treatment of dementia and other neurodegenerative diseases. Alzheimer disease (AD) is the most common form of dementia. Mild cognitive impairment (MCI) is a transitional state between normal aging and dementia, and is often considered a risk factor for AD. In this study, we employed resting-state MRI connectivity methods and the large-scale network analyses to discriminate between AD, MCI and healthy control subjects.

1961. Investigating Parkinson's Disease Using Rotating Frame MRI

Silvia Mangia[1], Timo Liimatainen[2], Igor Nestrasil[3], Michael Garwood[1], Paul Tuite[3], Dennis Sorce[1], Shalom Michaeli[1]

[1]CMRR - Dept. of Radiology, University of Minnesota, Minneapolis, MN, United States; [2]Department of Biotechnology and Molecular Medicine, A.I. Virtanen Institute for molecular Medicine, University of Kuopio, Kuopio, Finland; [3]Dept. of Neurology, University of Minnesota, Minneapolis, MN, United States

Rotating frame relaxation (T1rho and T2rho) were measured under a variety of RF pulses (namely continuous-wave, and frequency swept pulses in the adiabatic and subadiabatic regime) on twenty one Parkinson's disease (PD) subjects at 4T. Results demonstrate that different RF pulses significantly modulate the rotating frame relaxations in the substantia nigra (SN), providing the opportunity to extract fundamental parameters of the system based on theoretical modeling of the relaxation channels. The greatest sensitivity to identify sub-regions of the SN was achieved by the so-called RAFF pulse, which combines T1rho and T2rho relaxation mechanisms. Measurements from ferritin samples were additionally performed.

1962. Parkinson;¯s Disease and Imaging of the Substantia Nigra Structure with 7.0T MRI

Dae-Hyuk Kwon[1], Hye-Jin Jeong[1], Se-Hong Oh[1], Jong-Min Kim[2], Syung-Yeon Park[1], Young-Bo Kim[1], Beom-Seok Jeon[2], Zang-Hee Cho[1]

[1]Neuroscience Research Institute, Gachon University of Medicine and Science, Incheon, Korea, Republic of; [2]Movement Disorder Center, Seoul National University Hospital, Seoul, Korea, Republic of

T2* weighted MR image is influenced by iron deposition, so that SN shows up iron-related MRI contrast for all that SN is gray matter. Therefore T2* MR imaging shows great potential in PD study using ultra high field (UHF) 7.0T. And 3D T2* Gradient Echo (GE) sequence makes it possible to study a volumetric analysis and a structural morphometry for SN. This method is validated, despite the reduced SNR associated with fast imaging techniques. And 3D model of the SN shows quite well structural changes in PD case.

1963. Perfusion Networks in Parkinson's Disease Revealed Using Arterial Spin Labeling

Tracy R. Melzer[1,2], Richard Watts,[1,3], Michael R. MacAskill[1,2], Ross Keenan[4], Ajit Shankaranarayanan[5], David C. Alsop[6], Charlotte Graham[1,2], Leslie Livingston[1], John C. Dalrymple-Alford,[1,7], Tim J. Anderson[1,2]

[1]Van der Veer Institute for Parkinson's and Brain Research, Christchurch, New Zealand; [2]Medicine, University of Otago, Christchurch, New Zealand; [3]Physics and Astronomy, University of Canterbury, Christchurch, New Zealand; [4]Christchurch Radiology Group, Christchurch, New Zealand; [5]GE Healthcare, Menlo Park, CA, United States; [6]Beth Israel Deaconess Medical Center, Boston, MA, United States; [7]Pyschology, University of Canterbury, Christchurch, New Zealand

Pseudo-continuous ASL was used to investigate cerebral blood flow in 44 Parkinson's disease (PD) patients and 26 controls. Principal component analysis produced a set of covariance patterns which were used to form a perfusion network that successfully distinguished PD from control. The PD-related network was characterized by decreased perfusion in PD versus controls in bilateral posterior parietal-occipital regions, posterior medial cortices, precentral and bilateral middle frontal gyri, and left caudate. Preserved perfusion occurred in bilateral globus pallidus. This ASL-derived PD network provides a marker to objectively gauge disease severity and serves as a potential method to longitudinally track disease progression.

1964. Abnormal Spontaneous Brain Activity in Early Parkinson's Disease Revealed by ALFF Analysis

Hong Yang[1], Xu-ning Zheng[2], Yu-feng Zang[3], Yi-lei Zhao[1], Jue Wang[3], Min-ming Zhang[1]

[1]Department of Radiology, First Affiliated Hospital of College of Medical Science, Zhejiang University, Hangzhou, Zhejiang, China; [2]Department of Neurology, First Affiliated Hospital of College of Medical Science, Zhejiang University, Hangzhou, Zhejiang, China; [3]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China

Using a new biomarker, the amplitude of the low frequency fluct uation (ALFF), the current study is to explore the abnormal spontaneous neural activity of resting state in early PD. Ten early PD patients were compared with eleven gender- and age-matched controls. Data processing was performed using DPARS software. In this study, abnormal ALFF demonstrate that spontaneous neural activity in the resting state is changed in patients with early PD, furthermore, those abnormal neuronal activity should be considered in explaining findings in behavior deficits in early PD. This method is a potential tool to monitor the progression of PD.

1965. Investigation of Brain Iron Content in Patients with Parkinson's Disease Using Phase and R_2^* Obtained with Multi Echo Susceptibility Weighted Imaging

Christian Denk[1], Samantha Palmer[2], Martin J. McKeown[3], Alexander Rauscher[1]

[1]UBC MRI Research Centre, University of British Columbia, Vancouver, BC, Canada; [2]Brain Research Centre, Vancouver, BC, Canada; [3]Pacific Parkinson's Research Centre, Vancouver, BC, Canada

The main pathologic feature of Parkinson's disease (PD) is the loss of dopaminergic neurons in the substantia nigra pars compacta (Snc). There is increasing evidence that iron-mediated oxidative stress via the Fenton reaction is responsible for this loss of neurons. Iron's paramagnetism leads to changes in the relaxation rates R1, R2 and R2* and the phase of susceptibility weighted images (SWI). The aim of this study was therefore to use multi echo SWI for the investigation of both phase and R2* relaxation in deep brain structures of patients with PD. The strongest correlation with phase to the UPDRS score of -0.5 was found in the medial SN pars compacta as well as the largest phase differences between PD patients and controls. A smaller correlation was found with R2*, which is in agreement with previous studies of cerebral R2* in patients with PD.

1966. Susceptibility Mapping of the Substantia Nigra in Parkinson Patients at 7T

Andreas Schäfer[1], Derek VM. Ott[1], Almut Focke[2], Johannes Schwarz[2], Robert Turner[1], Sonja A. Kotz[1]

[1]Max-Planck-Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; [2]University Hospital Leipzig, Leipzig, Germany

Parkinsonâ€™s disease is the second most common neurodegenerative disorder in humans. It has been previously demonstrated that transverse relaxation times change in Parkinson patients, supporting pathological findings of increased iron content in the substantia nigra. However, relaxation time is a quite indirect measure of changes in iron concentration, and hard to quantify. Recent studies have used phase images to study neurodegenerative diseases, but this method has the disadvantage that field perturbation maps derived from phase data are non-local. Our study demonstrates that local susceptibility maps, directly indexing iron concentration, can be calculated from phase image data in Parkinson patients.

1967. A Single-Center, Phase 1, Open Label, Dosage-Escalation Study of Creatine Monohydrate in Subject with Amyotrophic Lateral Sclerosis

Eva-Maria Ratai[1,2], Nazem Atassi,[2,3], Stuart Wallace,[2,4], Jeffery Bombardier[1], David Greenblatt[5], Merit Cudkowicz,[2,3], Allitia Dibernardo,[2,3]

[1]Department of Radiology, A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [2]Harvard Medical School, Boston, MA, United States; [3]Neurology, Massachusetts General Hospital, Charlestown, MA, United States; [4]Psychiatry, Massachusetts General Hospital, Charlestown, MA, United States; [5]Pharmacology & Experimental Therapeutics, Tufts University School of Medicine, Boston, MA, United States

The purpose of this study was to evaluate the serum pharmacokinetics of orally administered creatine in subjects with ALS and to assess whether oral intake produces increased concentrations of creatine in the brain utilizing in vivo MR Spectroscopy. Six ALS

patients were enrolled in this open-label pilot study. Patients escalated weekly through 3 different dose levels. Creatine serum levels increased with daily use of 5, 10, 15 gm BID. MR Spectroscopy results are suggestive that creatine crosses the blood brain barrier when given at a high dose of 15 gm BID. Furthermore, glutamine and glutamate levels decreased post treatment.

1968. Cross-Sectional and Longitudinal Voxel-Based Relaxometry Study in ALS

Don Charles Bigler[1], Claire Flaherty-Craig[2], Yaman Aksu[3], Byeong-Yeul Lee[4], Kevin R. Scott[2], Helen E. Stephens[2], Jeffrey J. Vesek[5], Jianli Wang[5], Michele L. Shaffer[6], Paul J. Eslinger[2,5], Zachary Simmons[2], Qing X. Yang[5,7]

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The objectives of this study were to identify regions of T2 change in ALS cross-sectionally using VBR and determine the relationship of T2 with time, disease duration, and disease severity longitudinally. T1-weighted and multi spin-echo images were acquired from 12 control and 12 ALS at baseline, 7 at 6 months, and 6 at 12 months. After post-processing clusters of significant T2 increase cross-sectionally were found in frontal and temporal areas. Longitudinally, increased T2 was associated with disease duration mainly in frontal areas. Increased T2 in ALS is likely due to atrophy in cortical areas and acute inflammation in subcortical regions.

1969. Regional and Global Cerebral Blood Flow Is Reduced in Patients with Post-Stroke Dementia

Jiabao He[1], Michael J. Firbank[2], Rajesh N. Kalaria[2], Baldev Singh[2], Paul Danson[2], John O'Brien[2], Andrew M. Blamire[1]

[1]Newcastle MR Centre and Institute of Cellular Medicine, Newcastle University, Newcastle upon Tyne, United Kingdom; [2]Institute for Ageing and Health, Newcastle University, Newcastle upon Tyne, United Kingdom

Stroke is one of the most important risk factors for dementia. In stroke survivors who do not have immediate, severe cognitive impairment, the risk of developing dementia is significantly increased. Stroke may also exacerbate or trigger the development of neurodegenerative pathology. Small vessel vascular effects may be an important factor in neurodegeneration. We compared CBF in post-stroke patients with and without cognitive decline, patients with Alzheimer's disease and healthy controls. Regional and global deficits in CBF were found in patients with post-stroke dementia resembling patterns of change in AD patients, while cognitively intact post-stroke patients had normal CBF.

1970. The Effects of ApoE4 Allele and Age on Subcortical Brain Atrophy in HIV Positive Subjects

Linda Chang[1], Marilou Andres[2], Jeff Sadino[1], Caroline Jiang[1], Helenna Nakama[3], Ute Feger[1], Thomas Ernst[1]

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The presence of apolipoprotein (Apo) E4 allele may accelerate the progression of HIV disease, and increase the risk for developing HIV associated neurocognitive disorder (HAND). Whether Apo E4 allele and age may influence subcortical brain atrophy in HIV patients are unknown and were evaluated in this study. Smaller subcortical structures were found in HIV patients with HAND, less so in those with normal cognition. ApoE4 genotype was associated with greater atrophic effects in the younger but not older HIV patients, which suggests that ongoing neuro-inflammatory processes may be more robust and have stronger deleterious effects in the younger patients.

1971. Increased Folding Complexity of the Left Temporal Pole in Temporal Lobe Epilepsy

Natalie L. Voets[1,2], Boris C. Bernhardt[2], Hosung Kim[2], Andrea Bernasconi[2]

[1]University of Oxford FMRIB Centre, Oxford, Oxfordshire, United Kingdom; [2]Montreal Neurological Institute and Hospital, McGill University, NeuroImaging of Epilepsy Laboratory and McConnell Brain Imaging Centre, Montreal, Quebec, Canada

Converging histological and radiological data suggest neurodevelopmental abnormalities may play a role in the pathogenesis of drug-resistant temporal lobe epilepsy (TLE). Using surface-based cortical curvature measures, we identified abnormally increased cortical folding in the left temporal pole of patients with both left and right TLE as compared to healthy controls. Increased left temporopolar folding was associated with abnormal positioning of the ipsilateral hippocampus in left TLE patients, and associated with unfavourable surgical outcome in patients with a right-sided seizure focus. These results suggest abnormalities in global limbic network connectivity may play an important role in temporal lobe epileptogenesis.

1972. 1H NMR Metabolomics Study of Cerebrospinal Fluid (CSF) in Amyotrophic Lateral Sclerosis (ALS) Patients

Lydie Nadal-Desbarats[1], Helène Blasco[2], Segolene Veau[2], Patrick Vourc'h[2], Caroline Moreau[3], David Devos[3], Philippe Corcia[4], Christian R. Andres[2]

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Amyotrophic lateral sclerosis is a progressive neurodegenerative disease. Pathophysiological mechanisms involved in this disease are complex but remain for the most part unknown. This lack of knowledge might explain the absence of reliable biological marker. CSF could be a source of biomarkers. The aim of this study was to analyze CSF of patients with ALS by 1H NMR in order to identify biomarkers in the early stage of the disease, and to evaluate the biochemical factors involved in this disease. We quantified 18 metabolites like amino-acids, organic acids and ketonic bodies. Higher concentrations of metabolites such as ketone bodies contribute to the PCA separation between the two populations.

1973. T_1-Weighted Images Detect Motor Neuron Degeneration in ALS

Govind Nair[1], John D. Carew[2,3], Sharon Usher[4], Michael Benatar[4,5], Xiaoping P. Hu[1]

[1]Department of Biomedical Engineering, Emory University and Georgia Institute of Technology, Atlanta, GA, United States; [2]Institute for Health Studies, Carolinas HealthCare System, Charlotte, NC, United States; [3]School of Public Health, Emory University, Atlanta, GA, United States; [4]Department of Neurology, Emory University, Atlanta, GA, United States; [5]Department of Epidemiology, Emory University, Atlanta, GA, United States

Amyotrophic Lateral Sclerosis (ALS) is a progressive neurodegenerative disease affecting the motor neurons in the brain and spinal cord. VBM analysis performed on T1-weighted images of the brain revealed significant changes in the motor cortex and supporting white matter of ALS patients compared with age-matched healthy control subjects. ROI analysis revealed a significant decrease in signal intensity from these regions, with signal intensity of ALS group showing significant correlation with clinical measures of disease severity. These findings suggest that T1-weighted images may have utility as an imaging biomarker of disease progression in ALS.

1974. 31P and 1H MR Spectroscopic Studies on Changes of Cerebral Brain Metabolism Induced by Alcoholism and Detoxification

Ulrich Pilatus[1], Joerg Magerkurth[1], Nicole Schwan[2], Tilmann Wetterling[2], Barbara Schneider[2]

[1]Institute of Neuroradiology, University Hospital, Goethe-University, Frankfurt, Germany; [2]Department of Psychiatry, University Hospital, Goethe-University

Cerebral metabolites at day 1 and day 7 of alcohol detoxification therapy were studied using 1H and 31P spectroscopic imaging. Particularly for prefrontal brain, metabolite concentrations correlated with the withdrawal syndrome. The results suggest that less severe symptoms support neuronal recovery while a less pronounced deviation from control values for energy or membrane related compounds is correlated with more severe symptoms.

1975. Schizophrenia Impact on Perfusion Parameters: A Dynamic Susceptibility Contrast Magnetic Resonance Imaging Study.

Denis Peruzzo[1], Gianluca Rambaldelli[2,3], Alessandra Bertoldo[1], Marcella Bellani[2,3], Roberto Cerini[4], Sivlia Marini[5], Roberto Pozzi Mucelli[5], Michele Tansella[2,3], Paolo Brambilla[6,7]

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Abnormalities of Cerebral Blood Flow (CBF) and Volume (CBV) have been observed in schizophrenia patients, suggesting that a disruption of the vascular system may occur in this disease. However, cerebral perfusion is also influenced by several physiologic parameters, not necessarily connected to the pathology. We performed a DSC-MRI analysis to study the role of the demographic information on perfusion parameter estimates between patients with schizophrenia and normal control subjects. We found that differences (i.e. between-subject variability) in CBF and CBV are partially explained by the age and/or by a difference in the subject health conditions.

1976. Early Magnetic Resonance Spectroscopy Renormalized of Prefrontal Cortex and Anterior Cingulated Cortex Metabolites in Hepatic Encephalopathy After Liver Transplantation

Haiyan Lou[1], Desheng Shang[2], Minming Zhang[1]

[1]Department of Radiology, the First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, Zhejiang, China; [2]Department of Radiology, The First Affiliated Hospital, Hangzhou, Zhejiang, China

none

1977. **ARV-Mediated Changes in Viral Levels and Neuroaxonal Function Precede Improvements in Cognition in Chronically HIV-Infected Subjects.**

Margaret R. Lentz[1], Mona A. Mohamed[2,3], Hyun Kim[1], Jennifer A. Short[1], Mahaveer N. Degaonkar[2], Elkan Halpern[1], Katherine Conant[4], Ned Sacktor[5], Ola Selnes[5], Peter B. Barker[2,3], Martin G. Pomper[2]

[1]Department of Neuroradiology/A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States; [2]Russell H. Morgan Department of Radiology and Radiological Sciences, Johns Hopkins Medical Institutions, Baltimore, MD, United States; [3]F. M. Kirby Center for Functional Brain Imaging/Kennedy Krieger Institute, Johns Hopkins Medical Institutions, Baltimore, MD, United States; [4]Department of Neuroscience, Georgetown University Medical Center, Washington, DC, United States; [5]Department of Neurology, Johns Hopkins Medical Institutions, Baltimore, MD, United States

The application of combined antiretroviral (ARV) therapy has been shown to change viral and immune signaling kinetics, indicating that correlations between these and MR measures observed in cross-sectional studies may not last. MRSI, global deficit scorings (GDS) and CSF HIV RNA levels of 51 chronically HIV-infected subjects examined over 10 months of a new ARV administration were included in this study. Mixed model regression analysis indicated that later improvements in subjects' GDS were associated with earlier improvements in neuroaxonal function and CSF viral load, suggesting that ARV-mediated decreases in CSF viral levels and neuroaxonal recovery precede improvements in cognitive functioning.

1978. **Hippocampus Perfusion Studies of Gulf War Veterans Using OPTIMAL FAIR**

Xiufeng Li[1], Subhendra N. Sarkar[2], David E. Purdy[3], Qihua Lin[4,5], David M. Buhner[5], Robert W. Haley[5], Richard W. Briggs[1,5]

[1]Radiology, UT Southwestern, Dallas, TX, United States; [2]Radiology, Beth Israel Deaconess Medical Center, Boston, MA, United States; [3]Siemens Healthcare, Malvern, PA, United States; [4]Clinical Sciences, UT Southwestern Medical Center, Dallas, TX, United States; [5]Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States

To verify the previous findings and facilitate futher investigation of the pathological characteristics of Gulf War Illness, a semi-blind hippocampus perfusion study with physostigmine challenge was performed for veterans with Gulf War Syndromes 1, 2 and 3 and healthy veterans in two sessions two days apart: the first session with saline infusion and the second session with physostigmine infusion. New study results are similar to those found in the SPECT studies performed in 1997-1998, indicating that the physiological effects upon hippocampal blood flow still persist a decade later.

1979. **White Matter Abnormalities in Tourette Syndrome Extend Beyond Motor Pathways**

Irene Neuner[1,2], Yuliya Kupriyanova[3], Tony Stöcker[2,4], Oleg Posnansky[2], Marc Tittgemeyer[3], Frank Schneider[1,4], N. J. Shah[2,5]

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White matter abnormalities in patients with Tourette syndrome are investigated using diffusion tensor imaging, Tract-Based Spatial Statistics and correlation analysis. Our results indicate that TS is not restricted to motor pathways alone but affects association fibres such as the inferior fronto-occipital fascicle, the superior longitudinal fascicle and fascicle uncinatus as well. The detected abnormalities in Tourette patients complement the idea of the developmental character of the disorder. They show a pathological pattern reaching beyond the corticospinal tract. The alteration pattern of decreased fractional anisotropy and increased radial diffusivity might indicate a deficit myelination as one pathophysiologic factor in Tourette.

1980. **Persistent Basal Ganglia NAA/Cr Ratio Differences in Gulf War Illness**

Sergey Cheshkov[1,2], Audrey Chang[1], Hyeon-Man Baek[1], Sandeep Ganji[1], Evelyn Babcock[1], Richard Briggs[1,2], Robert Haley[2]

[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States; [2]Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States

Decrease in the N-acetylaspartate to creatine ratio (NAA/Cr) was previously measured via magnetic resonance spectroscopy at 1.5T in bilateral basal ganglia, pons, and in left hippocampus of Gulf War Illness patients. The Seabees cohort veterans (controls, Syndrome 1, 2, and 3 patients) studied in 1997-1998 recently participated in a follow-up study at 3T. The group comparison of this new spectroscopic data indicates reduced NAA/Cr ratio in all three Syndrome groups compared to the control group, the decrease is significant in the left and nearly significant in the right basal ganglia. This finding indicates possible neuronal damage in the affected population.

1981. Quantitative Sensory Testing FMRI: Differences Between Gulf War Illness Patients and Deployed Controls

Aman Ish Goyal[1], Parina Gandhi[1], Yan Fang[1], Lei Jiang[1], Luo Ouyang[1], Sandeep Ganji[1], David Buhner[2], Wendy Ringe[3], Kaundinya Gopinath[1,2], Richard Briggs[1,2], Robert Haley[2]

[1]Department of Radiology, UT Southwestern Medical Center, Dallas, TX, United States; [2]Department of Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States; [3]Department of Psychiatry, UT Southwestern Medical Center, Dallas, TX, United States

Previous studies have shown higher cooling and warming thresholds in hands and feet of Gulf War (GWI) veterans. In this study, brain activation to warm sensation stimuli and hot pain stimuli was measured with a quantitative sensory testing (QST) fMRI paradigm, in GWI veterans with Syndromes1 (Syn1), Syn2 and Syn3, as well as age-matched controls. Syn2 and Syn1 groups exhibited significantly decreased brain activation during warm sensation compared to controls. On the other hand, Syn2 and Syn1 groups evoked significantly higher activation to hot pain stimuli in a number of pain processing areas.

1982. Advanced Mr Imaging of Active Duty Military Personnel Following Acute Blast-Related Tbi

Christine Louise MacDonald[1], Dana Cooper[1], John Witherow[2], Abraham Snyder[3], Joshua Shimony[3], Marcus Raichle[3], Stephen Flaherty[2], Raymond Fang[2], David Brody[1]

[1]Neurology, Washington University, Saint Louis, MO, United States; [2]Landstuhl Regional Medical Center, Landstuhl, Germany; [3]Radiological Sciences, Washington University, Saint Louis, MO, United States

Military personnel have a higher rate than civilians of Traumatic Brain Injury (TBI) even during times of peace. TBI has been called the signature injury of the wars in Iraq and Afghanistan . Many of these injuries occur as the result of blast exposure, but little is known about the characteristics of blast-related TBI. Diffusion tensor imaging (DTI) was employed for this study of 85 active duty military personnel (20 control, 65 TBI). Abnormalities were found on DTI that were not apparent on conventional imaging. This is the first time this has been observed in this particular population.

1983. Transverse Relaxation Measurements of Brain Metabolites in Gulf War Illness

Audrey Jennifer Chang[1], Sergey Cheshkov[1,2], Richard Briggs[1,2], Robert Haley[2]

[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States; [2]Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States

Relaxation times are often an assumed value in spectroscopy studies, despite their potential diagnostic value and usefulness in quantifying metabolite concentrations. The purpose of this study was to measure the transverse (T2) relaxation times of the major brain metabolites (NAA, Crt, and Chot) in left and right basal ganglia of veterans with Gulf War Illness (GWI) and age-matched veteran controls to determine if the T2 values differ between ill veterans and controls or among the three syndrome variants of GWI.

1984. Reduced Hippocampal Body Functional Connectivity in Gulf War Illness

Yan Fang[1], Luo Ouyang[1], Cybeles Onuegbulem[2], Aman Goyal[1], Lei Jiang[1], Parina Gandhi[1], Sandeep Ganji[1], Wendy Ringe[2], Kaundinya Gopinath[1,3], Richard Briggs[1,3], Robert Haley[3]

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Memory loss is a common complaint among veterans with Gulf War Illness (GWI), and preliminary studies have documented hippocampal dysfunction in GWI. Abnormal functional connectivity to hippocampus has also been observed in various other diseased populations. This study used resting state or functional connectivity MRI (fcMRI) to examine functional connectivity of the hippocampus in GWI subjects. GWI veterans exhibited significantly reduced connectivity to left and right hippocampal body in a number of brain regions, indicating disruption of hippocampal networks and/or damage to hippocampus in GWI.

1985. neuGRID: A GRID-Based E-Infratructure for Data Archiving, Communication and Computationally Intensive Applications in the Medical Sciences

Keith S. Cover[1], Frederik Barkhof[1], Alex Zijdenbos[2], Christian Spenger[2], Richard McClatchey[3], David Manset[4], Lars-Olof Wahlund[5], Yannick Legre[6], Tony Solomonides[6], Giovanni B. Frisoni[7]

[1]VU University Medical Center, Amsterdam, Netherlands; [2]Prodema Medical; [3]University of the West of England; [4]MAAT G Knowledge SL; [5]Karolinska Institutet; [6]HealthGrid; [7]Fatebenefratelli

neuGRID is developing a new user-friendly Grid-based research e-Infrastructure enabling the European neuroscience community to carry out computer intensive research required for the pressing study of degenerative brain diseases (for example, the Alzheimer disease). In neuGRID, the archiving of large amounts of imaging data is paired with hundreds of CPU's and a variety of software packages. Neuroscientists will be able to identify neurodegenerative disease markers through the analysis of 3D magnetic resonance brain images via the provision of sets of distributed medical and GRID services. The infrastructure is designed to be expandable to services for other medical applications and is compliant with EU and international standards regarding data collection, data management, and Grid construction.

1986. **Accurate Mapping of Brains with Severe Atrophy Based on Multi-Channel Non-Linear Transformation**

Aigerim Djamanakova[1], Andreia V. Faria[2], Kenichi Oishi[2], Xin Li[2], Kazi Akhter[2], Laurent Younes[3,4], Peter van Zijl[2,5], Michael Ira Miller[3], Susumu Mori[2]

[1]Biomedical Engineering, Johns Hopkins School of Medicine, Baltimore, MD, United States; [2]Radiology, Johns Hopkins University, Baltimore, MD, United States; [3]Center for Imaging Science, The Johns Hopkins University, Baltimore, MD, United States; [4]Applied Mathematics & Statistics, Johns Hopkins University, Baltimore, MD, United States; [5]F.M. Kirby Center for Functional Magnetic Resonance Imaging, Kennedy Krieger Institute, Baltimore, MD, United States

We used Large Deformation Diffeomorphic Metric Mapping in order to improve the registration of brains with enlarged ventricles from patients with Alzheimer's disease . By employing a second channel of information comprised of the lateral ventricle segmentation maps, obtained semi-automatically and automatically, we were able to increase the accuracy of the mappings. The degree of accuracy was calculated by comparing the results of the manual segmentation of lateral ventricles and a neighboring structure, lingual gyrus, with the single and dual-channel registration-based segmentation. This approach can be a powerful tool for improving registration of images.

1987. **Optimization of the MPRAGE Sequence for Fully Automatic Brain Volumetry and a Comparison of Reproducibility Between Two Different Phased Array Receiver Head Coils at 3 T**

Love Erlandsson Nordin[1,2], Leif Svensson[1,2], Per Julin[3,4], Susanne Müller[5], Terri Louise Lindholm[1,2]

[1]Medical Physics, Karolinska University Hospital Huddinge, Stockholm, Sweden; [2]SMILE Image Laboratory, Karolinska University Hospital Huddinge, Stockholm, Sweden; [3]AstraZeneca R&D Neuroscience, Södertälje, Sweden; [4]Clinical Geriatrics, Karolinska University Hospital Huddinge, Stockholm, Sweden; [5]Radiology, Karolinska University Hospital Huddinge, Stockholm, Sweden

The aim of this study has been to optimize the contrast parameters of the MPRAGE sequence for fully automatic brain tissue segmentation. The goal has been to achieve as reliable and reproducible volumetric measurements of the human brain as possible. The optimization was carried out on a 3 T MRI unit using 2 different multi array head coils (12 and 32 channels) and 9 healthy young volunteers. The study also includes a comparison of the reproducibility in measurement between the two head coils. The results show that it is possible to achieve good reproducibility in measurement for the total brain volume and the 12 channel head coil gives slightly more reproducible results.

1988. **A Population-Based Template for High-Dimensional Normalization of Postmortem Human Brains from Elderly Subjects**

Robert John Dawe[1], David A. Bennett[2], Julie A. Schneider[2], Konstantinos Arfanakis[1]

[1]Department of Biomedical Engineering, Illinois Institute of Technology, Chicago, IL, United States; [2]Rush Alzheimer's Disease Center, Rush University Medical Center, Chicago, IL, United States

Postmortem MRI of the human brain offers several advantages over in vivo imaging. For example, histological analysis can be performed following the MR scan, allowing for verification of imaging findings and testing of new MRI diagnostic techniques. Spatial transformation of individual postmortem brain MRI volumes to a common reference would facilitate voxel-based investigations, which would provide information throughout the brain in a timely manner and without user bias, in contrast to ROI-based analyses. In this work, population-based methods were used to create an MRI template that is suitable for high dimensional spatial normalization of postmortem human cerebral hemispheres.

1989. **In Vivo 3D Imaging of Human Lateral Geniculate Nucleus Using Optimized Inversion Recovery Sequence at 3T and 7T**

Chan Hong Moon[1], Jung-Hwan Kim[1], JinHong Wang[1], Kyongtae Ty Bae[1]

[1]University of Pittsburgh, Pittsburgh, PA, United States

We demonstrated excellent tissue contrast of the lateral geniculate nucleus (LGN) with suppression of signals from the surrounding white matters, such as optic radiation using an (inversion-recovery) MPRAGE sequence with appropriate TI at 3T and 7T. The LGN was superiorly delineated with a high SNR at 7T, as compared to 3T. An imaging method that allows for accurate and reliable volume measurement of LGN is essential for the investigation of the association between LGN atrophy in vivo and neurodegenerative glaucoma.

1990. **Semi-Automatic Brain Ventricle Segmentation Using Partial Volume Fraction Calculation of CSF Based on Quantitative MRI**

J. B.M. Warntjes[1,2], J. West[1,3], R. Birgander[4], P. Lundberg[5]

[1]Center for Medical Imaging Science and Visualization (CMIV), Linköping, Sweden; [2]Department of Medicine and Health, Division of Clinical Physiology, Linköping, Sweden; [3], Department of Medicine and Health, Division of Radiation Physics, Linköping, Sweden; [4]Department of Radiology (NUS), Department of Radiation Sciences, Umeå, Sweden; [5]Department of Medicine and Health, Division of radiation physics, Linköping, Sweden

A method is described to measure the partial volume fraction of cerebrospinal fluid for each voxel in a complete brain volume within a scan time of 5 to 6 minutes, based on quantification of the relaxation rates R1 and R2 and proton density. This measurement allows to accurately segment the brains ventricular system independent of image resolution and without user-dependent image thresholding.

***1991*. Quantitative MR at 3.0 T of Patients with Non-Symptomatic Localization-Related Epilepsy: Association with Generalized and Partial Seizures**

Jacobus FA Jansen[1], Marielle Vlooswijk[2], H Majoie[2], Paul Hofman[2], Marc De Krom[2], Albert Aldenkamp[2], Walter H. Backes[2]

[1]Medical Physics, MSKCC, NY, United States; [2]MUMC, Maastricht, Netherlands

Although cognitive dysfunction is a prevalent co-morbidity in patients with chronic epilepsy, it is not clear whether these patients display cerebral abnormalities that are related to the cognitive impairment that can be detected with in vivo magnetic resonance (MR) techniques. This report study aims to determine neuronal determinants of cognitive impairment in patients with chronic epilepsy. Quantitative MR, comprising T2 relaxometry, diffusion tensor imaging, and spectroscopic imaging, was applied to detect possible neuronal correlates in terms of micro-structural and metabolic abnormalities.

***1992*. Deformation Based Morphometry (DBM) in Temporal Lobe Epilepsy with and Without Mesial Temporal Sclerosis**

Cathy Scanlon[1], Susanne G. Mueller[2], Duygu Tosun[2], Ian Cheong[2], Michael W. Weiner[2], Ken D. Laxer[3]

[1]Center for Imaging of Neurodegenerative Diseases , Dept. of Radiology and Biomedical Imaging, University of California,, San Francisco, CA, United States; [2]Center for Imaging of Neurodegenerative Diseases, Dept. of Radiology and Biomedical Imaging, University of California,, San Francisco, CA, United States; [3]Pacific Epilepsy Program, California Pacific Medical Center, San Francisco, CA, United States

Deformation-based morphometry (DBM) was applied to 2 sub-groups of temporal lobe epilepsy (TLE); 15 patients with mesial temporal sclerosis (TLE-mts) and 14 with normal MRI on visual inspection (TLE-no). TLE-mts demonstrated extensive extra-hippocampal abnormalities when compared with controls (n=33). TLE-no demonstrated more subtle but significant findings not previously reported with a similar analysis in voxel based morphometry (VBM). This may suggest DBM to be a more sensitive approach to detect subtle volume changes in this group.

***1993*. Quantification of Microtubule Stabilizing Drug Treatment Effect on Axonal Transport Rate in a Transgenic Mouse Model of Alzheimers Disease**

Jieun Kim[1], In-Young Choi[1,2], Mary L. Michaelis[3], Sang-Pil Lee[1,4]

[1]Hoglund Brain Imaging Center, University of Kansas Medical Center, Kansas City, KS, United States; [2]Neurology, University of Kansas Medical Center, Kansas City, KS, United States; [3]Pharmacology & Toxicology, University of Kansas, Lawrence, KS, United States; [4]Molecular & Integrative Physiology, University of Kansas Medical Center, Kansas City, KS, United States

Axonal transport impairment has been implicated as a common mechanism of Alzheimerâ€™s disease progression. A newly developed microtubule stabilizing agent, TH237-A, is known for protecting neurons against A_β toxicity, decreasing abnormal tau phosphorylation in cultured neurons, and permeating the blood-brain barrier. We have investigated the efficacy of TH237-A in preserving axonal transport integrity in an animal model of AD, 3xTg-AD mice, over one year by measuring axonal transport rates in olfactory bulbs using manganese enhanced MRI. Results show that the drug does not reverse axonal transport deficits but may be effective in preventing further axonal transport impairment.

***1994*. Imaging Correlates of Neuropsychological Tests in Minimal Hepatic Encephalopathy Due to Extrahepatic Portal Vein Obstruction**

Santosh Kumar Yadav[1], Amit Goel[2], Vivek A. Saraswat[3], Arti Srivastava[1], Sanjay Verma[4], Ram Kishore S. Rathore[5], Michael A. Thomas[6], Chandra M. Pandey[7], Kashi N. Prasad[4], Rakesh K. Gupta[1]

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Thirty-one EHPVO patients along with 23 controls were included in this study. All subjects underwent for neuropsychological tests, measurement of blood ammonia, MR imaging, 1H-MR spectroscopy. Serum cytokines were measured only in 10 patients and 8 controls. MHE was present in 45% patients. Significantly increased ammonia, Glx/Cr, and cytokines and MD with decrease in mI/Cr and MTR with no change in Cho/Cr were noted in patients with MHE compared to controls. Significantly increased Glx/Cr and blood ammonia indicates its central role in the pathogenesis of EHPVO related MHE. The presence of significant increased serum cytokines in these patients suggest that inflammation also pay an important role in the pathogenesis of MHE.

***1995*. Understanding Difference in Biochemical, Neuropsychological and Brain MR Imaging Profile of Minimal Hepatic Encephalopathy Secondary to Cirrhosis and Extrahepatic Portal Vein Obstruction**

Santosh Kumar Yadav[1], Amit Goel[2], Vivek A. Saraswat[2], R KS Rathore[3], M A. Thomas[4], A Yadav[1], K N. Prasad[5], C M. Pandey[6], Rakesh Kumar Gupta[1]

[1]Radiodiagnosis, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [2]Gastroenterology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [3]Mathematics and Statistics, Indian Institute of technology Kanpur, Kanpur, Uttar Pradesh, India; [4]Radiological Sciences, UCLA School of Medicine, Los Angeles, CA, Los Angeles, CA, United States; [5]Microbiology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [6]Biostatistics, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

Thirty-three cirrhotic MHE and 14 EHPVO MHE with 23 age/sex matched control were included in final analysis. Liver function test, NPT, CFF, blood ammonia, proinflammatory molecules, MR imaging and 1H MR spectroscopy were recorded in all patients. MHE was significantly higher in cirrhosis than EHPVO. Significantly increased blood ammonia, proinflammatory molecules, Glx/Cr and MD with decreased mIns/Cr was observed in both form of MHE as compared to controls, however Cho/Cr significantly decreased only in cirrhotic MHE as compared to EHPVO MHE and controls. Increased blood ammonia, proinflammatory molecules, Glx/Cr and MD with decreased mIns/Cr is common in both form of MHE and involved the pathogenesis of MHE, however Cho/Cr depletion was observed only in cirrhotic MHE, confirms that Cho/Cr depletion is related to liver dysfunction and is unrelated to MHE. Our study confirms that there are differences in biochemical, proinflammatory molecules and MR profile in MHE of cirrhosis and EHPVO.

***1996*. Amygdala Network Dysfunction Links Depressive Symptom and Memory Deficit in Elderly with Amnesic Mild Cognitive Impairment**

Chunming Xie[1,2], Wenjun Li[1], Joseph Goveas[1], Piero Antuono[1], Jennifer Jones[1], Guangyu Chen[1], Malgorzata Franczak[1], Zhilin Wu[1], Shi-Jiang Li[1]

[1]Medical College of Wisconsin, Milwaukee, WI, United States; [2]Neurology, School of Clinical Medicine, Southeast University, Nanjing, Jiangsu, China

The purpose of this study was to identify neural correlates of depressive symptoms and memory deficits in the amygdala functional connectivity network (AFCN) in elderly with or without amnesic mild cognitive impairment (aMCI) using the resting state functional connectivity MRI technique. aMCI subjects showed abnormal AFCN activity and the significant different correlation patterns in the distinct nodes within the AFCN correlated to depressive symptoms and memory deficits. This suggests the AFCN has dual effects that link depressive symptoms and memory deficits. The altered neural substrates of the AFCN underlying the emotional and cognitive functions mediation were associated with disease state.

***1997*. Assessing the Effect of Age on Voxel-Based Relaxometry of Epileptic Patients**

Rachel Sharkey[1,2], Robert Karl Kosior, [1,3], Paolo Federico[1,2], Richard Frayne, [12]

[1]Seaman Family MR Research Centre, Foothills Medical Centre, Calgary, AB, Canada; [2]Radiology and Clinical Neurosciences, Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada; [3]Biomedical Engineering, University of Calgary, Calgary, AB, Canada

Our objective was to assess the effect of age on T2 for voxel-based relaxometry (VBR) analysis. Regressions of T2 versus age were run on data from healthy controls with a voxel-based analysis and with regions of interest. For controls and epileptic patients, VBR was performed once with age included as a nuisance variable, and once without. The correlation was variable across the brain, and significant ($p < 0.05$) in four regions, including the hippocampus (decreasing T2 with age). Without adjusting for age, discrepancies in VBR findings are found in younger and older patients.

Normal Aging Brain

Hall B Wednesday 13:30-15:30

***1998*. A Multiparametric Study of White Matter Integrity and Cognition in Old Age**

Susana Muñoz Maniega[1], Lars Penke[2], María C. Valdés Hernández[1], Catherine Murray[2], Natalie A. Royle[1], Alan J. Gow[2], Jonathan D. Clayden[3], John M. Starr[4], Mark E. Bastin[5], Ian J. Deary[2], Joanna M. Wardlaw[1]

[1]Clinical Neurosciences, University of Edinburgh, Edinburgh, United Kingdom; [2]Psychology, University of Edinburgh, Edinburgh, United Kingdom; [3]Institute of Child Health, University College London, London, United Kingdom; [4]Geriatric Medicine, University of Edinburgh, Edinburgh, United Kingdom; [5]Medical Physics, University of Edinburgh, Edinburgh, United Kingdom

Using diffusion MRI tractography we segmented white matter tracts thought to be related with cognition in a cohort of healthy older people. We registered the tract segmentations to parametric maps of magnetization ratios and T1 relaxation times and used these parameters, as well as fractional anisotropy and mean diffusivity, to characterise the white matter integrity of the tracts. The study of how tract integrity relates to cognition in old age revealed new relationships not shown by diffusion parameters only. This work suggests that a multi-parameter approach could unravel the effects of ageing on the brain and cognition better than the lone use of diffusion MRI.

***1999*.** **Rates of Brain Tissue Changes in the General Population of Elderly - The AGES-Reykjavik Study**

Sigurdur Sigurdsson[1], Thor Aspelund[1,2], Lars Forsberg[3], Jesper Fredriksson[3], Olafur Kjartansson,[1,4], Palmi V. Jonsson,[1,4], Gudny Eiriksdottir[1], Tamara B. Harris[5], Alex Zijdenbos[6], Mark A. van Buchem[7], Lenore J. Launer[5], Vilmundur Gudnason[1,2]

[1]The Icelandic Heart Association, Kopavogur, Iceland; [2]The University of Iceland, Reykjavik, Iceland; [3]Raforninn Inc, Reykjavik, Iceland; [4]The University Hospital of Iceland, Reykjavik, Iceland; [5]The National Institute on Aging, Bethesda, United States; [6]Biospective Inc, Montreal, Canada; [7]Leiden University Medical Center, Leiden, Netherlands

Estimations on age-related rate of changes of brain tissues have mostly been gathered from cross-sectional MRI studies. A limitation of cross-sectional design is the inability to directly assess intra-individual change. Longitudinal studies on brain tissues and age in large population cohorts are lacking. We compared estimated rates of cross-sectional and longitudinal changes with age in brain tissues in a population-based cohort of 4614 older persons. The longitudinal data show a substantially higher age-related rate of change in tissue volumes when compared to the cross-sectional estimates and show that the cross-sectional data underestimates the rate of change in brain tissues.

***2000*.** **Effects of Sex and Age on Regional Frontal Lobe Gray Matter Distribution**

Vanessa Anne Sluming[1,2], Andrew Mayes[3], Iain D. Wilkinson[4], Charles Romanowski[4], Enis Cezayirli[5], Patricia E. Cowell[6]

[1]School of Health Sciences, University of Liverpool, Liverpool, Merseyside, United Kingdom; [2]Magnetic Resonance and Image Analysis Research Centre, University of Liverpool, Liverpool, Merseyside, United Kingdom; [3]School of Psychology, University of Manchester, Manchester, United Kingdom; [4]Academic Department of Radiology, University of Sheffield, United Kingdom; [5]Department of Anatomy, University of Celal Bayar , Turkey; [6]Department of Human Communication Sciences, University of Sheffield, United Kingdom

VBM analysis of grey matter distribution within the healthy adult brain was undertaken, in a sample of 31 males and 35 females (age range: 20-72 years) to investigate sex differences in the effect of brain ageing. Data were analysed using a full factorial analysis (2x2x2). There were no significant sex by age effects. Within sex regression analyses revealed that females showed age related GM decrements within several frontal regions tending medially, whereas males sowed age related decrements in bilateral structures including IFG (BA44/45). These findings are discussed.

***2001*.** **White Matter Lesion Intensity and Cognitive Ability: Relationships in Youth and Old Age**

Maria Valdés Hernandez[1], Lars Penke[2], Susana Muñoz Maniega[1], Catherine Murray[2], Natalie Royle[1], Alan J. Gow[2], John M. Starr[3], Mark E. Bastin[4], Ian J. Deary[2], Joanna M. Wardlaw[1]

[1]Clinical Neurosciences, University of Edinburgh, Edinburgh, United Kingdom; [2]Psychology, University of Edinburgh, Edinburgh, United Kingdom; [3]Geriatric Medicine, University of Edinburgh, Edinburgh, United Kingdom; [4]Medical Physics, University of Edinburgh, Edinburgh, United Kingdom

Intensity of white matter lesions (WMLs) on structural MRI may be linked to the severity of underlying white matter damage, and hence to old age cognitive decline. Here we investigate relationships between the volumes of intense (i) and less-intense (Li) WMLs in a unique cohort of ? subjects in whom cognitive ability is available in both youth (11 years) and old age (72-73 years). iWMLs were predominant located in frontal areas, while LiWMLs were mainly located posteriorly. iWMLs had a stronger relationship with cognition than LiWMLs in both youth and old age. These findings support the frontal ageing hypothesis.

***2002*.** **Investigation of Cerebral Ischemic Disease in the Aged with Aortic Stenosis**

Ping Wang[1], Elizabeth Strambrook[2], Michel Bilello[1], Thomas Floyd[3]

[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Anesthesiology & Critical Care, University of Pennsylvania, Philadelphia, PA, United States; [3]Anesthesiology & Critical Care, and Neurology, University of Pennsylvania, Philadelphia, PA, United States

To test the correlations of aging, sex, and aortic stenosis (AS) degree with the severity of pre-existing white matter and ischemia-like lesions. Aging was associated with rapidly progressive cerebral ischemic disease; female sex accounted for a 56% increased in lesion volume over men; while the severity of AS did not demonstrate statistical significance in influencing lesion volume, univariate analysis demonstrated an important trend of increasing lesion volume with increasing severity of AS.

***2003*.** **Novel Atlas-Based Technique for Longitudinal Investigation of Diffusion Tensor Tractography Data: Application to Healthy Ageing**

Ai Wern Chung[1], Rebecca A. Charlton[1], Nigel C. Lawes[2], Robin G. Morris[3], Hugh S. Markus[1], Thomas R. Barrick[1]

[1]Centre for Clinical Neuroscience, Saint George's University of London, London, United Kingdom; [2]Graduate Medical School, University of Limerick, Limerick, Ireland; [3]Department of Psychology, Institute of Psychiatry, King's College University of London, London, United Kingdom

We present a novel technique applying probabilistic diffusion tensor tractography on longitudinal data to assess white matter structural integrity in ageing subjects over a period of two years. Our method was able to consistently extract white matter tracts associated with

working memory over time and between two ageing cohorts (middle-aged and elderly). Tract connections were found between the fronto-temporal, fronto-parietal and temporo-parietal lobes. Our study suggests a decrease in white matter structural integrity of these tracts with age could be related to the decline in working memory performance.

2004. **Magnetization Transfer and Spin-Lattice Relaxation Time Measurements of White Matter Lesions in Normal Aging**

Mark E. Bastin[1], Maria Valdés Hernandez[2], Susana Muñoz Maniega[2], Catherine Murray[3], Alan J. Gow[3], Paul A. Armitage[2], Joanna M. Wardlaw[2], Ian J. Deary[3]

[1]Medical Physics, University of Edinburgh, Edinburgh, United Kingdom; [2]Clinical Neurosciences, University of Edinburgh, Edinburgh, United Kingdom; [3]Psychology, University of Edinburgh, Edinburgh, United Kingdom

White matter lesions are a common finding on T2- and FLAIR-weighted MRI scans of older subjects, but their etiology and relationship to cognitive function remains unclear. The aim of this pilot study was to characterize differences in magnetization transfer ratio and spin-lattice relaxation time between macroscopically normal-appearing white matter and white matter lesions in a subset of a unique cohort of aging subjects, the Lothian Birth Cohort 1936.

2005. **Hypertension, Arterial Health and Neuronal Integrity in Midlife**

Andreana P. Haley[1,2], Tarumi Takashi[3], Jun Sugawara[3], Hirofumi Tanaka[3]

[1]Psychology, The University of Texas at Austin, Austin, TX, United States; [2]UT Imaging Research Center, Austin, TX, United States; [3]Kinesiology, The University of Texas at Austin, Austin, TX, United States

The present study bridges the gap between midlife hypertension and late-life cognitive impairment, a relationship that has long been documented but remains poorly understood. We demonstrate that midlife hypertension and associated arterial thickening relate to cerebral measures of neuronal health and viability in middle-aged adults with intact cognitive performance.

2006. **Comparison of Brain Metabolites Changes Associated with Visual Sexual Arousal in Premenopausal and Menopausal Women: Functional MR Spectroscopy**

Tae-Hoon Kim[1], Gwang-Woo Jeong[1,2], Han-Su Baek[1], Gwang-Won Kim[1], Heoung-Keun Kang[2], Jong-Chul Yang[3], Kwangsung Park[4]

[1]Interdisplinary Program of Biomedical Engineering, Chonnam National University Medical School, Gwangju, Korea, Republic of; [2]Radiology, Chonnam National University Medical School, Gwangju, Korea, Republic of; [3]Psychiatry, Chonbuk National University Hospital, Chonbuk, Korea, Republic of; [4]Urology, Chonnam National University Medical School, Gwangju, Korea, Republic of

With menopause, women underwent changes of overall hormones, leading to functional changes of organs. A majority of menopausal women experience some exchanges in sexual function. Using fMRI technique, menopausal a few papers concerning differential brain activation patterns between premenopausal and menopausal women were published. However, it is unclear how brain metabolite change in menopause affects sexual arousal.

The purpose of this study was to investigate the brain metabolic changes associated with visual sexual arousal in premenopausal and menopausal women using functional MR spectroscopy (fMRS).

2007. **Motion Detection in Healthy Young, Middle-Aged, and Elderly Adults Using a Water Signal Based Navigator Echo: A ^{1}H MRS Study**

Sarah Andrea Wijtenburg[1], Kathleen L. Fuchs[2], Virginia I. Simnad[3], Jack Knight-Scott[1]

[1]Radiology, Children's Healthcare of Atlanta, Atlanta, GA, United States; [2]Neurology, University of Virginia, Charlottesville, VA, United States; [3]Neurology, Evergreen Hospital Medical Center, Kirkland, WA, United States

Here, we build upon our earlier work incorporating a CHESS pulse into a STEAM sequence by presenting a new method for analyzing and interpreting motion data collected from three age groups: healthy young (HY), healthy middle-aged (HM), and healthy elderly (HE). Our results show that listed in increasing order of motion during a ^{1}H MRS STEAM spectroscopy examination: HY, HM, and HE.

2008. **Cross-Site Reproducibility of ^{1}H-MRS**

Irene Margaret Vavasour[1], Cornelia Laule[1], Burkhard Maedler[2], Trudy Harris[1], David K.B. Li[1], Anthony L. Traboulsee[3], Alex L. MacKay[1]

[1]Radiology, University of British Columbia, Vancouver, BC, Canada; [2]Physics and Astronomy, University of British Columbia; [3]Medicine, Univeristy of British Columbia

Quantitative assessment of ^{1}H-MRS metabolite concentrations has the potential to be an in-vivo marker for disease progression and treatment efficacy in pharmaceutical trials. The present study examines cross-site reproducibility of ^{1}H-MRS metabolite concentrations measured on the same 5 people at 6 sites. Average percent differences of inter and intra-site reproducibility was <10% for n-acetyl-aspartate and myo-Inositol, <7% for creatine, <8% for choline and <21% for glutamate and glutamine. All percent differences between sites were of a similar magnitude increasing confidence in comparing results from across the sites.

***2009*. Aging Effects on the Functional Connectivity in the Resting Brain**

Zhengjun Li[1,2], Aniseh Kadivar[3], John Pluta[3], Holly D. Soares[4], Murray Grossman[3], John Detre[3], Ze Wang[5]

[1]Dept. of Biomedical Engineering, Shanghai Jiao Tong University, China; [2]Dept of Psychiatry, University of Pennsylvania, United States; [3]Dept of Neurology, University of Pennsylvania, United States; [4]Pfizer Inc, United States; [5]Dept of Psychiatry, University of Pennsylvania, Philadelphia, PA, United States

Functional connectivity (FC) and the default mode network represents two recent active research directions in fMRI. Previous studies have shown the aging effect in resting FC based on independent component analysis or concurrent task involved fMRI defined region-of-interests (ROIs). No published work has assessed the aging effects on resting FC in the DMN using the seed region based method. To meet this gap, we here report some preliminary results of the aging inter-region FC in the normal brain using resting fMRI and found age-dependent FC decrease in anterior cingulate cortex and posterior cingulate cortex.

***2010*. Correlation Between Venous Blood T1 and BOLD FMRI in Young and Elderly Subjects**

Lirong Yan[1], Yan Zhuo[1], Bo Wang[1], Cheng Li[2], Jiongjiong Wang[2]

[1]Institute of Biophysics, Chinese Academy of Sciences, Beijing, China; [2]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States

We investigated the relationship between in vivo measurement of venous blood T1 and BOLD signal changes during visual stimulation in two groups of young and elderly subjects. There was a significant negative correlation between venous blood T1 and BOLD activation across subjects. Upon including venous blood T1 as a covariate, the differences in BOLD activation between the two age groups weakened, suggesting that aging effects on BOLD fMRI may be partly attributed to baseline hematocrit variations.

***2011*. Increased Resting State Connectivity Between Left and Right Hemispheres with Increasing Age**

Daniel Joshua Cox[1,2], Rafat S. Mohtasib[3], Daniela Montaldi[4], Laura M. Parkes[1,2]

[1]Imaging Sciences and Biomedical Engineering, School of Cancer and Imaging Sciences, The University of Manchester, Manchester, Lancashire, United Kingdom; [2]Biomedical Imaging Institute (BII), The University of Manchester, Manchester, Lancashire, United Kingdom; [3]Magnetic Resonance and Image Analysis Research Centre (MARIARC), University of Liverpool, United Kingdom; [4]School of Psychological Sciences, The University of Manchester, Manchester, Lancashire, United Kingdom

This study aims to investigate changes in resting state functional connectivity with increasing age. 40 healthy subjects (aged 20 – 76) participated. Gradient echo EPI images were collected during a Stroop task and active regions were found across the group. The BOLD amplitude in the right middle frontal gyrus (MFG) increased with age, reducing laterality of activation. Partial correlation was used to investigate functional connectivity between bilateral MFG, which was found to increase with age between bilateral MFG in adults aged 40yrs+. Increased connectivity was also associated with improved accuracy, suggesting alterations in functional connectivity may be important for performance.

***2012*. Age-Related Effects on Resting State Default, Executive and Salience Networks Reveal Different Pruning Mechanisms – a Resting State FMRI Study.**

Vesa Kiviniemi[1], Harri Littow[1], Ahmed Abou-elseoud[1], Katariina Mankinen[2], Jukka Rahko[3], Jukka Remes[1], Juha Nikkinen[1], Tuomo Starck[1], Juha Veijola[4], Christian Beckmann[5], Osmo Tervonen[1]

[1]Diagnostic Radiology, Oulu University Hospital, Oulu, Finland; [2]Pediatric department, Oulu University Hospital, Oulu, Finland; [3]Child Psychiatry, Oulu University Hospital, Oulu, Finland; [4]Psychiatry, Oulu University, Oulu, Finland; [5]Clinical Neuroscience, Imperial College, London, United Kingdom

Resting state networks undergo various age related changes both in strength and spatial distribution. Some occur in adolescence while many changes also occur later in adulthood. A salience network splits without much strength in any age group. These different findings reflect multiple normal ageing processes of the central nervous system.

***2013*. Age-Related Differences of Brain Activation Patterns Upon Imaginary Walking**

Ekkehard Küstermann[1,2], Markus Ebke[3], Katja Dolge[4], Natascha Lohr[1], Dieter Leibfritz[2], Manfred Herrmann[1]

[1]ZKW/Neuropsychologie, Universität Bremen, Bremen, Germany; [2]Organische Chemie, Universität Bremen, Bremen, Germany; [3]Neurologie, Klinikum Bremen-Mitte, Bremen, Germany; [4]JCLLaID, Jacobs University Bremen, Bremen, Germany

The steadiness of walking decreases in elderly with advancing age. This study was designed to explore changes in the activation pattern during walking. Healthy young and elderly subjects performed imaginated walking tasks while being scanned. Elderly subjects exhibited stronger and larger activations as compared to younger subjects with a marked increase in the IPL. During imaginated walking, negative BOLD signal changes were only observed in younger, but not in elderly subjects.

***2014*. Naming Errors and Gray Matter Structural Variations**

Katie McMahon[1], Anna Holmes[2], Shiree Heath[2], Anthony Angwin[3], Lindsey Nickels[4], Eril McKinnon[2], Sophie Van Hees[2], David Copland[2,3]

[1]Centre for Magnetic Resonance, University of Queensland, Brisbane, Queensland, Australia; [2]UQ Centre for Clinical Research, University of Queensland, Australia; [3]School of Health and Rehabilitation Sciences,

University of Queensland, Australia; [4]Macquarie Centre for Cognitive Science (MACCS), Macquarie University, Sydney, NSW, Australia

The frequency of naming errors increases in normal aging. In this study we examined an elderly cohort of subjects; classified their naming difficulties and correlated this with high resolution structural MRI images. Different regions were structurally correlated for reduced semantic, phonological and visual perception errors, including the inferior temporal lobe, middle temporal lobe, and occipital-parietal regions.

2015. **Correlations Between Semantic Priming, Word Recognition and Gray Matter Density**

Katie McMahon[1], Anthony Angwin[2], Anna Holmes[3], Shiree Heath[3], Sophie Van Hees[3], David Copland,[2,3]

[1]Centre for Magnetic Resonance, University of Queensland, Brisbane, Queensland, Australia; [2]School of Health and Rehabilitation Sciences, University of Queensland, Australia; [3]UQ Centre for Clinical Research, University of Queensland, Australia

A normal elderly cohort was examined with MRI and a lexical access/semantic priming task. The priming effect (semantically related vs unrelated prime-target pairs), and the word (semantic + unrelated response times) versus non-word targets were calculated. These variables were covaried with the individual subjects' high resolution MRI images, to investigate any possible structural dependencies. Structures of areas associated with attentional and semantic priming networks were significant when compared against non-word responses, and areas of conceptual object knowledge and familiarity when compared with the priming effect.

2016. **The Hemodynamic Response Characteristics Underlying the Age-Related Change of Brain Activation During Motor Execution**

Toshiharu Nakai[1], Makoto Miyakoshi[1], Epifanio Bagarinao[1], Chikako Nakai[2], Kayako Matsuo[3]

[1]Functional Brain Imaging Lab, National Center for Geriatrics and Gerontology, Ohbu, Aichi, Japan; [2]School of Health Sciences, Toyoshashi Sozo University, Toyohashi, Aichi; [3]Psychology, National Taiwan University, Taipei, Taiwan

The characteristics of the hemodynamic response function underlying the age-related change was investigated to estimate its contribution to the statistical evaluation of fMRI by using motor tasks. It was suggested that the neuronal demanded was augmented to support cognitive processing for motor regulation rather than motor execution itself. Augmented activation in the elderly subjects mostly depended on the increased BOLD signal amplitude between the initial and post-stimulus peaks. It will be recommended to consider the potential bias induced by the non-linear dynamics of HRF to assess the age-related change of brain activation.

2017. **Differences in GABA to Creatine Ratio Between the Occipital and the Medial Pre-Frontal Cortices**

Jan Willem W. van der Veen[1], Paul J. Carlson[1], Jun Shen[1]

[1]NIH, NIMH, MAP, Bethesda, MD, United States

GABA and Glx were measured in 28 volunteers using a PRESS-based two step J editing sequence. Two voxels located in the medial prefrontal cortex (MPFC) and the occipital lobe (OCC) were studied. The GABA/Cre ratio was significantly higher ($P<0.001$) in the OCC (0.115 +/- 0.008) than in the MPFC (0.102 +/- 0.009). Co-edited Glx/Cre ratio was significantly ($P<0.001$) lower in the OCC (0.0806 +/- 0.006) than in the MPFC (0.0974 +/- 0.009). Our results, combined with previously reported Cre distribution in brain, show that there are significant differences in GABA and Glx between MPFC and OCC.

Developing Brain & TTS Abnormalities

Hall B Thursday 13:30-15:30

2018. **Optimizing a 3D Double Inversion Recovery (DIR) Protocol to Obtain Optimal Grey/White Matter Contrast in the Pediatric Brain**

Amy Louise Kotsenas[1], David W. Stanley[2], Dan W. Rettmann[3], John D. Port[1]

[1]Dept. of Radiology, Mayo Clinic, Rochester, MN, United States; [2]GE Healthcare, Proctor, MN, United States; [3]GE Healthcare, Rochester, MN, United States

The double inversion recovery (DIR) sequence supresses both cerebrospinal fluid and white matter signal which is of benefit in detecting subtle malformations of cortical development. Using the TI parameters from our adult DIR protocol did not provide optimum white matter signal suppression in pediatric patients as the T1 of the white matter varies with the degree of myelination. We were able to determine approximate TIwm values for use in DIR sequence to optimize the grey-white matter contrast in patients aged 1 year to 7.5 years. We were unable to optimize white matter suppression in children under 1 year of age.

***2019*. An Optimized, 3D, High-Resolution MR Imaging Protocol to Study In-Utero Gyrification and Myelination of the Brain of Non-Human Primate.**

Peter Kochunov[1], David Purdy[2], Duff Davis[1]

[1]Reseach Imaging Institute, UTHSCSA, san antonio, TX, United States; [2]Siemens Healthcare USA, Malvern, PA , United States

Because non-human primates (NHPs) and humans share a highly orchestrated pattern of cerebral development, imaging of fetal brain maturation in NHPs provides an excellent opportunity to validate theories regarding gyrification of the cortex. Compared to human studies, structural imaging in NHPs is challenging because of the small brain size, and spatial sampling comparable to human studies (~1.0 mm3) requires brain-size-adjusted sampling volumes of ~150 microns3. Longitudinal studies of in utero NHP brain were accomplished with a true FISP isotropic 3D protocol having superior signal-to-noise ratio, low SAR, and good contrast among gray matter, white matter, CSF, and amniotic fluid.

***2020*. Diffusion Spectrum Tractography and Histology: Developing Connectivity in the Cat Brain**

Emi Takahashi[1], Guangping Dai[2], Ruopeng Wang[2], Kenichi Ohki[3], Glenn D. Rosen[4], Albert M. Galaburda[4], Rebecca D. Folkerth[5], Van J. Wedeen[2], P. Ellen Grant[1,6]

[1]Department of Medicine, Children's Hospital Boston, Harvard Medical School, Boston, MA, United States; [2]Department of Radiology, Massachusetts General Hospital; [3]Department of Neurobiology, Harvard Medical School; [4]Department of Neurology, Beth Israel Deaconess Hospital, Harvard Medical School; [5]Department of Pathology, Childrens Hospital Boston; [6]Department of Radiology, Children's Hospital Boston

The transient subplate (SP), located just below the immature cortex, is crucial for the formation of neuronal circuits, but it has been challenging to image abundant crossings running through the SP. Using high-resolution diffusion spectrum imaging (DSI) tractography, we successfully imaged 3-dimensional cortical/subcortical pathways in P0 (newborn), P35 (pediatric), and P100 (adult) cats and compared the findings to histology. In some regions, perpendicular to the projecting pathways, emergence of long association fibers was also imaged. These results show the potential of DSI in fixed pathological specimens at any stage of myelination to provide information on developing organization and connectivity.

***2021*. Diffusion MRI of *in Utero* Mouse Embryos**

Lin Zhao[1], Scott E. Fraser[1], J. Michael Tyszka[1]

[1]California Institute of Technology, Pasadena, CA, United States

In utero MR microscopy of developing mouse embryos is complicated by maternal respiratory motion and by the general lack of tissue contrast between embryonic tissues, particularly in the CNS. We explore here the use of volumetric diffusion-weighted MR microscopy to visualize the embryonic brain in utero at later development stages.

***2022*. Prenatal MR Imaging of Focal Cortical Gyration Anomalies at Early Stage of Development**

Andrea Righini[1], Cecilia Parazzini[1], Chiara Doneda[1], Laura Avagliano[2], Filippo Arrigoni[1], Mariangela Rustico[1], Gaetano Bulfamante[2], Fabio Triulzi[1]

[1]Radiology and Neuroradiology, Children's Hospital V. Buzzi, Milan, Italy, Italy; [2]Pathology, San Paolo Hospital, Milan, Italy, Italy

We report the MRI patterns of focal cortical gyration anomalies, as they appear at a very early stage of the sulcation process (when fetal brain is almost "lyssencephalic"). 22 cases (gestational age between 21 and 24 weeks) showed focal gyration anomalies, which could be divided in four basic patterns of cortical rim distortion: "wart-like", "saw-tooth", major aberrant invaginating sulucs/i, single or multiple bumps. Most of these cases presented similarities to the rat model of experimentally induced polymicrogyria. The present cohort shows how focal cortical gyration anomalies can be detected even at very early sulcation process stage

***2023*. Fetal Imaging with Multitransmit MR at 3.0T: Preliminary Findings**

Christopher G. Filippi[1], Alisa Johnson[2], Joshua P. Nickerson[3], Betsy Sussman[4], Jay Gonyea[5], Trevor Andrews[6]

[1]Radiology, University of Vermont School of Medicine-Fletcher Allen Health Care, Burlington, VT, United States; [2]radiology, fletcher allen health care, burlington, VT, United States; [3]Radiology, Fletcher Allen Health Care, Burlington, VT, United States; [4]Radiology, Fletcher Allen Health Care-University of Vermont School of Medicine, Burlington, VT, United States; [5]Radiology, University of Vermont School of Medicine, Burlington, VT, United States; [6]Radiology, Philips Health Care, Cleveland, OH, United States

Multitransmit MR corrects B1 inhomogeneity which lessens dielectric shading, and a more uniform flip angle reduces focal SAR hot spots and allows for safe fetal MR imaging at 3.0 T for brain anomalies, and using multitransmit MR with SENSE allows for faster scan times and better signal to noise. We present 3 cases comparing 3.0T fetal MR imaging with and without multitransmit to follow-up MR imaging in the perinatal period to assess the accuracy, image quality, and clinical feasibility of multitransmit MR imaging of the fetus at 3.0T

***2024*. Fetal Cortex Extraction Using Subject Specific Priors**

Paul Aljabar[1], Mellisa S. Damodaram[2], Mary A. Rutherford[3], Daniel Rueckert[1], Joseph V. Hajnal[3]

[1]Visual Information Processing group, Department of Computing, Imperial College London, London, United Kingdom; [2] Division of Surgery, Oncology, Reproductive Biology and Anaesthetics, Imperial

College London, London, United Kingdom; [3]Robert Steiner MR Unit, Imaging Sciences Department, MRC Clinical Sciences Centre, Hammersmith Hospital, Imperial College London, London, United Kingdom

Automatic segmentation of the cortex from fetal brain MRI has potential as a significant tool in developmental neuroscience. We developed an accurate and robust method for extracting the cortex based on creating subject specific cortical priors using label propagation from automatically produced neonatal atlases. The method was tested on 12 fetal subjects with gestational age range from 20 -30 weeks, imaged using single shot Fast Spin Echo sequences with Slice to Volume (SVR) 3D reconstruction. The method was validated against manual segmentation and found to yield a mean error of 1.15±1.03mm.

2025. **White Matter Maturation of Normal Human Fetal Brain-An in Vivo Diffusion Tensor Imaging Tractography Study**

Emilie ZANIN[1], Jean-Philippe Ranjeva[1], Sylviane Confort-Gouny[1], Maxime Guye[1], Danielle Denis[2], Patrick J. Cozzone[1], Nadine GIRARD[1]

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Objective of this study was to demonstrate the ability of DTI tractography, to assess in vivo and in utero a crucial stage of human fetal brain development: the white matter maturation. We observed that evolution of diffusion characteristics during gestation were different for cortical spinal tract, optic radiations, anterior, middle and posterior part of corpus callosum reflecting the presence of structural heterogeneity between these large WM tracts during gestation. Non-linear curve fittings of normalized longitudinal and radial water diffusivities as a function of age identify 3 different phases of maturation with specific dynamics for each WM bundle type.

2026. **Birth the Hardest Journey in Life and a Brain Warping Experience. a Deformation Field Morphology Study of Fetal Brain During Labor**

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Neonates of Old World monkeys have the longest gestational development phase among comparably sized mammals, and as a consequence, neonatal heads approach the size of the birthing canal. This can lead to cephalo-pelvic limitation, a situation in which the size of the birthing canal presents a physical limit on the size and shape of neonate during parturition. An unexpected labor provided a rare opportunity to map deformations experienced by the neonatal brain during these normal contractions. A deformation field analysis produced a 3-D array of 3-D displacement vectors, showing dramatic regional deformation of the fetal brain during normal labor.

2027. **Mapping the Development of the Human Connectome**

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From birth to early adulthood the brain undergoes dramatic modifications resulting in network development and optimization. In the present study we investigate the development of the human connectome but measuring myelination trajectories of individual connections over the entire brain structural network using high b-value diffusion imaging and tractography. We found significant changes in several network measures that support increased integration and efficiency. We also observe that the network doesn't myelinate at a uniform rate but with different myelination speeds dependant on the type of cortex.

2028. **Mapping Primary Gyrogenesis. In-Utero, High-Resolution Structural MRI Study of Brain Development in Fetal Baboons**

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Primary gyrogenesis is a poorly-understood developmental process that transforms the lissencephalic cortex of a maturing mammalian brain toward its mature, gyrencephalic state by sculpting an intricate pattern of folds (gyri) and burrows (sulci). A novel in utero MRI protocol developed specifically for high-resolution imaging of fetal brain was used for precise tracking of global and regional gyrification in fetuses of baboons, information that would otherwise be difficult to obtain. These studies revealed a disparity in the growth rates of revealed a disparity of the growth rates in sulcal length and depth.

***2029*. Central and Cortical Gray Mater Segmentation of Magnetic Resonance Images of the Fetal Brain**

Meritxell Bach Cuadra[1], Marie Schaer[2], Gabriele Bonano[1], Anouk André[1], Laurent Guibaud[3], Stephan Eliez[2], Jean-Philippe Thiran[1]

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In this work we present our methodology to segment central (basal ganglia) and cortical gray mater of brain in magnetic resonance fetal imaging. This is a key step in the study of early human brain development. The results for basal ganglia segmentation are quantitatively validated in 4 cases from 29 to 32 gestational weeks. Cortical brain surface is evaluated qualitatively in a case study. Our efforts are now in testing such approach on a wider range of gestational ages that we will include in the final version of this work and studying as well its generalization to different scanners and different type of MRI sequences.

***2030*. Correction Strategy for Infants' Diffusion-Weighted Images Corrupted with Motion**

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Diffusion Tensor Imaging (DTI) offers the possibility to study the developing white matter non-invasively. However, diffusion-weighted images obtained in non-sedated infants are often corrupted with motion artifacts. We propose a post-processing methodology which takes advantage of the high diffusion orientation count and corrects these images before the computation of diffusion maps. The strategy relies on three successive steps: two steps of correction of corrupted slices (using decomposition on a spherical harmonics basis), separated by a step of 3D motion registration. This approach was validated on DTI data from 15 infants, by reliably evaluating the corpus callosum maturation with tractography-based quantification.

***2031*. Characterization of the Pig Brain as a Neuroimaging Model for Early Human Brain Development: A Combined Structural MRI and DTI Study**

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In this study, we explored the potential of the swine brain for neurodevelopmental imaging by MRI characterization of structural and microstructural changes. We collected anatomical and diffusion tensor images from 11 juvenile (1-12 wk) pigs. A significant positive logarithmic relationship existed between body weight and tissue brain volumes, as well as the surface folding index, a measure of cortical folding. Similar to humans, fractional anisotropy exhibited a logarithmic increase with body weight for all regions investigated. No mean diffusivity changes existed. These results suggest the swine brain may provide an informative model for translational studies of early human brain development.

***2032*. Quantitative Fiber Tracking in the Premature at Term Age Shows a Correlation with MRI Findings, Gestational Age and Head Circumference**

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We studied 92 prematurely born neonates (<31 weeks) at term equivalent age using quantitative Fiber Tracking (FT), generated on 3.0T MRI. Patients were divided into three groups, based on scoring of the conventional MRI's. Using a general linear model, the effects of factor (group) and variables (gestational age, birth weight and head circumference) were tested. For the FA and ADC in corpus callosum fiber bundle, a significant relation with MR group was observed. Furthermore, for the corpus callosum, volume, Cl and length depended significantly on the gestational age, suggesting an influence of age at birth on brain maturation.

***2033*. High Angular Resolution Diffusion Imaging (HARDI) Analysis of the Motor Pathway in Infants**

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High angular resolution diffusion imaging (HARDI) was used to examine white matter microstructre in 3 and 6 month old infants with a history of birth asphyxia. Residual-bootstrap probabilistic q-ball tractography was used to delineate the motor pathway. As in adults, the motor tract intersects other white matter tracts in the centrum semiovale and q-ball fiber tractography could traverse these regions. Diffusion parameters were measured in the 3D region defined by fiber tractography. This study demonstrates the feasibility of using in-vivo HARDI to discriminate complex white matter architecture in infants within a reasonable exam time.

2034. Vein Quantification of SWI in Infants with Hypoxic-Ischemic Encephalopathy (HIE)

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The use of susceptibility weighted imaging (SWI) in hypoxic-ischemic encephalopathy (HIE) can give additional information about the varying amounts of deoxyhemoglobin in cerebral veins as an indicator of metabolic stress. Abnormal levels of deoxyhemoglobin (low or high) are correlated with poor clinical outcome. This work compares different qualitative and quantitative measures of venous visibility as an indicator of deoxyhemoglobin levels and how it correlates with clinical outcome.

2035. Gender Differences in the Rate of White Matter Microstructural Development During Late Childhood and Adolescence

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There is evidence for various changes in white matter microstructure during development, in some cases specific to certain pathways. In this study we report what we believe to be the first evidence of gender differences in the rates of change of diffusion MRI parameters, in a healthy group of 8-17 year old children.

2036. Clinical Application of Readout-Segmented (RS)-EPI for Diffusion-Weighted Imaging in Pediatric Brain

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Readout-segmented (RS)-EPI has been suggested as an alternative approach to EPI for high resolution diffusion-weighted imaging (DWI) with reduced distortions. Here we implemented GRAPPA-accelerated RS-EPI DWI on 35 pediatric patients at 3T. We compared these images with standard accelerated (ASSET) EPI DWI used routinely for pediatric clinical studies. Images were categorized by resolution, distortion level, SNR, lesion conspicuity, and diagnostic confidence. RS-EPI out-performed ASSET EPI and demonstrated that it may be a useful method for DWI for evaluating lesions such as hypoxic-ischemic brain injury, diffuse axonal injury, tumors, dermoid/epidermoid, and skull base/orbital pathology.

2037. Assessment of Structural Maturation of the Optic Radiation in Children with Probalistic Tractography

Michael Dayan[1], Chris A. Clark[1]

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The optic radiation (OR) is a component of the visual pathway assumed to mature before 3 years old. This study aimed at evaluating diffusion tensor (DT) metrics within this tract, notably fractional anisotropy (FA) and radial diffusivity (RD), as a function of age, hemisphere and gender in children aged from 7 to 18. DT probabilistic tractography based on 10000 iterations was carried out for this purpose. A one sample t-test demonstrated a hemispheric dependence for RD ($p < 0.01$) but not for FA ($p > 0.96$). A multiple regression analysis did not show any gender effect for any DT indices. A significant age dependence was found for FA ($p < 0.001$) and RD ($p < 0.04$). These findings suggest an age-related effect from 7 to 18 years well after the OR is myelin mature, which suggests that maturational and/or developmental changes occur in the OR long after myelination.

2038. Anatomical Assessment of the Optic Radiation in Children with Probabilistic Tractography

Michael Dayan[1], Chris A. Clark[1]

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Temporal lobectomy, a surgical procedure notably carried out in children affected by intractable epilepsy, may be associated with visual field defects if the optic radiation (OR) is damaged. The lack of data in children on the spatial dimensions and location of this pathway with highly variable anterior aspect, Meyer's loop (ML), lead us to reconstruct the OR in children in the age range 7 to 18 with probabilistic tractography. The segmentation was assessed by computing two reference anatomical distances, the distance from ML to the temporal pole (ML-TP) and to the occipital pole (ML-OP), and comparing them with other tractography and dissection studies in adults. A one sample t-test showed a hemispheric dependence for ML-TP and ML-OP ($p < 0.02$) and a multiple regression analysis demonstrated a gender dependence but no age effect. The distances reported in this study were similar to tractography and dissection studies in adults. These data and the statistically significant dependence on gender and hemisphere are envisaged to be relevant when considering neurosurgical planning for temporal lobectomy in children.

2039. White Matter Properties Predict the Speed of Neural Processing and Cortical Maturation in Children

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We investigated age-related changes in the latency of the P100m visual response in occipital cortex and the biophysical properties of white matter in eleven healthy children to determine the impact of white matter growth on the maturation of neuronal signaling. Using TBSS, we found a significant relationship between FA and P100m latency in the dorsal processing stream. The latency of the P100m was inversely related to FA and positively related to age. Our findings suggest that simple measures of evoked latency on a visuomotor-attention task reflects dorsal stream integrity that is related to stage of cortical maturation in healthy children.

2040. Precision and Accuracy of Arterial Spin Labeling Perfusion MRI in the Pediatric Population

Varsha Jain[1], Mariel Giannetta[1], Michael Langham[1], Sharon Xie[1], Daniel Licht[1], Joan Giannetta[1], Timothy Roberts[2], John Detre[1], Hallam Hurt[2], Felix Wehrli[1], Jiongjiong Wang[1]
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We evaluated the precision and accuracy of absolute CBF measurements using two arterial spin labeling (ASL) techniques, pulsed ASL (PASL) and pseudo-continuous ASL (pCASL) in a typical developing cohort of 18 healthy children 7 to 17 years old. Longitudinal reproducibility (precision) was assessed by repeated scans 2-4 weeks apart, while accuracy was assessed by comparison with total blood flow volume measured by phase-contrast (PC) MRI at the labeling plane. The results demonstrate excellent precision (ICC=0.62) and accuracy (ICC=0.77) of quantitative CBF measured by pCASL.

2041. Optimisation of Fast Quantitative T2 Imaging of the Premature Brain: A Fantom Study

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The aim of this work was to optimize and compare different T2 sequences so we could find one suitable for quantitative study of premature newborn brain. Four sequences were tested. After mathematical correction, T2 values found for each sequence were comparable to those calculated by the reference sequence. We choose the SSFSE sequence for premature T2 maps due to its duration. This sequence was optimized in order to decrease final acquisition time. This work allowed us to create a sequence, SSFSE 4 echoes, reliable and reproducible to calculate pediatric neurologic T2 maps with duration suitable for routine clinical practice.

2042. Investigating the Need and Feasibility of Cardiac Triggering for Diffusion Imaging Data in Neonatal Subjects

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The feasibility of cardiac triggered diffusion data acquisition in a pediatric population was investigated. Data was collected with and without cardiac triggering either along the z gradient direction and then subjected to bootstrap statistics (3 subjects) or in 15 non-collinear directions and fitted to a tensor model (3 subjects). We found that cardiac triggering decreases the variability in the data without a significant increase in acquisition time in the investigated pediatric population.

2043. RF Shield Coat for Mother to Be in the Magnet with Her Child.

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For pediatric imaging, accompanying scan, in which an accompanying person wearing an RF shield coat is in the magnet with the child, was examined. Although there are two problems, peripheral nerve stimulation and SNR reduction, this technique is proved to be a feasible solution to avoid risks in pediatric imaging.

2044. Young Adults Born with Very Low Birth Weight Demonstrate Widespread White Matter Abnormalities on Brain DTI

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Preterm birth with very low birth weight (VLBW, ≤ 1500 g) is associated with reduced white matter integrity and connectivity in childhood and adolescence. These changes in white matter are correlated to motor, sensory and neuropsychological impairments. This study demonstrates that preterm birth with VLBW results in significant and long-term irreversible changes in white matter microstructure that may interfere with neuropsychological functioning. Lower birth weight and perinatal problems requiring prolonged treatment on mechanical ventilator and/or intensive care have permanent negative effects on white matter integrity.

2045. Fractional Anisotropy Correlates with Total IQ and Visual Perception in Young Adults Born with Very Low Birth Weight

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Perinatal brain injury caused by very preterm birth with very low birth weight (VLBW, ≤ 1500 g) is associated with changes in white matter integrity and connectivity, and to a variety of neurodevelopmental problems including cognitive impairments and visual perceptual deficits in childhood and adolescence. Widespread correlations between fractional anisotropy and total IQ and visual perception scores was detected in a young adult VLBW group, demonstrating the pervasive nature of the reduction in cognition and perception in this group. The results demonstrate that the neuroimpairments persist into adulthood.

2046. The Rate of Reduction in Cerebral Cortical Diffusion Anisotropy Reflects the Rate of Brain Development

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Throughout the human gestational period, morphological differentiation of cortical neurons and glial cells cause water diffusion anisotropy within the developing cerebral cortex to decrease with age. Herein, the loss of cortical fractional anisotropy (FA) reported by several research groups in five different species is referenced against a systematic comparative study of the timing of several milestones in brain development. It is found that, when the loss of cortical FA is approximated as an exponential decay with age, the time constant reflecting the rate of FA change is in agreement with independent estimates of the rate in which developmental events occur.

2047. MRI Characterization of Cleft Lip and Palate Resulting from Hedgehog Signaling Antagonism in Mice

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In utero Hedgehog (Hh) signaling antagonist exposure causes a spectrum of birth defects including holoprosencephaly (HPE) and cleft lip and palate (CLP). High resolution MRI and standard histological methodologies were used to characterize the CNS phenotype of GD16.5 mouse fetuses exposed to Hh antagonists. HPE fetuses exhibited incompletely separated cerebral hemispheres and complete pituitary and olfactory bulb agenesis. Those with CLP exhibited olfactory bulb hypoplasia and anterior pituitary aplasia. These results demonstrate phenotypic fidelity of the mouse model to known clinical phenotypes and highlight subtle CNS abnormalities as are expected to occur in a subset of clinical CLP populations.

2048. Impaired Neurodevelopmental Outcome Associated with Increased White Matter Chol/Cr in Preterm Infants

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Infants born prematurely have a higher incidence of neurodevelopmental disorders. Diffuse white matter injury is the commonest MR finding in preterm infants, and has been described qualitatively and quantitatively; the clinical correlate of diffuse white matter injury is currently unknown. In the current study raised Cho/Cr and Lac/Cr, and reduced Naa/Cho were significantly associated with composite motor outcome at 12 months corrected age, and accounted for by significant associations with gross motor development.

The raised choline could be attributed to delayed myelination, astrogliosis; the raised Lac/Cr suggests impaired oxidative phosphorylation, and the reduced Naa is in keeping with neuronal loss.

2049. Developmental Coordination Disorder: A Voxel-Based MRI Study of Neural Correlates

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Developmental Coordination Disorder (DCD) is a common childhood disease that affects roughly 6% of the population and can have a long-term impact for sufferers. The role of specific brain areas in DCD has long been postulated from behavioural studies, yet the underlying aetiology of the disease remains poorly understood. We used MRI to investigate correlations between regional brain volumes and psychometric measures in a DCD population. The research presented here provides, to the best of our knowledge, the first structural neuroimaging evidence of the role of regional brain structure in DCD.

2050. Diffusion Tensor Imaging Study of Adolescents with Spina Bifida

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Diffusion tensor imaging study was performed on adolescents with spina bifida and age matched controls. The study was aimed to detect the abnormalities in cerebral white matter microstructures in spina bifida patients. We found significantly elevated mean diffusivity of water in major white matter tracts, as well as decreased fractional anisotropy in the corpus callosum and callosal fibers. In addition, significant changes of white matter DTI parameters were observed in the cerebral hemisphere with ventricular shunt in spina bifida patients. Our study provides useful information of brain development affected by spina bifida.

2051. Ornithine Transcarbamylase Deficiency with Persistent Abnormality in Cerebral Glutamate Metabolism

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Despite effective treatment of hyperammonemia, children and adult survivors of ornithine transcarbamlyase deficiency (OTCD) a frequent enzyme defect of the hepatic urea cycle, exhibit a wide variety of neurological, neuropsychological, neuroimaging and neurochemical abnormalities. Most recently, in addition to proton MRS abnormalities o sub-clinical hepatic encephalopathy, residual deficits in glutamate neurotransmission have been identified by non-invasive 13C MRS studies after 'loading' tests with 1-13C and 2-13C glucose. The results point to a hitherto unrecognized defect in cerebral glucose metabolism. Successful therapies of this new lesion may improve long term neurological outcome for this and other defects of urea synthesis.

2052. Diffusion MRI Detects Different Developmental Trajectory in the Thalamus of Adolescents with Attention-Deficit Hyperactivity Disorder (ADHD) Compared with Typically Developing Controls

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Since the neuroanatomical basis of attention deficit-hyperactivity disorder (ADHD) is postulated to involve the frontal cortical-basal ganglia-thalamic-cerebellar circuits, we decided to examine the microstructural integrity of the thalamus in adolescents with ADHD using diffusion MRI, including a new technique called diffusional kurtosis imaging (DKI). We report that for a typically developing adolescent (12-18 yr), there are age-related diffusion changes in the thalamus, but no diffusion changes in the ADHD group, which suggest that there may be a difference in the trajectories of structural development in the thalamus between typically developing and ADHD adolescents.

2053. Cerebellar Vermis Impairment in Children Treated for Brain Malignancies

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The goal of this prospective longitudinal study in children receiving brain radiation involving the cerebellum was to evaluate vermal volumes and performance on neuropsychological tests associated with cerebellar function. In patients, lower mean vermal volumes and impaired performance on visual-spatial and fine motor tasks were detected at baseline. At 6-months post-radiation, further decrease in vermal volumes was detected in medulloblastoma patients; the vermal volumes decrease was not associated with reduction in neuropsychological performance compared to baseline. Regression analyses of the 6-months follow-up data from all subjects revealed better performance on the Purdue Pegboard tests with larger vermal volumes.

2054. Susceptibility-Weighted Imaging in Pediatric Epilepsy

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Susceptibility-weighted imaging (SWI) exploits phase shift itself to enhance contrast caused by the susceptibility differences between tissues. SWI provides high-spatial resolution, blood-oxygen-dependent contrast without requiring contrast media. We present two pediatric patients who showed prominent cortical veins with marked hypointensity on SWI in the acute stage after onset of generalized seizure. SWI findings reflect transient misery perfusion secondary to hyperexcitation in status epilpticus. SWI directly detect impaired oxygen metabolism caused by increased oxygen demand of the cerebral tissue in pediatric patients with epileptic seizures. SWI has the possibility to diagnose acute postictal encephalopathy, before cytotoxic edema occurs on DWI.

2055. Changes of Fractional Anisotropy in Ischemic White Matter in Childhood Moyamoya Disease: Correlation with Perfusion MRI.

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The purpose of this study is to evaluate the clinical relevance to FA measurement in white matter suffering from decreased perfusion in moyamoya disease, through the correlation between FA value and perfusion MRI.

In the areas of chronic hypoperfusion in Moyamoya disease, FA was decreased significantly although overt infarct was not demonstrated. Diffusion tensor imaging can be used in the assessment of intergrity of white matter suffering from chronic ischemia.

2056. Measurement of Brain Water in Children During and After Treatment for Diabetic Ketoacidosis

Michael H. Buonocore[1], Sandra L. Wootton-Gorges[2], Nathan Kuppermann[3], Ryan Caltagirone, Nicole S. Glaser

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The purpose of this study was to measure brain water in children undergoing treatment for DKA to assess cerebral edema. Brain water was measured on a 3T system using FSPGR scans with five different flip angles, followed by non-linear curve fitting to derive proton density (M0) maps, and calibrating regional M0 map values with the values from 100% water reference vials placed within the imaged volume. Results from seven children suggest that regional brain water is elevated early in the course of treatment, confirming a degree of cerebral edema. Edema increases during the course of treatment with fluids and insulin, and then resolves after the child recovers.

2057. Regional Grey-White Matter Volume Abnormalities in Children with Histories of Early Deprivation

Jeong-Won Jeong[1,2], Michael Behen[1,2], Piti Sinsoongsud[1,2], Otto Muzik, [2,3], Benjamin Wilson[1,2], Harry T. Chugani, [2,3]

[1]Pediatrics and Neurology, Wayne State University, Detroit, MI, United States; [2]PET center, Children's Hospital of Michigan, Detroit, MI, United States; [3]Pediatrics, Neurology, and Radiology, Wayne State University, Detroit, MI, United States

A previous 18FDG-PET study revealed that children with histories of institutional rearing showed significantly decreased glucose metabolism in neumerous brain regions. Dysfunction in these regions may result from severe stress of early deprivation. This study presents an atlas-based analysis to assess specific volumetric changes in predefined brain regions of the children with histories of early deprivation and examines associations between regional findings and cognitive, socioemotional, and behavioral difficulties that commonly are observed in the orphans. Significant bilateral volume reduction in grey-white matter was observed in the orphan group. It was highly correlated with their externalizing behavioral deficit and perceptual functioning.

***2058*. Aberrant Change of Arcuate Fasciculus Geometry in Children with Angelman Syndrome: Diffusion Tensor MRI Study**

Jeong-Won Jeong[1,2], Senthil Sundaram[1,2], Benjamin Wilson[1,2], Harry T. Chugani,[2,3]
[1]Pediatrics and Neurology, Wayne State University, Detroit, MI, United States; [2]PET center, Children's Hospital of Michigan, Detroit, MI, United States; [3]Pediatrics, Neurology, and Radiology, Wayne State University, Detroit, MI, United States

Angelman syndrome (AS) is a genetic disorder characterized by mental retardation, speech impairment, and gait apraxia. Speech impairment is universal but severity differs, which can be characterized by myelination delay or deficits of white matter associated with language production and conception, especially of arcuate fasciculus (AF) bridging Broca¡¯s and Wernicke¡¯s areas. This study presents new DT-MRI methodology to identify aberrant shapes of arcuate fibers and quantify abnormal tracts in terms of their geometry. We found that the AF of AS patients have steeper lateral-curvatures cauisng them not to reach Wernicke¡¯ area and also their FA values were significantly reduced.

***2059*. DTI Evaluation of Language Tracts in Autistic Patients with and Without Language Impairment Compared to Typically Developing Children**

Lidia M. Nagae[1], John Dell[1], Robert A. Zimmerman[1], Timothy P.L. Roberts[1]
[1]Radiology, Children's Hospital of Philadelphia, Philadelphia, PA, United States

The superior longitudinal fasciculus (SLF), related to language, was evaluated using diffusion tensor imaging in autistic patients, in particular in a specific group of autistics patients with language impairment (ASD/+LI), compared to autistic patients without language impairment (ASD/-LI), and typically developing children and adolescents (TD). Mean diffusivity, along with axial diffusivity were found to be increased in ASD/+LI when compared to TD. Intermediate values were obtained in ASD/-LI. These findings might reflect reported microstructural abnormalities of the brain, thought to be related to immature white matter development.

***2060*. Asymmetric Interhemispheric Fiber Tracts in Patients with Hemimegalencephaly on Difusion Tensor MRI**

Noriko Sato[1], Tomoyuki Takahashi, Miho Ota, Nakata Yasuhiro, Masayuki Sasaki
[1]National Center Hospital of Neurology and Psychiatry, Kodaira, Tokyo, Japan

Asymmetrical fiber tract distributions passing through the corpus callosum in hemimegalencephaly patients.

***2061*. Diffusion Tensor Imaging of Rostral Brain Areas in Patients with Congenital Central Hypoventilation Syndrome**

Rajesh Kumar[1], Paul M. Macey[2,3], Mary A. Woo[2], Ronald M. Harper[1,3]
[1]Neurobiology, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States; [2]School of Nursing, UCLA, Los Angeles, CA, United States; [3]Brain Research Institute, UCLA, Los Angeles, CA, United States

Congenital central hypoventilation syndrome (CCHS) patients show respiratory and autonomic deficits likely resulting from PHOX2B mutations affecting autonomic development, or from hypoxic injury. We evaluated axial- and radial-diffusivity, indicating axonal and myelin deficits, respectively, in rostral brain of CCHS. Increased radial-diffusivity emerged in the corona-radiata, internal-capsule, and corpus-callosum, suggesting myelin injury. Axial-diffusivity changes appeared in the thalamus, internal-capsule, corona-radiate, occipital, and temporal lobes, suggesting axonal deficits. Increased axial- and radial-diffusivity appeared in basal forebrain, limbic, occipital, and temporal areas, indicating myelin and axonal deficits. The mechanisms of brain injury are unknown, but likely include both hypoxic and genetic processes.

***2062*. Surface Deformation-Based Analysis of Regional Shape Variations of Hippocampus in Children with FAS**

Jesu Christopher Joseph[1], Anton Eicher[2], Christopher Warton[1], Sandra W Jacobson[3], Joseph L Jacobson[3], Christopher D Molteno, Patrick Marais[2], Ernesta M Meintjes[1]
[1]Human Biology, University of Cape Town, Cape Town, Western Cape, South Africa; [2]Computer Science, University of Cape Town, Cape Town, Western Cape, South Africa; [3]Psychiatry and Behavioral Neurosciences, Wayne State University, Detroit, United States

The main objective of this work is to assess the shape variations of the hippocampus structure between control and FAS affected children. For this High-resolution structural MRI images were acquired of 12 children aged 9-12 years on a 3T Siemens Allegra Scanner (6 controls and 6 FAS). Hippocampi were manually delineated. The entire structure of the hippocampus was divided into three regions, namely head, body and tail. A point distribution model, which represents the mean geometry of a shape using landmark points, was used to capture the true geometry of the hippocampus. Approximately 2366 landmark points were used. Principal Component Analysis (PCA) was used to study correlations of movement between groups of landmark points among the control children who were used as the training set and to assess the geometric variations between the healthy and exposed subjects.

2063. A Realistic Model of Brain Tissue in Case of Hydrocephalus: Application of MRI, DTI and MRE

Kamal Shahim[1], Ralph Sinkus[2], Jean-Marie Drezet[1], Shahan Momjian[3], jean-francois Molinari[4]

[1]LSMX, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Vaud, Switzerland; [2]Laboratoire Ondes et Acoustique, ESPCI, Paris, France; [3]University Hospitals of Geneva and University of Geneva, Switzerland; [4]LSMS, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Vaud, Switzerland

Hydrocephalus is a cerebral disease wherein the brain ventricles dilate and the parenchyma is stressed. In order to study this condition, a finite element model is built using the geometries of the ventricles and the skull measured by MRI. DTI is used to establish the fiber direction and the local frame. Indeed, elasticity data based on MRE is incorporated into the constitutive equation. The brain parenchyma is modeled as a porous medium. Under an applied pressure gradient, Isotropic and Transverse Isotropic models are tested and compared together. The transmission of the applied pressure is substantially influenced by the anisotropy and inhomogeneity of brain parenchyma.

2064. Abnormal Brain Tissue Sodium Metabolism on MRI After Cardiac Arrest in Children

Ericka L. Fink[1,2], Patrick M. Kochanek[1,2], Ashok Panigrahy[3], Fernando E. Boada[4,5]

[1]Critical Care Medicine, Children's Hospital of Pittsburgh of UPMC, Pittsburgh, PA, United States; [2]Safar Center for Resuscitation Research, Pittsburgh, PA, United States; [3]Radiology, Children's Hospital of Pittsburgh of UPMC, Pittsburgh, PA, United States; [4]Radiology, UPMC, Pittsburgh, PA, United States; [5]Magnetic Resonance Research Center, Pittsburgh, PA, United States

In two children with cardiac arrest, tissue sodium concentration was increased in regions of the brain that are most vulnerable to hypoxia-ischemia and reperfusion (basal ganglia and occipitoparietal cortex), representing prolonged or delayed deranged brain tissue Na metabolism.

2065. Diffusional Kurtosis Imaging Assessment of Tuberous Sclerosis Complex

Vitria Adisetiyo[1], Sarah S. Milla[2], Howard Weiner[3], Caixia Hu[2], Ali Tabesh[2], Jens H. Jensen[1,2], Joseph A. Helpern[1,2]

[1]Neuroscience and Physiology, New York University School of Medicine, New York, NY, United States; [2]Radiology, New York University School of Medicine, New York, NY, United States; [3]Neurosurgery, New York University School of Medicine, New York, NY, United States

Tuberous Sclerosis Complex (TSC) is a rare genetic disease that manifests in the CNS as cortical/subcortical tuber lesions consisting of abnormal dysplastic neurons. Tubers are presumed to contribute to epileptogenesis and to developmental delays in TSC. Given several reports of "silent" tubers with active surrounding perilesion tissue, we applied Diffusional Kurtosis Imaging (DKI) to quantitatively characterize the microstructure of tubers as compared to surrounding perilesion and normal appearing contralateral tissue in TSC patients aged 2-10 years and age-matched controls. Region of interest analysis found that only tubers are associated with significant increase in diffusivity and substantial decrease in microstructural heterogeneity.

2066. Fetal Brain During a Binge Drinking Episode. a Dynamic Susceptibility Contrast Fetal Brain Perfusion Study.

Peter Kochunov[1], Carlos Castro[2], Gerald Schatten[3], David Purdy[4], Hsiao-Ying Wey[1], Duff Davis[1]

[1]Reseach Imaging Institute, UTHSCSA, san antonio, TX, United States; [2]Ob / Gyn and Reproductive Sciences, University of Pittsburgh School of Medicine, Pittsburgh, PA, United States; [3]Pittsburgh Development Center, University of Pittsburgh School of Medicine, Pittsburgh, PA, United States; [4]Siemens Healthcare USA, Malvern, PA , United States

While the teratogenic properties of alcohol are well known, the mechanisms by which alcohol-induced damage is produced in the CNS are still largely unknown. We present findings of changes in dynamic susceptibility contrast (DSC) in fetal brain of a non-human primate (baboon) during a protocol designed to approximate a binge drinking episode. Signal changes in the brain and uterus/placenta were compared using a pulse sequence protocol with high temporal and spatial resolution, showing that gadodiamide entered fetal cerebral circulation following alcohol administration.

Multiple Sclerosis

Hall B Monday 14:00-16:00

2067. **7 Tesla 3D-FLAIR and 3D-DIR: High Sensitivity in Cortical Regions in Multiple Sclerosis**

Wolter L. de Graaf[1], F. Visser[2,3], M. P. Wattjes[1], J. Geurts[4], P. Pouwels[5], C. H. Polman[6], F. Barkhof[1], P. R. Luijten[2], J. A. Castelijns[1]

[1]Radiology, VU University Medical Center, Amsterdam, Netherlands; [2]Image Science Institute, University Medical Center Utrecht, Utrecht, Netherlands; [3]PHILIPS Healthcare; [4]Pathology, VU University Medical Center, Amsterdam, Netherlands; [5]Physics and Medical Technology, VU University Medical Center, Amsterdam, Netherlands; [6]Neurology, VU University Medical Center, Amsterdam, Netherlands

MR diagnostics in Multiple Sclerosis have benefited from sequences like fluid attenuated inversion recovery (FLAIR) and double inversion recovery (DIR), that increase sensitivity especially in cortical regions. We demonstrate use of 3D (isotropic) FLAIR, DIR and T1-weighted clinically feasible imaging at 7 Tesla. Images were read for the number of lesions visible in the regular classifications for the several sequences. Results were also compared with images obtained from the same patients at 3 Tesla. A large sensitivity increase especially in cortical regions was found at 7 Tesla for all 3D sequences. 3D-FLAIR however, proofed to be the most sensitive.

2068. **3D Magnetization Prepared Double Inversion Recovery (3D MP-DIR) at 7 Tesla**

Frederik Visser[1,2], Jaco J M Zwanenburg[1], Wolter L. de Graaf[3], J A. Castelijns[3], Peter R. Luijten[1]

[1]UMC, Utrecht, Netherlands; [2]PHILIPS Healthcare; [3]VU UMC Amsterdam

Dedicated magnetization preparation pre-pulses (MP) have been designed to acquire high resolution 3D DIR images covering the whole brain at 7-Tesla.The ability to detect sub-millimeter cortical and/or sub cortical lesions has great potential for future clinical studies.

2069. **Cortical Lesions in MS: Assessment at 7T**

Kathrine T. Bluestein[1], Cherian Renil Zachariah[1], Steffen Sammet[1], Devin Elizabeth Prior[1], David Pitt[2], Aaron Boster[2], Amir Abduljalil[1], Michael V. Knopp[1], Petra Schmalbrock[1]

[1]Department of Radiology, The Ohio State University, Columbus, OH, United States; [2]Department of Neurology, The Ohio State University, Columbus, OH, United States

Assessment of cortical lesions in MS is of significant interest, because correlation of conventional MRI with clinical findings is limited. However, detection of cortical lesions has been hampered by their small size and low contrast. In this study, we assessed cortical lesion detection in 7 MS patients and healthy controls at 7T using high resolution 3D T2* weighted, white matter attenuated (WHAT) turbo field echo and T1-weighted IR-TFE imaging. Cortical lesions were best seen with the WHAT sequence, and there was little reader variability.

2070. **High Resolution Magnetization Transfer Imaging at 7T : Detection of Cortical Lesions in MS Patient**

Olivier E. Mougin[1], Jennifer Dixon[1], Ian Donaldson[2], Emma Tallantyre[2], Nikos Evangelou[2], Penny A. Gowland[1]

[1]Sir Peter Mansfield Magnetic Resonance Centre, School of Physics & Astronomy,University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Institute of Neuroscience, Nottingham, Nottinghamshire, United Kingdom

This study aims to detect cortical lesions in MS patients. High resolution MTR scans (0.5mm isotropic, as well as 0.35mm in plane resolution) have been acquired at 7T using a novel imaging sequence. The MTR contrast has been compared between white matter and grey matter, showing a greater grey matter (GM) / white matter (WM) contrast to noise ratio at 7T, providing a good delineation of WM and GM lesions at high resolution with the MTR contrast. The sequence is being used to study changes in the cortex of MS patients.

2071. **Surface-Based Analysis of Subpial T2*signal Changes at 7T in Multiple Sclerosis**

Julien Cohen-Adad[1,2], Douglas Greve[1,2], Thomas Benner[1,2], Amy Radding[1,2], R Philip Kinkel,[2,3], Bruce R. Rosen[1,2], Bruce Fischl[1,2], Caterina Mainero[1,2]

[1]A. A. Martinos Center for Biomedical Imaging, Dept. of Radiology, MGH, Charlestown, MA, United States; [2]Harvard Medical School, Boston, MA, United States; [3]Beth Israel Deaconess Medical Center, Boston, MA, United States

The ability to detect and to classify in vivo gray matter (GM) lesions in multiple sclerosis (MS) is required to better understand pathological processes associated with disease progression and disability. In this paper we combined ultra high field MRI (7T) with surface-based analysis to achieve quantitative assessment of subtle and diffuse cortical changes in multiple sclerosis (MS). Results show a significant increase of the T2* signal in MS patients versus controls. This increase may reflect the diffuse subpial pathology that has been described in autopsy cases of MS. Surface-based analysis facilitates the characterization of cortical lesions in vivo.

2072. What Does (Quantitative) MRI of the MS Cortical Gray Matter Measure? a Post Mortem Imaging Exploration.

Alexandra Marion Seewann[1,2], Hugo Vrenken[3,4], Evert-Jan Kooi[5], Paul van der Valk[5], Dirk Knol[6], Chris Polman[1], Petra Pouwels[4], Frederik Barkhof[3], Jeroen Geurts,[3,5]

[1]Neurology, VU University medical center, Amsterdam, Netherlands; [2]Neurology, Medical University Graz, Graz, Austria; [3]Radiology, VU University medical center, Amsterdam, Netherlands; [4]Physics and Medical Technology, VU University medical center, Amsterdam, Netherlands; [5]Pathology, VU University medical center, Amsterdam, Netherlands; [6]Epidemiology and Biostatistics, VU University medical center, Amsterdam, Netherlands

Only few lesions in cortical gray matter (CGM) of multiple sclerosis (MS) patients can be visualized with conventional MRI. Quantitative MRI techniques are more sensitive to cortical damage, but the histopathological correlates of quantitative MRI changes in the MS CGM are unclear. We aimed to define the underlying pathology of cortical quantitative MRI changes, and to compare MRI visible and invisible lesions by histopathology. 16 brain slices from 10 chronic MS patients were imaged with qualitative and quantitative MRI at 1.5T. Regions of interests were correlated with histopathology.
Quantitative MRI measurements reflect the extent of cortical demyelination. Conspicuity of cortical GM lesions on conventional MRI is determined by lesional size.

2073. Quantification of Formalin-Fixed MS Brain Tissue Parameters T1, T2*, PD and Phase at 7T and Comparison with Histopathology

Cherian Renil Zachariah[1], David Pitt[2], Peter Wassenar[1], Bradley D. Clymer[1], Amir Abduljalil[1], Michael V. Knopp[1], Petra Schmalbrock[1]

[1]Radiology, The Ohio State University, Columbus, OH, United States; [2]Neurology, The Ohio State University, Columbus, OH, United States

Depiction of cortical demyelination in MS is still hampered by low contrast, spatial resolution and specificity.This study applies T2*-gradient echo and inversion recovery turbo field echo (IR-TFE) sequences 7T to image formalin-fixed tissue specimen and measure T1,T2*,PD and phase differences. We notice that PD maps and phase maps may be promising for enhancing cortical lesion depiction . Following MRI, specimen were cut and labeled with anti-myelin basic protein antibodies to detect myelin and with anti-CD68 antibodies to detect activated macrophages/microglia. Scanned histology slides were scored for cortical lesions and compared to MRI

2074. MRI Texture Correlates of Pathological Findings in Post-Mortem Multiple Sclerosis Brain

Yunyan Zhang[1,2], GR Wayne Moore[1], Cornelia Laule[1], Thorarin A. Bjarnason[2], Piotr Kozlowski[1], Alex L. Mackay[1], Anthony L. Traboulsee[1], David K. B. Li[1]

[1]University of British Columbia, Vancouver, BC, Canada; [2]University of Calgary, Calgary, AB, Canada

Ten post-mortem brain samples from 3 MS subjects were imaged at 7T. Regions of interest were marked on histological sections staining for myelin and axon, then were matched on MR images including lesions (14), normal appearing white matter (NAWM, 12) and regions of reduced myelin and axon (rLrB). MRI texture analysis based on polar Stockwell Transform (PST) was performed. Texture was highest in lesions, intermediate in rLrB and lowest in NAWM ($p < 0.01$) providing evidence that texture abnormality associates with tissue pathology. PST analysis may be a potential tool to quantify tissue integrity in MS or other neurological disorders.

2075. Evaluating MACC for Improved MS Rater Agreement

David S. Wack[1], Michael G. Dwyer[1], Niels Bergsland[1], Sara Hussein[1], Robert Zivadinov[1]

[1]University at Buffalo, Buffalo Neuroimaging Analysis Center, Buffalo, NY, United States

The software method of Minimum Area Contour Change (MACC) is evaluated for use to improve same scan inter-rater agreement for the delineation of T2 hyper-intense MS lesions; and for the application of ROIs to follow up time points. The MACC method improves inter-rater agreement, and performs about on par with another rater for the purpose of drawing lesion ROIs on a follow-up scan.

2076. Lesion Recognition in Multiple Sclerosis: A Sequence Comparison and Quantification Study at 3T

Tobias Kober[1,2], Cristina Granziera[3,4], Delphine Ribes[1,2], Patrick Browaeys[5], Myriam Schluep[6], Katrin Wohlfarth[7], Reto Meuli[5], Gunnar Krueger[2]

[1]Laboratory for functional and metabolic imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Advanced Clinical Imaging Technology, Siemens Suisse SA - CIBM, Lausanne, Switzerland; [3]Department of Neurology, Hôpitaux Universitaires de Genève, Lausanne, Switzerland; [4]Brain and Mind Institute, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [5]Department of Radiology, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland; [6]Department of Neurology, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland; [7]H IM MR PLM AW Neurology, Siemens AG, Erlangen, Germany

Detection and radiological characterisation of multiple sclerosis (MS) lesions is an essential part both of clinical diagnosis and MS research. Ten early-stage MS patients and ten controls were included in this study aiming at (i) comparing five different high-resolution imaging sequences (FLAIR, MP-RAGE, DIR, SPACE, MP2RAGE) and (ii) quantifying T1 relaxation times of lesions with

respect to their location in the brain. Results suggest that the DIR sequence is the most sensitive for total lesion count, followed by the MP2RAGE. Confirming previous studies, T1 relaxation times were found to be overall prolonged.

2077. Pre-Filling MS Lesions on T1 and T2-Weighted Images for Improved Tissue Segmentation

Jonathan S. Jackson[1,2], Declan Chard[2], Antonia Ceccarelli[1], Elisa Dell'Oglio[1], Ashish Arora[1], Mohit Neema[1], Rohit Bakshi[1], David Miller[2], Claudia Angela Michela Wheeler-Kingshott[2]

[1]Laboratory for Neuroimaging Research, Brigham & Women's Hospital, Harvard Medical School, Brookline, MA, United States; [2]Department of Neuroinflammation, UCL Institute of Neurology, London, United Kingdom

Robust lesion in-painting has been demonstrated on T1 and T2-weighted images. Many automated algorithms rely on accurate histograms for segmentation; therefore this approach to lesion WM correction based on the global histogram is appropriate and strongly recommended as a pre-processing step for MS images.

2078. A New MRI Analysis Method for Lesional Heterogeneity Characterisation in Multiple Sclerosis as Demonstrated by Quantitative MRI.

Marios C. Yiannakas[1], Daniel J. Tozer[1], Declan T. Chard[1], David H. Miller[1], Claudia A.M Wheeler-Kingshott[1]

[1]UCL - Institute of Neurology, London, United Kingdom

In this work a new MR analysis method is presented which utilises conventional FSE dual echo data sets with the use of advanced images algebra (ADIMA) in order to enhance the dynamic range in the image with a consequent enhancement of lesional heterogeneity in MS lesions. It is found that the images show bright and dark lesions indicating heterogeneity of pathological process. Masks of these bright and dark lesions are applied to MRI parameter maps and it is found that the corresponding areas on MTR, T1 and T2 maps show different values, corresponding to the two lesion types.

2079. Characterization of Multiple Sclerosis Lesions Through a Quantitative Study of Perfusion Using a Gadolinium Contrast Agent

Ryan Griffin[1], Adam Brandenberry[1], Jiachao Liang[1], Christopher Murphy[1], Trenton Rink[1], Joe Konrad[1], Xiangyu Yang[1], Michael Knopp[1], Steffen Sammet[1]

[1]Radiology, The Ohio State University, Columbus, OH, United States

The purpose of this study was to use Dynamic Contrast Enhanced MRI at 3T to quantitatively study the perfusion of MS lesions. Using Brix's two compartment model, we found statistically significant differences in the mean extracted values of the pharmacokinetic values *Amp* and k_{el} of enhancing lesions with respect to those from normal appearing brain tissue, as well as a statistically significant difference in the mean extracted value of *Amp* from hypointense lesions with respect to normal appearing brain tissue. Rising enhancement after the initial uptake of gadolinium (indicated by a negative k_{el} value) was observed for every enhancing lesion.

2080. Altered Brain Perfusion and Tissue Injury in Early Multiple Sclerosis Assessed by ASL and MTR Statistical Mapping Analyses

Wafaa Zaaraoui[1], Françoise Reuter[1], Mathias Lemaire[1], Audrey Rico[1], Anthony Faivre[1], Virginie Callot[1], Irina Malikova[1], Elisabeth Soulier[1], Sylviane Confort-Gouny[1], Patrick J. Cozzone[1], Jean Pelletier[1], Bertrand Audoin[1], Jean-Philippe Ranjeva[1]

[1]Faculté de Médecine, CRMBM UMR CNRS 6612, Marseille, France

Recent studies have evidenced the crucial role of perfusion alteration in multiple sclerosis (MS). However, little is known about the relationships between hemodynamical parameters and local tissue damage encountered at all stages of the disease, and especially at the early phase. To investigate the putative relationships between perfusion alterations and structural local white matter and grey matter impairments in early MS, we designed a MR protocol combining statistical mapping analyses of arterial spin labeling (ASL) data and magnetization transfer ratio (MTR) data obtained in 12 patients with clinically isolated syndromes (CIS) and 12 matched controls.

2081. Identifying the Start of Multiple Sclerosis Tissue Injury: A Longitudinal DTI Study

Robert J. Fox[1], Daniel Ontaneda[1], Xiofeng Wang[2], Ken Sakaie[3], Jian Lin[3], Mark J. Lowe[3], Michael D. Phillips[3]

[1]Mellen Center for MS, Cleveland Clinic, Cleveland, OH, United States; [2]Quantitative Health Sciences, Cleveland Clinic, Cleveland, OH, United States; [3]Radiology, Cleveland Clinic, Cleveland, OH, United States

We used HARDI DTI in a longitudinal study of multiple sclerosis patients to identify changes in brain tissue prior to the development of acute inflammation (gadolinium enhancement). We found significantly decreased fractional anisotropy (FA) up to 10 months prior to the development of gadolinium-enhancing lesions. Changes in FA were driven an increase in transverse diffusivity, while longitudinal diffusivity remained unchanged. This study provides evidence for impaired myelin integrity up to 10 months prior to development of gadolinium enhancement.

***2082*. Corpus Callosum Atrophy and Diffusion Abnormalities in Clinically Isolated Syndrome Revealed by Diffusion Tensor Tractography**

Fuchun Lin[1], Chunshui Yu[2], Yaou Liu[2], Hao Lei[1]

[1]Wuhan Institute of Physics & Mathematics, The Chinese Academy of Sciences, Wuhan, Hubei, China; [2]Department of Radiology, Xuanwu Hospital of Capital Medical University, Beijing, China

Diffusion tensor based group tractography was used to determine the corpus callosum (CC) integrity in clinically isolated syndrome (CIS). Compared to the healthy subjects, the CIS patients had significantly reduced midsagittal CC area, and significantly higher MD, λ_1, λ_{23} and significantly lower FA in the entire CC. Moreover, the average FA of the normal-appearing CC of the CIS patients correlated negatively with the whole-brain lesion load while the other three diffusion indices correlated with the lesion load positively. These results suggested that both the morphology and the microstructure of the CC appear to be damaged at the stage of CIS.

***2083*. Characterization of Early White Matter Damages in Multiple Sclerosis Patients with a Clinically Isolated Syndrome: A Tract Based Spatial Statistics Study**

Salem Hannoun[1,2], Françoise Durand-Dubief, [1,3], Christian Confavreux[3], Dominique Sappey-Marinier[1,2]

[1]CREATIS-LRMN, University of Lyon 1, Lyon, Rhone-Alpes, France; [2]CERMEP-Imagerie du Vivant, Bron, Rhone-Alpes, France; [3]Neurological Hospital, Lyon, Rhone-Alpes, France

This study aims to characterize early pathological processes occurring in twelve multiple sclerosis (MS) patients with a clinically isolated syndrome (CIS) compared to relapsing remitting (RR) patients and control subjects using tract-based spatial statistics (TBSS). Significant alterations of diffusivity including FA decrease, and axial (ëa) and radial (ër) diffusivities increases, were found in extensive white matter regions of CIS patients, with ër being the most affected. If ër alterations may reflect the demyelinating processes occurring in MS, ëa can be more evocative of late appearing axonal damage as confirmed by the increase of ëa in RR compared to CIS patients.

***2084*. Correlation of Clinical Parameters and DTI Imaging Features in Multiple Sclerosis**

Carli Jessica Lehr[1], Mustafa Okan Irfanoglu[1], Firdaus Janoos, Steffen Sammet[1], Michael V. Knopp[2]

[1]Department of Radiology, The Ohio State University, Columbus, OH, United States; [2]Department of Radiology, OSU, Columbus, OH, United States

Diffusion Tensor Imaging plays an important role in the quantitative analysis of Multiple Sclerosis lesions. This study investigates the correlation between clinical parameters and DTI imaging features such as FA, ADC, lesion volumes, and tract connectivity. DTI derived features provide better correlations to clinical scores than conventional MRI-based characteristics. The strongest correlations were found when all DTI imaging features were analyzed together against clinical data values. This illustrates the usefulness of comprehensive DTI imaging features in analyzing clinical deficits in Multiple Sclerosis.

***2085*. Effect of Gradient Resolution in Diffusion Tensor Imaging on the Appearance of Multiple Sclerosis Lesions at 3T**

Mustafa Okan Irfanoglu[1], Raghu Machiraju[1], Michael V. Knopp[1], Steffen Sammet[1]

[1]Department of Radiology, The Ohio State University, Columbus, OH, United States

Diffusion Tensor Imaging proved to be a useful modality for the diagnosis of Multiple Sclerosis. However, the quality of the DTI-derived scalar maps and tractography is directly dependent on experimental design. In clinical settings, scan time is a major constraint and not many diffusion weighted volumes can be acquired. In this work, we analyze the effects of gradient resolution on the appearance of multiple sclerosis regions. Results indicate that with increasing number of gradients, statistics based on lesion scalar map distributions becomes more stable and spending extra minutes might be beneficial if DTI is to be assessed for diagnosis.

***2086*. Radial Diffusivity in Remote Optic Neuritis Discriminates Visual Outcomes**

Junqian Xu[1], Robert T. Naismith[1], Nhial Tutlam[1], Kathryn M. Trinkaus[2], Sheng-Kwei Song[3], Anne Cross[1]

[1]Neurology, Washington University in St. Louis, St. Louis, MO, United States; [2]Biostatistics, Washington University in St. Louis, St. Louis, MO, United States; [3]Radiology, Washington University in St. Louis, St. Louis, MO, United States

We studied 70 remote optic neuritis (ON) patients using the previously described high-resolution reduced field-of-view optic nerve diffusion tensor imaging protocol at 3 T. Radial diffusivity (RD) strongly correlated with visual functional assessments, retinal nerve fiber layer thickness, and visual evoked potential. RD also discriminated nerves with normal recovery from those with mild visual impairment, and those with mild impairment from profound visual loss. In addition, RD differentiated healthy controls from both the clinically affected nerves and unaffected fellow nerves after ON. RD differentiated all categories of 5% contrast sensitivity (CS) outcomes, and all categories of Pelli-Robson CS with the exception of normal recovery from mildly affected.

2087. Low Contrast Visual Stimuli Yield Differential Volumes of Functional MRI Activation in Affected and Unaffected Eyes Following Recovery from Optic Neuritis

Robert A. Bermel[1], Jeffrey A. Cohen[1], Lael A. Stone[1], Blessy Mathew[2], Mark J. Lowe[2], Michael D. Phillips[2]

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Optic neuritis (ON) is caused by inflammatory demyelination in the optic nerve, commonly as an early component of multiple sclerosis (MS). Recovery from ON is variable, facilitated by mechanisms which may include remyelination and cortical reorganization. We used visual fMRI with stimuli at three different contrast levels to investigate cortical activation following ON in 6 patients with MS and remote unilateral ON. Differences in cortical activation between affected and unaffected eyes were most apparent when utilizing the lower contrast visual stimulus. We conclude that low-contrast visual fMRI may be sensitive to detect cortical changes following ON.

2088. Quantitative Fast T1 Mapping at 7 Tesla: Initial Results in Multiple Sclerosis Patients and Healthy Controls

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In Multiple Sclerosis, T1 mapping has shown to be able to differentiate normal from normal appearing grey and white matter. At high field, T1 relaxation times increase and therefore it is expected that changes in brain tissue due to multiple sclerosis become more pronounced. A fast T1 mapping sequence of 4.5 minutes with an in-plane resolution of 1x1 mm2 and slice thickness of 1.5 mm is applied at 7 Tesla to assess the sensitivity of the method at high field. Patients as well as healthy controls are examined and whole brain histograms and analysis of specific brain regions are made.

2089. *In Vivo* Quantitative Evaluation of Multiple Sclerosis Progression Using Gradient Echo Plural Contrast Imaging Technique

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One reason for the weak correlation between conventional MRI (based on T1/T2 weighted images) and clinical findings is the inability of conventional MRI to quantify the extent of tissue damage. In this study, we demonstrated that an efficient method based on GEPCI technique not only depicts MS lesions similar to conventional T1w and FLAIR images, but also allows quantitative evaluation of disease progression. Combining characteristics of main peak in R2* histograms and quantitative score assigned to MS lesions, allows the evaluation not only of the volume of cerebral MS lesions, but incorporates the degree of tissue damage as well.

2090. Absolute Quantification of Myelin Related Volume in the Brain

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A method is described to measure the myelin related volume fraction for each voxel for a complete brain within a scan time of 5 to 6 minutes, based on absolute quantification of the relaxation rates R1 and R2 and proton density. The absolute decrease of visible PD with a simultaneous increase of R1 and R2 corresponds to an increase of myelin. Myelin related volume is correlated with Fractional Anisotropy maps and conventional T1W, T2W and FLAIR images. Repeated measurements show a standard deviation of 1-2% in myelin volume for the whole brain.

2091. Changes in Multiple Sclerosis Over 6 Months as Seen with T2 Relaxation and Diffusion Histograms

Irene Margaret Vavasour[1], Shannon Heather Kolind[2], Cornelia Laule[1], Burkhard Maedler[3], David K.B. Li[1], Anthony L. Traboulsee[4], Alex L. MacKay[1,3]

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Twelve multiple sclerosis subjects and 12 healthy age and gender matched controls were scanned twice at a 6 month interval to compare histograms derived from normal white matter (NWM), normal appearing white matter (NAWM) and multiple sclerosis lesions. Myelin water fraction (MWF), geometric mean T_2 (GMT_2), fractional anisotropy, mean diffusivity and the eigenvalues were measured. Mean MWF and GMT_2 histograms did not differ between the two time points although histograms from NWM, NAWM and lesions were different. Histograms from the diffusion metrics differed slightly between month 0 and 6. T_2 relaxation and diffusion metrics give complementary information about MS tissue.

2092. **Myelin Water Fraction Reduction in Multiple Sclerosis Normal Appearing White Matter: Where Are All the Zeroes?**

Cornelia Laule[1,2], Shannon H. Kolind[3], Irene M. Vavasour[1], Burkhard Mädler[2], Joel Oger[4], Anthony L. Traboulsee[4], Wayne Moore[5], David KB Li[1], Alex L. MacKay[1]

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Using T_2 relaxation it is possible to measure myelin water fraction in multiple sclerosis (MS) normal appearing white matter (NAWM). Previous work employing a region of interest based approach found reduced myelin water fraction (MWF) in MS NAWM relative to normal white matter in controls. Using an improved 3D T2 relaxation sequence at higher field strength, we also found reduced MWF in MS NAWM which correlated with EDSS. Voxels with lowest MWF values were not uniformly distributed throughout the NAWM, but rather tended to arise near grey/white matter interfaces in the periphery of the brain.

2093. **Individual Voxel Based Analysis of Brain Magnetization Transfer Maps Evidences High Variability of Grey Matter Injury in Patients at the First Stage of Multiple Sclerosis**

Lorena Jure[1], Wafaa Zaaraoui[1], Celia Rousseau[1], Françoise Reuter[1], Audrey Rico[1], Irina Malikova[1], Sylviane Confort-Gouny[1], Patrick J. Cozzone[1], Jean Pelletier[1], Bertrand Audoin[1], Jean-Philippe Ranjeva[1]

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Various MR studies, based on group comparison have demonstrated a common pattern of grey matter (GM) injury in patients since the early stage of multiple sclerosis (MS). However, little is know about the potential variability of this early GM involvement which may determine the high variability of the functional prognosis. We propose an optimized method to obtain from statistical mapping analyses applied on MTR data, the GM MTR abnormalities of subjects at the individual level. Feasibility is demonstrated in early MS patients showing variable individual patterns of GM injury that could explain heterogeneity of clinical progression for this disease.

2094. **Definition of Regional Distribution of Gray Matter Loss in MS Patients with Fatigue: A Voxel-Based Morphometry Study**

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Using voxel-based morphometry, we defined the topographical distribution of gray matter (GM) atrophy in multiple sclerosis (MS) patients with fatigue. Compared to healthy volunteers and to MS patients without fatigue, patients with fatigue had reduced GM volume in several areas of the left frontal lobe, including the middle frontal gyrus (MFG), the precentral gyrus, the superior and inferior frontal gyrus, and the cingulate gyrus. Fatigue severity was significantly correlated with atrophy of the precentral gyrus, suggesting that structural damage in areas that are part of the sensorimotor network might be among the mechanisms responsible for the presence of MS-related fatigue.

2095. **Evidence of Subcortical Grey Matter Atrophy and Surface Morphology Differences in Primary Progressive Multiple Sclerosis**

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Grey matter damage is important in the pathology of Primary Progressive Multiple Sclerosis (PPMS). We scanned 22 patients and 7 controls at baseline, and 2, 50, and 52 weeks. FreeSurfer was used to segment subcortical grey matter and vertex analysis was performed with FSL's FIRST to identify differences in surface morphology between groups. Significant atrophy and correlations with EDSS and/or disease duration were seen in some structures at baseline and all structures showed volume reduction over one year. Surface morphology differences were found in the thalamus and pallidum. Results highlight importance of subcortical atrophy and structural morphology differences in PPMS.

2096. **Regional Gray Matter Volumes Changes in Relapsing-Remitting and Secondary Progressive Multiple Sclerosis – a Longitudinal Comparative Voxel-Based Morphometry Study**

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We used optimized voxel-based morphometry to study similarities and differences of regional gray matter volume development in relapsing remitting and secondary progressive MS. Although regional gray matter volume measures reveal areas of significant gray matter volume loss in RRMS, the results from this study suggest, that there is no marked acceleration in the progressive phase of the disease. This implies that the more pronounced impact of gray matter pathology in the secondary progressive phase is a result of longer linear accrual of such damage, rather than a phase-specific acceleration.

2097. **Gender Effects on Atrophy in MS: Cognitive Implications**

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Multiple sclerosis displays clear gender effects in female predisposition, as well as male negative clinical prognosis. To investigate gender effects of atrophy and cognition in MS, we acquired brain volumes and neuropsychological assessments in 32 RRMS patients (14 male, 17 female) and 22 healthy controls (10 male, 12 female). Atrophy and cognitive impairment were present in male patients only. An interaction between group and gender was present for whole-brain volume and verbal memory. These were correlated in the patient group only. This underlines the need for future research to investigate gender effects in MS more thoroughly, with possible therapeutic implications.

2098. **Memory Impairment in MS Correlates to Hemodynamic Response in Event-Related FMRI of Episodic Memory**

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Nineteen patients with MS performed a verbal incidental encoding task, followed by a word recognition task (WR). Stimuli from the WR task were split into "encoded" and "non-encoded" based on performance of each subject. The encoded stimuli of the five highest performers were used to create an average t-map to select regions of interest for a correlation analysis. Areas involved in semantic encoding, including the DLPFC and the inferior frontal gyrus, showed a significant positive correlation between the fit hemodynamic response amplitude during encoded stimuli on the WR task and a test of verbal memory.

2099. **Corpus Callosum Fractional Anisotropy Predicts Clinical Progression and Cognitive Dysfunction in Early Primary-Progressive MS: A 5 Year Follow-Up Study**

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The aim of this study was to identify which brain area predicts the development of disability over five years and cognitive dysfunction after five years in 32 patients with early primary-progressive multiple sclerosis. Employing tract-based spatial statistics and voxel-based morphometry, we found that lower fractional anisotropy in the corpus callosum at study entry predicted a greater progression of disability, as measured by the EDSS, over the follow-up, and worse verbal memory, attention and speed of information processing, and executive functions, after five years. Our findings highlight the importance of damage to the inter-hemispheric callosal pathways in determining disability in MS.

2100. A Voxel Based Diffusion Tensor Image Analysis on Cognitive Decline in Mildly and Moderately Impaired Multiple Sclerosis Patients

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The aim of this study was to examine the relationship between the Paced Auditory Serial Addition Test and the diffusion properties that are related to microstructural white matter breakdown in patients with mild and moderate Multiple Sclerosis.

2101. Early Compensatory Changes Within the Memory Network of Multiple Sclerosis Patients

Hanneke E. Hulst[1], Stefan D. Roosendaal[1], Menno M. Schoonheim[1], Lizanne J. Schweren[1], Ysbrand D. van der Werf[2], Chris H. Polman[3], Frederik Barkhof[1], Jeroen J. Geurts[1,4]

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Cognitive decline is frequently seen in multiple sclerosis (MS). This study investigates the changes in hippocampal activation patterns in MS. Functional MRI, an encoding- and retrieval paradigm, was acquired of 24 cognitively preserved (CP) and 10 cognitively impaired (CI) MS patients and 15 healthy controls (HC). Where CP patients only showed increased brain activation in the dorsal streams of the memory system, CI patients showed reduced brain activation in the (para)hippocampal areas and the ventral stream of the memory system. Our findings indicate that functional reorganization takes place early in the disease course and is a finite phenomenon in MS.

2102. Memory Impairment in MS Correlates to Hemodynamic Response in Event-Related FMRI of Incidental Encoding

Katherine A. Koenig[1], Blessy Mathew[1], Jian Lin[1], Lael Stone[2], Stephen Rao[3], Michael Phillips[1], Mark J. Lowe[1]

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Eighteen patients with MS performed a verbal incidental encoding task, followed by a word recognition task. Performance on the WR task was used to split incidental encoding stimuli into “encoded” and “non-encoded” maps. The fit hemodynamic response amplitude during encoded and non-encoded stimuli on the encoding task was correlated with a test of verbal memory. Against expectation, the non-encoded words showed only positive correlations, while the encoded words showed only negative correlations with verbal memory performance. It is unclear if this result is due to disease processes in MS, or due to compensatory strategies.

2103. Cognitive Impairment in Early Multiple Sclerosis Related to Metabolic Impairment in Cerebellum

Wafaa Zaaraoui[1], Françoise Reuter[1], Audrey Rico[1], Irina Malikova[1], Elisabeth Soulier[1], Patrick Viout[1], Yann Le Fur[1], Sylviane Confort-Gouny[1], Patrick J. Cozzone[1], Jean Pelletier[1], Jean-Philippe Ranjeva[1], Bertrand Audoin[1]

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While metabolic changes and cognitive impairment are known to be present in multiple sclerosis (MS) from the earliest stage of the disease, no exhaustive examinations have been performed to assess potential relationships between metabolite levels and cognitive status. Our study aimed to investigate whether magnetic resonance spectroscopic markers in normal appearing brain tissues are related to cognitive status in multiple sclerosis.

2104. Is Myelin Water Fraction a Clinically Viable Biomarker of Disease in Primary Progressive Multiple Sclerosis?

Shannon Kolind[1,2], Lucy Matthews[1,3], Heidi Johansen-Berg[1], Rose Gelineau-Kattner[1,4], M Isabel Leite[3], Jacqueline Palace[3], Sean Deoni[2]

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Critical need exists for a sensitive and specific biomarker in primary progressive multiple sclerosis (PPMS), which features diffuse neuronal and myelin damage. This study explored estimates of myelin water fraction (MWF) as such a biomarker. Sixteen PPMS patients were imaged using the mcDESPOT multi-component relaxometry technique, and correlations between MWF estimates and clinical disability scores were investigated. We found significant negative correlation between MWF and EDSS scores across diffuse brain regions. Correlations between MWF and specific scores of bladder/bowel, mental and sensory functions were found in appropriate brain regions. Findings support the emerging relevance of MWF changes to clinical manifestations.

2105. Preparation for Multi-Site Myelin Water Relaxation Studies: Inter and Intra-Site Reproducibility in Normal Controls

Cornelia Laule[1,2], Irene M. Vavasour[1], Burkhard Mädler[2], Trudy Harris[3], David KB Li[1], Anthony L. Traboulsee[4], Alex L. MacKay[1,2]

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Quantitative assessment of T_1 and T_2 relaxation has the potential to provide important in-vivo markers for disease progression and treatment efficacy in pharmaceutical trials. The present study examine cross-site reproducibility of mean T_1, geometric mean T_2 (GMT_2) and myelin water fraction (MWF) measured on the same 5 people at 6 sites. Average percent differences of inter and intra-site reproducibility was <1% for GMT_2, ~3% for T_1 and ~6% for MWF. While mean T_1 and GMT_2 have slightly better reproducibility, MWF provides a specific measure of brain myelin content, and is hence ideal for assessing neuroprotective and remyelination strategies.

2106. 1H-MRS and Water Proton T1 Investigations of New Lesions in Relapse Remitting Multiple Sclerosis

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Little is known about the pathological evolution of acute MS lesions. Using 1H-MRS one can measure changes in metabolites such as n-acetyl-aspartate (NAA), which may become altered in MS. We used 1H-MRS and water proton T1 measurements to investigate the time-course of biochemical changes occurring in new MS lesions. Multi-voxel 1H-MRS data was acquired monthly from 20 Relapsing-Remitting MS subjects. Metabolite and water proton T1 changes for the same volume were investigated Lesions exhibited a significant decrease in NAA and a significant increase in mean T1, compared to normal appearing white matter, 2 months before lesion appearance on conventional imaging.

2107. 1H-MRS Study of Secondary Progressive MS Patients Followed Over 2 Years in the Dirucotide (MBP8298) Placebo Controlled Study

Madeleine Hodgson[1], Cornelia Laule[1,2], Irene Vavasour[1,2], David Li[2], Yinshan Zhao[3], Tony Traboulsee[3], Joel Oger[3], Alex MacKay[1,2]

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1H-MRS is a useful technique for evaluating demyelination and axonal integrity and thus can be used to monitor disease progression in Multiple Sclerosis (MS). Dirucotide (MBP8298) has exhibited potential as a treatment for Secondary Progressive MS (SPMS) to slow disease progression. The effects of Dirucotide were investigated using 1H-MRS in a single centre, double-blinded MRI substudy with a placebo control. There is no change observed in important metabolites in either of the cohorts over a two-year period, which is perhaps not surprising given that Dirucotide did not meet primary endpoints in the MAESTRO-01 Phase III trial.

2108. In Vivo Measurement of Glutathione (GSH) in the Human Brain with Secondary Progressive Multiple Sclerosis Using Selective Multiple Quantum Chemical Shift Imaging of GSH

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Oxidative stress has been implicated in multiple sclerosis (MS), a chronic inflammatory disease with the presence of a neurodegenerative process particularly in progressive MS. However, the effects of oxidative stress in MS have not been well described in the living human brain. In this study, we measured the cerebral GSH levels in the patients with secondary progressive MS (SPMS) using doubly selective multiple quantum GSH CSI. The GSH levels were significantly lower in the SPMS patients compared with those in the age- and gender-matched healthy controls, indicating the presence of increased oxidative stress in the absence of measurable inflammation.

2109. Quantitative Venous Vasculature Assessment on Susceptibility-Weighted Imaging Reflects Presence of Severe Chronic Venous Insufficiency in the Brain Parenchyma of Multiple Sclerosis Patients. a Case-Control Study

Guy U. Poloni[1], Paolo Zamboni[2], E. Mark Haacke[3], Stefano Bastianello[4], Michael G. Dwyer[1], Niels Bergsland[5], Claudiu V. Schirda[1], David Wack[1], Christopher R. Magnano[1], Bianca Weinstock-Guttman[6], Fabrizio Salvi[2], David Hojnacki[6], Robert Zivadinov[1]

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To develop an objective method for quantifying venous vasculature in brain parenchyma on susceptibility-weighted imaging (SWI). To apply this technique in multiple sclerosis (MS) patients and in healthy controls (HC).

2110. A Semi-Automated Analysis Pipeline for Reproducible SWI Analysis of Multiple Sclerosis Pathology

Michael G. Dwyer[1], Niels Bergsland[2], Claudiu Schirda[2], Mari Heininen-Brown, Ellen Carl, David Wack, Guy U. Poloni, Robert Zivadinov[3]

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Susceptibility-weighted imaging (SWI) has gained much interest recently as a sensitive means for detecting iron deposition in a variety of diseases, including multiple sclerosis (SM). We propose a fast and reproducible analysis pipeline to extract detailed quantitative SWI data and to combine it with other established indicators of disease state (including magnetization transfer and perfusion imaging).

2111. Chronic Cerebrospinal Venous Insufficiency and Iron Deposition on Susceptibility-Weighted Imaging in Patients with Multiple Sclerosis

Robert Zivadinov[1], Paolo Zamboni[2], E. Mark Haacke[3], Erica Menegatti[4], Bianca Weinstock-Guttman[5], Claudiu Schirda[1], Anna M. Malagoni[2], David Hojnacki[5], Cheryl Kennedy[1], Ellen Carl[1], Niels Bergsland[1], Sara Hussein[1], Mari Heininen-Brown[1], Ilaria Bartolomei[6], Fabrizio Salvi[2], Michael G. Dwyer[1]

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Chronic cerebrospinal venous insufficiency (CCSVI) is a vascular picture in multiple sclerosis patients characterized by stenoses affecting the main extracranial venous outflow pathways and by a high rate of cerebral venous reflux that may lead to increased iron deposition in the brain. We explored relationship between venous hemodynamic (VH) parameters and disability and iron concentration in deep-gray matter (DGM) structures and lesions on susceptibility-weighted imaging. There was a significant association between higher number of VH criteria and higher iron concentration in T2 and T1 lesion volumes. Higher iron concentration in DGM structures was strongly associated with higher disability status.

2112. Cine Cerebrospinal Fluid Imaging in Multiple Sclerosis. a Case-Control Study

Robert Zivadinov[1], Christopher Magnano[2], Bianca Weinstock-Guttman[3], David Wack[2], Eric Lindzen[3], David Hojnacki[3], Niels Bergsland[2], Cheryl Kennedy[2], Justine Reuther[2], Michael G. Dwyer[2], Claudiu Schirda[2]

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To investigate the cerebrospinal fluid (CSF) dynamics in Sylvius aqueduct in multiple sclerosis (MS) patients versus healthy controls (HC) and to define correlates with other specific disease metrics.

2113. An Objective Quantification Technique of the Cerebrospinal Fluid (CSF) Flow in the Cerebral Aqueduct, in Patients with Multiple Sclerosis

Claudiu Schirda[1], Paolo Zamboni[2], Christopher Magnano[1], Eric Lindzen[3], David Wack[1], Bianca Weinstock-Guttman[3], Deepa Ramasamy[1], Ellen Carl[1], David Hojnacki[3], Cheryl Kennedy[1], Michael Dwyer[1], Niels Bergsland[1], Jennifer Cox[1], Fabrizio Salvi[2], Robert Zivadinov[1,3]

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When compared to white matter or gray matter, the involvement of the cerebrospinal fluid (CSF) in the Multiple Sclerosis (MS) disease has scarcely been explored until now and typically a lumbar puncture is required. We investigate the flow properties of the CSF in the aqueduct of Sylvius and how they relate to other MS disease metrics, by using non-invasive MRI in a pilot study with MS patients and healthy controls. An objective flow quantification technique using automatic segmentation of the aqueduct was developed and was validated on a flow phantom and scan-rescanning 4 subjects within a week.

2114. Effects of Temporal Resolution on Blood-Brain Barrier Permeability Measurement with Dynamic Contrast Enhanced MRI in Multiple Sclerosis Enhancing Lesions

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Accurate and reproducible measurements of blood-brain barrier permeability in MS enhancing lesions would benefit follow-ups of lesion activity and comparison of detection sensitivity between different Gd-enhanced protocols. We propose a Dynamic Contrast Enhanced MRI protocol that allows sampling of the arterial input function with high temporal resolution in the first minute post-injection, followed by a lower temporal resolution but high spatial resolution acquisition of enhancement in lesions. This "dual temporal resolution" method was tested experimentally and through simulations and, compared to previous methods, has proven to yield more accurate and precise estimates over a wide range of permeability values.

2115. Relative Recirculation (RR): A Potential Tool for Monitoring Blood-Brain Barrier Disruption in Secondary Progressive Multiple Sclerosis

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Multiple sclerosis (MS) is an inflammatory demyelinating disease of the central nervous system. While blood-brain barrier (BBB) disruption associated with relapsing-remitting MS is readily identified using gadolinium-enhanced T1-weighted MRI, these MRI markers lack the sensitivity required for monitoring secondary progressive MS. Relative recirculation (rR), a parameter extracted from dynamic susceptibility contrast (DSC) data, can delineate BBB disruption in patients with acute ischemic stroke. Relative recirculation was measured from DSC perfusion data obtained from 19 patients with secondary progressive MS. The average lesion rR was significantly greater than in normal appearing white matter and shows potential for monitoring secondary progressive MS.

2116. A Three-Dimensional Multi-Scale Line Filter Algorithm for Segmentation of Vein Vessels in Susceptibility Weighted Images

Guy U. Poloni[1,2], Michael G. Dwyer[1], Niels Bergsland[1], Claudiu V. Schirda[1], Stefano Bastianello[2], Robert Zivadinov[3,4]

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SWI is a MRI application that can directly image cerebral veins through the use of phase information to enhance local susceptibility. The present work introduces an algorithm, based on a 3-dimensional linear filter, for segmenting and measuring vein vessels in the brain and for classifying vessels according to their diameter. The resultant multi-scale line-filtered images provide significantly improved segmentation and visualization of curvilinear structures, in particular with respect to small vessels, contributing to the quantitative investigation of vascular impairment in the pathologies of the central nervous system.

White Matter Diseases

Hall B Tuesday 13:30-15:30

2117. MR Relaxometry and Diffusion Tensor Imaging of Normal Appearing White Matter in Mild Traumatic Brain Injury.

Christopher James Andrew Cowie[1,2], Benjamin S. Aribisala[1], Jiabao He[1], Joshua Wood[1], Alexander David Mendelow[2], Patrick Mitchell[2], Andrew M. Blamire[1]

[1]Newcastle Magnetic Resonance Centre, Newcastle University, Newcastle upon Tyne, Tyne & Wear, United Kingdom; [2]Department of Neurosurgery, Newcastle General Hospital, Newcastle upon Tyne, Tyne & Wear, United Kingdom

Mild traumatic brain injury (mTBI) is associated with long term cognitive and affective symptoms. Findings on conventional MRI often do not account for the duration and severity of these symptoms. The aim of this study was to ascertain whether MR relaxometry and diffusion tensor imaging would reveal abnormalities in normal appearing white matter (NAWM) in patients with mTBI. Whole group analysis showed no significant differences, but after grouping the patients according to the side of the visible lesion, a significant increase in the mean diffusivity (MD) of ipsilateral frontal lobe NAWM was demonstrated.

2118. Quantification of DTT Metrics in Various Fiber Bundle in Patients with Frontal Lobe Injury and Its Correlation with Neuropsychological Tests

Manoj Kumar[1], Deepa Pal[1], Ram KS Rathore[2], Bal K. Ojha[3], Anil Chandra[3], Raj Kumar[3], Rakesh Kumar Gupta[1]

[1]Radiodiagnosis, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [2]Mathematics and Statistics, Indian Institute of Technology, , Kanpur, Uttar Pradesh, India; [3]Neurosurgery, Chhatrapati Shahuji Maharaj Medical University,, Lucknow, Uttar Pradesh, India

Diffusion tensor imaging (DTI) was performed within 7 days and after 6 months of injury in 21 traumatic brain injury (TBI) patients with frontal lobe injury and 21 age/sex matched controls. Diffusion tensor tractography (DTT) was proposed for quantification of various white matter (WM) tracts in patients with frontal lobe injury to assess diffuse axonal injury (DAI) and to look for correlation of these fiber bundles measures with various neuropsychological tests (NPT). We found reduced fractional anisotropy (FA) and increased mean diffusivity (MD) values in all WM tracts in TBI patients compared to controls, NPT scores were found to be significantly impaired in follow-up patients compare to controls and some of these tests showed significant correlation with DTI indices with different WM tracts. WM tracts which show significant difference on DTT were also correlated with those NPT which are associated with main function of frontal lobe such as memory, attention, visual and motor function. It appears more realistic methods for DAI quantification in TBI patients and provides information about structural integrity and connectivity of whole fiber tracts.

2119. White Matter Degradation in Fornix After Mild Traumatic Brain Injury: Cross-Sectional and Longitudinal MRI Investigations

Wang Zhan[1], Grant Gauger[2], Lauren Boreta[1], Gary Abrams[2], Karl Young[1], Yu Zhang[1], Marzieh Nezamzadeh[1], Norbert Schuff[1], Michael W. Weiner[1]

[1]Radiology and Medical Imaging, University of California, San Francisco, San Francisco, CA, United States; [2]VA Medical Center, San Francisco

Fornix is one of the primary white matter structures of the limbic system, and its damage in mild traumatic brain injury (TBI) may explain the memory and learning dysfunctions in the post-concussion syndrome. N=24 TBI patients were longitudinally studied in two time points using T1 anatomical imaging and diffusion tensor imaging (DTI) to measure the fornix-to-brain ratio (FBR) and WM integrity of fornix, and compared with matched healthy controls. Our data show that the WM degradation in fornix onset in the acute stage after mild TBI, and that this degradation continued during the following 6-month period of recovery.

2120. Detection of Tissue Changes in Traumatic Brain Injury Patients Using Automatic Regional Analysis of Quantitative MR Scans

Benjamin Segun Aribisala[1], Christopher J.A. Cowie[1,2], Jiabao He[1], Joshua Wood[1], David A. Mendelow[2], Patrick Mitchell[2], Andrew M. Blamire[1]

[1]Institute of Cellular Medicine, Newcastle Magnetic Resonance Centre, Newcastle University, Newcastle upon Tyne, England, United Kingdom; [2]Department of Neurosurgery, Newcastle General Hospital, Newcastle University, Newcastle upon Tyne, England, United Kingdom

Traumatic head injury is one of the major causes of neurological morbidity and mortality in the UK with more than 0.1 million admissions per year with primary diagnosis of head injury. This constitutes a huge drain on medical resources. Majority of these patients have ongoing symptoms which do not correlate with MRI or CT findings. Here we investigated a cohort of patients with mild TBI using multi-parametric real space analysis. Our results show that a fully automatic real space method of analysing quantitative MR parameters can be used to detect changes in normal appearing tissues in patients suffering mild TBI.

2121. Using Jacobean Determinants to Map Within-Subject Serial Changes in Brain Volume in Difficult Contexts: Implementation in Traumatic Brain Injury with Decompressive Craniectomy

Steve Sawiak[1], Virginia FJ Newcombe[2], M G. Abate[2], Jo G. Outtrim[2], John D. Pickard[1], T A. Carpenter[1], Guy B. Williams[1], David K. Menon[2]

[1]Wolfson Brain Imaging Centre, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [2]Division of Anaesthesia, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom

Atrophy is common post traumatic brain injury (TBI) and may correlate with outcome. We hypothesised that quantification of Jacobian determinants could assess progressive changes in brain volume in within subject analyses, even in contexts that produce major problems with comparative analyses. We show implementation of the approach in a single TBI subject with serial scans before and up to 12 months after decompressive craniectomy, compared to results from healthy controls. The results indicate it is possible to monitor the changes in brain volume over time post TBI in an individual.

2122. The Relationship of White Matter Lesion and Contract Enhanced Lesion Development Courses in Radiation Induced Brain Injury: An MRI Based Study

H Huang[1,2], M Deng[1], S F. Leung[3], Y L. Chan[1], D K. Yeung[1], H C. Chan[1], A T. Ahuja[1], Y X. Wang[1]

[1]Department of Diagnostic Radiology and Organ Imaging, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, NT, Hong Kong; [2]Department of Radiology, The Shenzhen Third People's Hospital, Shenzhen, China; [3]Department of Clinical Oncology, The Chinese University of Hong Kong, Prince of Wales Hospital

The natural course of radiation induced brain injury still remains poorly understood. Among the abnormalities white matter edema-like lesions (WML) and contrast enhanced necrotic lesions (CEL) have been most commonly reported. It was recently reported that radiation induced brain injury was not always an irreversible and progressive process, but one that could show regression and resolution. In total 22 nasopharyngeal carcinoma patients with 36 lobes displaying WML and CEL were analysed in this study. The preliminary results of this study suggest the development of WML and CEL tend to follow the same pattern, and not develop in the opposite direction.

2123. Dynamic Susceptibility Contrast Mr Perfusion Imaging of the Brain in X-Linked Adrenoleukodystrophy

Otto Rapalino[1], Mara Kunst[1], Patricia Musolino[2], Florian Eichler[2,3]

[1]Radiology, Massachusetts General Hospital, Boston, MA, United States; [2]Neurology, Massachusetts General Hospital, Boston, MA, United States; [3]Martinos Center for Biomedical Imaging, Charlestown, MA, United States

Dynamic Susceptibility Contrast (DSC) MR perfusion was used to characterize the perfusion abnormalities in patients with adrenoleukodystrophy and adrenomyeloneuropathy. This study demonstrates that the combination of conventional MR and DSC perfusion MR techniques allows the definition of five different zones with characteristic profiles of abnormal signal and perfusion in patients with adrenoleukodystrophy that correspond to the zonal anatomy previously described on pathological studies. These findings can be helpful in predicting disease progression, selecting patients for therapeutic interventions and elucidating the pathophysiology of this disorder.

2124. Diffusion Tensor Imaging Detects Abnormalities in the Corticospinal Tract of the Brain in Patients with Adrenomyeloneuropathy

Aliya Gifford[1], Anna Binstock[2], Joseph Wang[3], Kathy Zackowski[3,4], Jonathan Farrell[5,6], Peter C.M. van Zijl[5,6], Gerald Raymond[1,4], Seth Smith[7,8]

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Adrenomyeloneuropathy (AMN) is characterized by primary distal axonopathy with secondary demyelination. In this study we performed diffusion tensor imaging (DTI) at 1.5T on 29 healthy volunteers and 39 AMN patients. Tractography of the left and right corticospinal tracts (CST) were performed and diffusion anisotropy and diffusivity were computed. A significant change in FA and perpendicular diffusivity was found from the pons to mid-brain ($p<0.01$) and mid-brain to thalamus ($p<0.001$) regions in AMN patients. This suggests that DTI can quantify the pathway-specific abnormalities in AMN, and results are in corroboration with knowledge that cerebral damage is present in AMN.

2125. A Seven Years Quantitative MRI and MRS Follow-Up Study on Successful Bone Marrow Transplantation for Presymptomatic Juvenile Metachromatic Leukodystrophy

Xiao-Qi Ding[1], Annette Bley[2], Alfried Kohlschütter[2], Jens Fiehler[3], Heinrich Lanfermann[1]

[1]Institute of Diagnostic and Interventional Neuroradiology , Hannover Medical School, Hannover, Germany; [2]Department of Paediatrics, University Medical Centre Hamburg-Eppendorf, Hamburg, Germany; [3]Department of Neuroradiology, University Medical Centre Hamburg-Eppend, Hamburg, Germany

Bone marrow transplantation (BMT) has been advocated as treatment of juvenile metachromatic leukodystrophy (MLD). The effectiveness of this high-risk treatment is still questionable due to the rarity of follow-up reports. We carried out a 7 years MRI follow-up on a boy with juvenile MLD who had received BMT treatment in the presymptomatic phase and remained free of MLD symptoms during the observation. Conventional morphological MRI showed minor stable white matter lesions while quantitative T2-mapping and MR spectroscopy evidenced a stagnancy of the demyelination process and an ongoing maturation of the brain.

2126. Voxelwise Analysis of Pelizeaus-Merzbacher Disease in 17 Genetically Proven Cases Using Diffusion Tensor Imaging

Onur Ozyurt[1], Alp Dincer[2], Zuhal Yapici[3], Cengiz Yalcinkaya[4], Mefkure Eraksoy[3], Cengizhan Ozturk[1]

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In this study, tract based spatial statistics (TBSS) approach is used for the investigation of Pelizeaus-Merzbacher Disease (PMD), which is a rare X-linked disease characterized by defective central nervous system myelination due to a mutation in the proteolipid protein 1 gene.

2127. In Vivo Proton MR Spectroscopy Findings Specific for Adenylosuccinate Lyase Deficiency

Steffi Dreha-Kulaczewski[1], Marco Henneke[1], Knut Brockmann[1], Marinette van der Graaf[2,3], Michel Willemsen[4], Udo Engelke[5], Peter Dechent[6], Arend Heerschap[3], Gunther Helms[6], Ron Wevers[5], Jutta Gaertner[1]

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Adenylosuccinate lyase (ADSL) deficiency is an inherited metabolic disorder and characterized by the accumulation of succinylaminoimidazolecarboxamide riboside and succinyladenosine (S-Ado) in tissue and body fluids. In three children, presenting with psychomotor delay, autistic features, and white matter changes on brain MRI, screening for inborn errors of metabolism included in vitro proton MRS. It revealed resonances at 8.27 and 8.29ppm that correspond to S-Ado. In vivo proton MRS showed a signal at 8.3ppm in gray and white matter brain regions of all three patients, which was undetectable in controls. In vivo proton MRS provides a conclusive finding in ADSL deficiency.

2128. Cerebral Accumulation of 3-Hydroxyisovaleric Acid in Adults Until Recently Unaware of Having 3-Methylcrotonyl-CoA Carboxylase (MCC) Deficiency

Marinette van der Graaf[1,2], Udo F.H. Engelke[3], Eva Morava[4], Mirian C.H. Janssen[5], Maaike C. de Vries[4], Leo AJ Kluijtmans[3], Bozena Goraj[1], Arend Heerschap[1], Ron A. Wevers[3]

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Recently, our group showed for the first time cerebral accumulation of 3-hydroxyisovaleric acid (3HIVA) in a pediatric patient with 3-Methylcrotonyl-CoA Carboxylase deficiency (MCCD). 3HIVA has been considered to have neurotoxic effects, but this is under debate. The present study reports on cerebral accumulation of 3HIVA detected by 3T proton MRS in two adult women with MCCD, whom deficiency was discovered by a positive neonatal screening of their healthy new-born babies. As the women had not been aware of having this disorder before and they have no or limited complaints, 3HIVA is postulated to have no or minor neurotoxic effect.

2129. White Matter Lesion Load in Type 2 Diabetes - A VBM Study

Lars Eric Forsberg[1,2], Sigurdur Sigurdsson[3], Thor Aspelund[3,4], Jesper Fredriksson[2], Smári Kristinsson[2], Ólafur Kjartansson[3], Bryndís Óskarsdóttir[3], Pálmi V. Jónsson[3,4], Gudný Eiríksdóttir[3], Tamara B. Harris[5], Mark A. van Buchem[6], Alex Zijdenbos[7], Lenore J. Launer[5], Vilmundur Gudnason[3,4]

[1]Department of Neuroscience, Karolinska Institutet, Stockholm, Sweden; [2]Raförninn ehf, Reykjavik, Iceland; [3]Icelandic Heart Association, Kopavogur, Iceland; [4]The University of Iceland, Reykjavik, Iceland; [5]Laboratory of Epidemiology, Demography, and Biometry, National Institute of Aging, Bethesda, MD, United States; [6]Department of Radiology, Leiden University Medical Center, Leiden, Netherlands; [7]Biospective Inc., Montreal, Canada

Type 2 diabetes (DM2) is a known risk factor for white matter lesions (WML) in elderly subjects. In this study, we used voxel-based morphometry (VBM) to analyse the common distribution of WML in 215 subjects with DM2 (average age 76.1 years) compared to 1675 non-diabetic controls (average age 75.8 years). Our main finding is that DM2 subjects have commonly large WML areas in the brain that extend from the frontal lobe to the parietal lobe.

2130. Relationship Between Serum Inflammatory Markers, Regional Brain Volumes, and Perfusion in Older Diabetic Subjects

Peng Zhao[1], Vera Novak[1], Kun Hu[1], Medha Munshi[1], David Alsop[2], Amir Abduljalil[3], Peter Novak[4]

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Type 2 DM is a major risk factor for both large and small vessel atherosclerosis, stroke, and vascular dementia. Hyperglycemia is a common mechanism of endothelial dysfunction and neuronal cell damage. Microvascular disease manifests as white matter hyperintesities on MRI, regional atrophy and functional decline. Inflammation further affects microcirculatory regulation and contributes to arteriolosclerosis. We investigated the effects of inflammation on regional perfusion and neurodegenerative changes in grey and white matter on MRI. Inflammatory markers had different effects on regional brain volumes. sICAM was associated with atrophy across all regions in the DM group, with the most significant effects in the frontal and parietal regions. In the control group, regional perfusion on both sides in the parietal lobe is positively correlated with sICAM, and perfusion in the right occipital lobe is positive with sVCAM. Associations between regional brain volumes and other inflammatory markers were not prominent. Frontal and parietal regions with high energy demands are more vulnerable to the effects of DM in the brain.

2131. Quantification of Frontal Glutamate Neurotranmission in Human HIV

Napapon Sailasuta[1], Kimbery Shriner[2], Kent Harris[1], Thao T. Tran[1,3], Osama Abulseoud[4], Brian D. Ross[1,5]

[1]Clinical MR Spectroscopy, Huntington Medical Research Institutes, Pasadena, CA, United States; [2]The Phil Simon Clinic, Huntington Memorial Hospital, Pasadena, CA, United States; [3]Rudi Schulte Research Institute, Santa Barbara, CA, United States; [4]University of Southern California, Keck School of Medicine, Los Angeles, CA, United States; [5]Rudi Schulte Research Institute, Santa Barbara , CA, United States

Despite successful treatment of HIV and AIDS, neuroimaging and neurospectroscopy abnormalities persist suggesting residual viral effects or unwanted neurological side effects of effective therapies. Elucidation of the recently described reduction in frontal lobe glutamate concentration in white matter of HIV-affected individuals requires independent 13C MRS measurement of glutamate turnover neurotransmitter rates in neurons and glia. This study develops the necessary frontal lobe assay of neuronal and axonal glutamate turnover by infusion of 2-13C glucose followed by low-power nOe 13C MRS in HIV and normal control subjects. Preliminary results indicate reduced 13C glutamate turnover in successfully treated HIV.

2132. Proton MR Spectroscopy Findings in Chronic Neuroborreliosis

Caitlin Judith Hardy[1], Amit Gokhale[2], David Younger[2], Nissa Perry[2], Oded Gonen[2]

[1]Radiology, NYU, New York, NY, United States; [2]NYU School of Medicine

Abnormal metabolite levels were found in 3/3 patients with a diagnosis a post Lyme disease syndrome using 1H-MRS.

Animal Models of White Matter Disease

Hall B Wednesday 13:30-15:30

2133. Vascular Endothelial Growth Factor - A Novel Player in SCI Pain

Laura Sundberg[1], Juan Herrera[1], Olivera Nesic[2], Ponnada Narayana[1]

[1]Diagnostic and Interventional Imaging, The University of Texas Medical School, Houston, TX, United States; [2]Biochemistry and Molecular Biology, University of Texas Medical Branch, Galveston, TX, United States

Vascular endothelial growth factor (VEGF) has been investigated as a potential treatment for spinal cord injury (SCI) due to its vascular-promoting and neuroprotective effects; however, studies have provided conflicting information about the post-SCI effects of VEGF. In this study, VEGF was delivered immediately after SCI and longitudinal MRI and behavioral studies were performed into the chronic phase of injury. It was found that VEGF treatment results in tissue sparing and increased markers of neurofilament, but many animals also displayed a higher incidence of mechanical allodynia. VEGF may spare tissue, but may also encourage non-specific sprouting of axons into pain pathways.

2134. Viscoelastic Properties Change at an Early Stage of Cuprizone Induced Affection of Oligodendrocytes in the Corpus Callosum of C57/black6 Mice

Katharina Schregel[1], Eva Wuerfel[1], Jens Wuerfel[1], Dirk Petersen[1], Ralph Sinkus[2]

[1]University of Luebeck, Luebeck, Germany; [2]Institut Langevin, ESPCI, Paris, France

MRE is an innovative imaging technique developed to non-invasively map and quantify the viscoelastic properties of tissue in vivo. As pathological alterations cause changes in elasticity and viscosity, MRE might be applied to characterize the structural integrity of given tissues and could be employed for diagnosis and clinical monitoring of neurodegenerative diseases such as multiple sclerosis. Therefore it appears to be essential to evaluate the effect of pathological processes occurring in multiple sclerosis on the viscoelastic properties of cerebral tissue with the help of experimental rodent models. We introduced the cuprizone mouse-model (C57/black6) which depicts key features of multiple sclerosis.

2135. Hybrid Diffusion Imaging in a Spinal Cord Model of Dysmyelination

A P. Hosseinbor[1], I D. Duncan[2], A L. Alexander, A A. Samsonov[3], Y-C Wu[4], S A. Hurley, R A. Fisher, A S. Field[3]

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The shaking pup (shp) is a canine mutant model of dysmyelination, and suffers from severe myelin deficiency. In a previous study of shp brain, Po was shown to differentiate between a control and diseased pup with respect to myelin content. In this study, WM integrity is examined in the spinal cord of shp using both DTI and DSI measurements acquired from a HYDI approach. Standard DTI measures and Po are compared to see if one or both are sensitive to changes in myelin content between shp and control, as well as to more subtle differences between two diseased pups.

2136. Ex Vivo Visualization of Cortical Lesions in Non-Human Primates with MS Using Inversion Recovery Experiments

Erwin Lambert Blezer[1], Yolanda S. Kap[2], Jan Bauer[3], Bert L. 't Hart[2]

[1]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands; [2]Department of Immunobiology, Biomedical Primate Research Center, Rijswijk, Netherlands; [3]Brain Research Institute, University of Vienna, Vienna, Austria

Cortical pathology is an important feature of MS. However visualization with MRI is poor although sensitivity is increased using FLAIR and Double Inversion Recovery (suppression of CSF and white matter) experiments. Various inversion recovery experiments were tested ex vivo on brains of marmoset with MS, which develop cortical lesions, in their ability to improve cortical lesion detection. Experiments included settings of inversion times in which CSF, white or grey matter was suppressed and a DIR experiment in which both white and grey matter was suppressed. Cortical lesions were best visualized after suppression of white matter or in the DIR experiment.

2137. Increasing Diffusion Time Improves in Vivo DTI Sensitivity to White Matter Degeneration

Ying-Jr Chen[1], Joong Hee Kim[1], Jian Wang[1], Tsang-Wei Tu, [12], Sheng-Kwei Song[1]

[1]Radiology, Washington University in St. Louis, Saint Louis, MO, United States; [2]Mechanical, Aerospace and Structural Engineering, Washington University in St. Louis, Saint Louis, MO, United States

The sensitivities of detecting white matter injury using 6 ms and 38 ms diffusion time were examined in the present study. We demonstrated that increased diffusion time in diffusion tensor imaging measurements improves the sensitivity of detecting axonal injury and myelin damage in cuprizone treated mice. In the cuprizone model of demyelination, axonal injury was seen as significantly decreased axial diffusivity at both 6 and 38 ms diffusion time with more significantly decreased axial diffusivity observed at longer diffusion time.

2138. The Effect of Systemic Depletion of Natural Killer Cells in an EAE Mouse Model of Multiple Sclerosis Examined by Magnetic Resonance Imaging and Bioluminescence Imaging

Gregory Harrison Turner[1], Junwei Hao[2], Ruolan Liu[2], Wenhua Piao[2], Timothy L. Vollmer[3], Rong Xiang[4], Antonio La Cava[5], Denise I. Campagnolo[2], Luc Van Kaer[6], Fu-Dong Shi[2]

[1]Keller Center for Imaging Innovation, Barrow Neurological Institute, Phoenix, AZ, United States; [2]Neurology, Barrow Neurological Institute, Phoenix, AZ, United States; [3]Neurology, University of Colorado Denver School of Medicine, Aurora, CO, United States; [4]Medicine, Nankai University, Tianjin, China; [5]Medicine, University of California Los Angeles, Los Angeles, CA, United States; [6]Microbiology and Immunology, Vanderbilt University School of Medicine, Nashville, TN, United States

Natural killer (NK) cells of the innate immune system can profoundly impact the development of adaptive immune responses against foreign invaders, as well as self-antigens. In this study a combination of in vivo MRI and bioluminescence imaging was used to investigate effects of systemic depletion of NK cells on lesion development in an experimental autoimmune encephalomyelitis (EAE) mouse model of multiple sclerosis. The results of this study suggest organ-specific activity of NK cells on the magnitude of CNS inflammation.

Imaging of Psychiatric Disorders

Hall B Thursday 13:30-15:30

***2139*. Glutamate, Glutamine, NAA, and GABA Levels in Hippocampus in Schizophrenia as Measured by 1H-MRS at 3T**

Ana Stan[1], Perry Mihalakos[2], Deborah Douglas[3], Stephanie Morris[2], Changho Choi[3], Carol Tamminga[2]

[1]Western Psychiatric Institute and Clinic, University of Pittsburgh Medical Center, Pittsburgh, PA, United States; [2]Psychiatry, University of Texas Southwestern Medical Center, Dallas, TX, United States; [3]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States

We report a result of a 3T 1H-MRS study in schizophrenia. The concentrations of glutamate (Glu), glutamine (Gln), and N-acetylaspatate (NAA) in hippocampus (voxel 50x15x15 mm) were measured using a triple refocusing sequence. GABA was measured with a difference editing method. MRS scans were conducted on 13 schizophrenia volunteers (10 on medication (SV-ON) and 3 off-medication (SV-OFF)) and 14 normal volunteers (NV). LCModel fitting was used for spectral analysis. [Glu]/[Cr] was observed to be similar between NV and SV-ON ($p = 0.4$). However, [Glu]/[Cr] in SV-OFF was significantly lower (~30%) than in both NV and SV-ON ($p = 0.02$ and 0.04, respectively). For Gln, the concentrations were about the same between the three groups ($p > 0.2$). Compared to NV, [NAA]/[Cr] was reduced (by 10%) in SV-ON ($p = 0.006$), but not in SV-OFF ($p = 0.55$). The GABA data showed difference between SV-OFF and SV-ON ($p = 0.05$).

***2140*. Asymmetry Patterns of Association Fibers in Schizophrenia: Preliminary Results Using Diffusion Spectrum Imaging Tractography**

Yu-Chun Lo[1], Su-Chun Huang[2], Hai-Gwo Hwu[3], Chih-Min Liu[3], Chen-Chung Liu[3], Wen-Yih Isaac Tseng[2,4]

[1]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan, Taiwan; [2]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan, Taiwan; [3]Department of Psychiatry, National Taiwan University Hospital, Taipei, Taiwan; [4]Center for Optoelectronic Biomedicine, National Taiwan University College of Medicine, Taipei, Taiwan

Three association fibers connecting the frontal and temporal lobes and three commissural fibers connecting the bilateral orbitofrontal lobes, inferior frontal gyri, and superior temporal gyri related to the social and language functions that might serve the neuropsychopathology of patients with schizophrenia inferred from diffusion spectrum imaging tractography. In neurotypical participants, a consistent leftward asymmetry in the three pairs of association fibers was found. However, adults with schizophrenia did not demonstrate such asymmetry. Lack of leftward asymmetry in schizophrenia may imply a disruption in the normal pattern of structural and functional connectivity in frontal-temporal brain regions.

***2141*. White Matter Abnormalities Associated with Neurological Soft Signs in First-Episode Schizophrenia: A Diffusion Tensor Imaging Study.**

Christine Rodriguez-Régent[1], Sabine Mouchet-Mages[2], Sebastian Rodrigo, Marie-Odile Krebs[2], Catherine Oppenheim, Jean-François Meder

[1]Department of Morphologic and Functional Imaging, University Paris Descartes, Sainte Anne Hospital, PARIS, France; [2]Pathophysiology of Psychiatric Diseases, University Paris Descartes, Sainte Anne Hospital, PARIS, France

Schizophrenic patients often present with neurological soft signs (NSS) but the cerebral changes underlying these signs are poorly understood. This study examines the microstructural changes associated with NSS using Diffusion Tensor Imaging. Forty-five patients with first-episode schizophrenia underwent DTI and a neurological examination. Fractional anisotropy (FA), calculated using a voxel based analysis, was analyzed with NSS scores. FA was negatively correlated with NSS scores in the white matter of the right prefrontal, left occipital and right parietal areas. Thus, this is the first study which confirms that microstructural changes of white matter are associated with NSS in schizophrenia.

***2142*. Interaction of Hippocampal Volume and N-Acetylaspartate Concentration Deficits in Schizophrenia: A Combined MRI and 1H-MRS Study at 3 T**

Florian Schubert[1], Andreas Klaer[2], Martina Ballmaier[2], Karolina Leopold[2], Ines Haeke[2], Martin Schaefer[3], Ruediger Bruehl[1], Juergen Gallinat[2]

[1]Physikalisch-Technische Bundesanstalt, Berlin, Germany; [2]Charite University Medicine, Berlin, Germany; [3]Kliniken Essen, Essen, Germany

We used single voxel 1H-MRS at 3 Tesla to measure absolute NAA concentrations and, as a gold standard of CNS volumetry, a validated delineation protocol for the hippocampus to study the interaction between between hippocampal NAA reduction and volume deficits in 29 schizophrenic patients and 44 controls. The hippocampus of the patients exhibited a significantly smaller volume and lower NAA concentration than that of healthy controls. For schizophrenic patients a significant negative correlation between hippocampal NAA concentration and volume was observed. The results argue for a coexistent neurochemical and structural deficit in the hippocampus of schizophrenic patients.

2143. An MRI Study of the Caudate Nucleus in Euthymic Bipolar I Disorder

Louise Emsell[1], Camilla Langan[1], Sarah Hehir[1], Helen Casey[1], Wil van der Putten[1], Peter McCarthy[1], Rachel Skinner[1], Dara M. Cannon[1], Colm McDonald[1]
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Bipolar disorder is a complex illness characterised by extremes of mood. It is likely that subtle changes in neuroanatomy contribute to the underlying aetiopathology of the disorder. This study sought to identify differences in the volume of the caudate nucleus in a prospectively confirmed sample of 59 remitted patients compared to 59 individually age and gender matched healthy controls to identify trait related anatomical changes. We did not find a main of effect of diagnosis. However,we did detect gender differences in caudate volume (F>M),age-related volumetric decrease across the study population and a main effect of family history in patients.

2144. Brain Matter Corrected Quantification of Phosphomono- And Phosphodiesters in the Brain of Patients with Schizophrenia

Wolfgang Weber-Fahr[1], Mathias Zink[2], Andreas Meyer-Lindenberg[2], Monika Uhrig[1], Nuran Tunc-Skarka[1], Mareen Hoerst[1], Helga Welzel-marquez[1], Alexander Sartorius[2], Gabriele Ende[1]
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A 3D-whole head RINEPT sequence was used together with point-spread function corrected tissue segmentation for robust absolute quantification of spectral edited Phosphomono- and –diester-signals in the brains of schizophrenic patients and controls. The corrected metabolite concentrations show a significant reduction of Phosphocholine and Glycerophosphocholine (GPC) in the basal ganglia and thalamus of schizophrenic patients compared to controls. GPC was also significantly lower in the cerebellum while Phosphorylethanolamine showed a trend for lower concentration in patients in the frontal region.

2145. Altered Fiber Radial Diffusivity in Schizophrenia Revealed by HARDI

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We performed a group comparison of the diffusion properties and intravoxel fiber coherence estimated by FORECAST analysis. Significantly higher FA is found in schizophrenia patients compared to healthy controls in the left superior longitudinal fasciculus and bilateral internal capsules. In all three regions, strong negative correlation between FA and radial diffusivity is found at both voxel and cluster levels, even after controlling for coherence variation. Significantly lower coherence is found between the two groups at the cluster level, but not voxel level. Our results suggest the altered FA was mainly due to structural rather than organizational changes in these regions.

2146. Comparison of Different CSF Correction Methods in a MRS Study of Depressed Psychiatric Patients

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Various methods have been used to correct for the amount of CSF within spectroscopic voxels. However, it remains unclear which method is best. We performed CSF correction on an MRS dataset comparing depressed psychiatric patients to normal controls, using the ratio to creatine as well as two anatomically-based CSF correction methods. All three CSF correction methods yielded significant results for most statistical comparisons; ROC analysis demonstrated no single CSF correction technique to be better than the others. If the metabolite value used in the denominator is stable, ratios may actually improve statistical sensitivity relative to anatomically-based CSF correction methods.

2147. fMRI and Connectivity Effects of Electro-Convulsive Therapy (ECT) in Depressed Patients

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ECT is a safe and effective treatment for depression. However its mechanisms have not been studied with the BOLD effect in a pre- and post-ECT fMRI and connectivity study. We present preliminary results that show reduced activation and connectivity in response to working memory and affective tasks.

2148. Decreased Anterior Cingulate Cortex GABA in Depressed Adolescents Measured by Proton MRS at 3T

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Adolescent major depressive disorder (MDD) is a serious public health concern as it often leads to suicide. However, limited research has been conducted to date in this clinical population. This is the first study to examine in vivo γ-aminobutyric acid (GABA) in adolescents with MDD. Using proton MRS, levels of GABA were measured in the anterior cingulate cortex of adolescents with MDD and found to be decreased compared to matched healthy control subjects. This finding supports the notion that GABA abnormalities may be involved early in the etiology of MDD.

2149. Reduced Functional Connectivity in Major Depression: A Whole Brain Study of Multiple Resting-State Networks

Ilya M. Veer[1,2], Christian F. Beckmann[3,4], Evelinda Baerends[1,2], Marie J. van Tol[1,5], Luca Ferrarini[6], Julien R. Milles[6], Dick J. Veltman[7], Andre Aleman[8], Mark A. van Buchem[1,2], Nic J. van der Wee[1,5], Serge A. Rombouts[1,2]

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Major depression is associated with abnormal function of a large-scale mood processing and regulating brain circuit of interconnected regions. Therefore, resting-state (RS) functional connectivity networks were investigated in a group of 19 medication-free patients diagnosed with major depressive disorder without comorbidity, and 19 age- and gender-matched healthy controls. Using independent component, 13 relevant RS networks were found for the entire group. Adopting a dual regression method, subject specific maps were calculated and subsequently used for permutation analysis. We found decreased functional connectivity in three networks, which may relate to the affective and cognitive symptoms in major depression.

2150. Investigating Transverse Relaxation Time Abnormalities in Autism

Yann Gagnon[1,2], N Rajakumar[3], Neil Gelman[1,2], Peter Williamson[3], Dick Drost[1,2], Jean Théberge[1,2], Rob Nicolson[3]

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Quantitative transverse relaxation time (T2) imaging offers a unique opportunity to evaluate the neurobiology of brain tissue. In the current study, we further localize our previously reported overall white matter T2 increase in a sample of children with autism to developmentally relevant neuroanatomic white matter regions.

2151. Aberrant Neurodevelopment of the Social Cognition Network During Adolescence in Autism Spectrum Disorders

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The autism spectrum disorders (ASD), during childhood, undergoes precocious growth, followed by maturation deceleration. But how the ASD brain changed during adolescence is unclear. We enrolled 25 male adolescents with ASD and 25 controls for voxel-based morphometric analysis. Global brain volume enlargement of ASD did not persist into adolescence. The right inferior parietal lobule and posterior cingulate cortex, a role in social cognition, had a significant interaction of age by group as indicated by an accelerated age-related loss in the adolescents with ASD but an age-related gain in the controls. The findings provided evidence of aberrant neurodevelopment in ASD.

2152. White Matter Abnormalities in Boys with Autism Spectrum Disorders: Preliminary Evidence from Diffusion Tensor Imaging

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Autism spectrum disorders (ASD) are characterized by qualitative impairments of reciprocal social interaction and deficits in communication, and stereotyped or repetitive pattern of behavior. A few reports have shown the abnormalities of white matter in

autism using diffusion tensor imaging (DTI), however there is still lack of evidence showing strong relation to abnormalities in white matter structural integrity with autism. We enrolled thirty four male subjects (17 ASD, 17 healthy controls, matched on age, IQ, handedness.). Our preliminary findings which showed significant reduction of FA in white matter structure related social cognition in ASD subjects compared control subjects support previous findings that social brain structure may be disrupted in ASD. These findings will help on understanding of more advanced neurobiological basis underlying the social deficits in ASD.

2153. Imaging Myelin in Autism

Janneke Zinkstok[1], Eileen Daly[1], Christine Ecker[1], Patrick Johnston[1], Shannon Kolind[2], Declan Murphy[1], Sean Deoni[2]

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Using the novel Multi-Component Driven Equilibrium Single Pulsed Observation of T1 and T2 (mcDESPOT) method, we quantitatively compared myelin content between individuals with autism and healthy controls. We found significantly reduced myelin content in adults with autism in brain regions previously implicated in autism, including the body of the corpus callosum, and in frontal, temporal, parietal and occipital regions; and in white matter tracts including the left and right uncinate, the left inferior occipitofrontal tract, the left inferior cerebellar peduncle, the left arcuate, the right anterior segment, the left inferior and superior longitudinal fasciculus, and the posterior segments bilaterally.

2154. Inter-Subject Comparison of Fractional Anisotropy in Attention-Deficit/hyperactivity Disorder

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In this study, white matter abnormalities of attention-deficit hyperactivity disorder were investigated using diffusion tensor imaging. Two different algorithms, including the well-known voxel-based morphometry (VBM) method and recently proposed tract-based spatial statistics (TBSS), were applied for inter-subject comparison. 26 male adolescents (12 ADHD patients and 14 age-matching control subjects) were recruited in this study. Significant decrease of FA was observed on white matter tracts widespread in a scattering pattern by the use of both methods in patients compared to the control group.

2155. MRS Measurement of GABA and Glutamate-Glutamine in Frontal Cortex in Obsessive-Compulsive Disorder

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This MRS study addressed GABA and glutamate-glutamine levels in a hypothesized abnormal neurochemical circuit in obsessive-compulsive disorder (OCD). Recent animal and human studies have implicated the glutamate system in OCD in these abnormalities. We used the J edited spin echo difference method to evaluate glutamate-glutamine and GABA in two frontal cortical regions, the anterior cingulate and dorsolateral prefrontal cortex in OCD. We found no differences between OCD subjects and controls in either measure in either brain region, suggesting that further studies are needed to fully characterize the neurochemistry of the hypothesized abnormal circuitry in OCD.

2156. Impaired Default-Mode Networks of Affective Disorders: Evidences of Image-Guided Proton MRS

Tzu-chen Yeh[1,2], Chih-Ying Lin[2], Cheng-Wen Ko[3], Ton-Ping Su[4], Wan-Yuo Guo[5], Jen-Chuen Hsieh[2], Low-Ton Ho[1]

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The spatial template of default-mode network (DMN) has been constructed and shown precuneus/posterior cingulate areas (PC, Brodmann area 31) with highest reproducibility in 60 normal subjects. High resting metabolic rate of DMN was implied by previous deoxy-glucose positron emission tomography. In this study of affective disorders (bipolar and major depressive disorders), bioenergetics of Brodmann area 24 and DMN was probed by total creatine using real-time localized image-guided proton magnetic resonance spectroscopy (ig-HMRS) and LCModel quantification. As compared to affective disorders, higher metabolism of PC (representing DMN) in normal subjects was supported by higher total creatine concentration.

***2157*. Glutamate Levels in the Anterior Cingulate Cortex Correlate with Self-Reported Impulsivity in Patients with Borderline Personality Disorder and Healthy Controls**

Mareen Hoerst[1,2], Wofgang Weber-Fahr[1], Nuran Tunc-Skarka[1], Matthias Ruf[1], Martin Bohus[2], Christian Schmahl[2], Gabriele Ende[1]

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Dysfunction and deficits in the structure of the anterior cingulate cortex (ACC) have been reported in borderline personality disorder (BPD). Impulsivity belongs to the key features of BPD and can be related to ACC function. In this study we found significantly increased self-reported impulsivity and higher levels of glutamate in the anterior cingulate cortex in subjects with BPD as compared to healthy controls. In both groups the ACC glutamate concentrations were positively correlated with self-reported impulsivity.

***2158*. Grey Matter Abnormalities in Adult Attention Deficit/hyperactivity Disorder as Measured with Structural MRI**

Natalia del Campo[1,2], Julio Acosta-Cabronero[3,4], Samuel R. Chamberlain, Dowson Jonathan[5], Tim D. Fryer, [4], Trevor W. Robbins, Barbara J. Sahakian[5], Ulrich Muller

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Attention deficit/hyperactivity disorder (ADHD) is the most prevalent psychiatric disorder in children. To date, little is known about the persistence and stability of anatomical changes in ADHD across the lifespan. 16 adult ADHD patients and 17 healthy controls undertook structural magnetic resonance imaging. Using cluster-based permutation analysis we found that ADHD patients had reduced grey matter density in distributed circuitries including the right inferior and middle frontal cortex, as well as bilateral putamen, hippocampus, amygdala and cerebellum. These findings add to a growing body of evidence implicating abnormalities in fronto-striatal, fronto-cerebellar and limbic circuitries in ADHD.

***2159*. A Systematic Analysis of Association Fiber Tracts in Chronic Alcoholics Found Significant Deficit of White Matter Integrity in Superior Longitudinal Fasciculus Using Diffusion Spectrum Imaging Tractography**

Cheng-Liang Liu[1], I-Chao Liu[2], Wen-Yang Chiang[3], Fang-Cheng Yeh[4], Li-Wei Kuo[1], Wen-Yih Isaac Tseng[1,5]

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In this study, we investigated the relationship between the effect of alcoholic use and the microstructural alteration of seven association fiber tracts using diffusion spectrum imaging tractography and tract-specific analysis. The metric of generalized fractional anisotropy (GFA) was used to identify the difference between control and alcoholic groups. Among all the association fiber tracts, a significant GFA deficit was found in bilateral superior longitudinal fasciculus for chronic alcoholics. A future study to analyze the segmented parts of the tract is needed to further reveal the subtle change of microstructural alteration of association fiber tracts in alcoholism.

***2160*. Frontal White Matter Choline-Containing Compounds Increase with Alcohol Consumption and Glutamate Decreases with Increasing Addiction Criteria**

Gabriele Ende[1], Derik Hermann[2], Mareen Hoerst[1], Nuran Tunc-Skarka[1], Gunilla Oberthuer[1], Svenja Wichert[2], Juri Rabinstein[2], Wolfgang Weber-Fahr[1], Karl Mann[2], Sabine Vollstaedt-Klein[2]

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With this 1H MRS study we aimed to investigate correlations between frontal white matter choline-containing compounds and glutamate with alcohol consumption and addictions scores in heavy drinking as well as in non-abstinent alcohol dependent patients. A positive correlation of choline-containing compounds and alcohol consumption could be replicated but the high variance could not be explained by addiction criteria (OCDS, ICD-10 and DSM IV). However, measures of addiction showed significant negative correlations with glutamate in the heavy drinking groups.

2161. Test and Retest of the Emotional Responses in Adolescents Prenatally Exposed to Cocaine

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The present fMRI study examined the interaction effect of prenatal cocaine exposure (PCE) and development on brain activations associated with emotional arousal, in adolescents. Comparing age 17 to 15, cortical responses elicited by negative emotional stimuli are reduced in the controls but remain roughly the same in the PCE adolescents. The present results suggest a long-term and stable PCE effect on emotional arousal regulation.

2162. Altered Cortical Thickness in Young Cannabis Abusers

Deborah Yurgelun-Todd[1,2], Piotr Bogorodzki[3], Melissa Lopez-Larson[1,2], Robert Kurjata[3], John Churchwell[1], Jadwiga Rogowska[4]

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It is unknown whether altered cortical thickness during adolescence is associated with marijuana (MJ) use. This investigation used cortical-surface based techniques to compare MJ using adolescents and healthy controls (HC). Eighteen adolescents with DSM-IV MJ Dependence and 18 HCs had an MRI scans using a 3T Siemens Trio scanner. Cortical reconstruction and volumetric segmentation was performed with the Freesurfer image analysis suite. Compared to HCs, MJ users had decreased cortical thickness in bilateral superior frontal cortex and bilateral and left insula. Furthermore, the average thickness of the right insula was found to negatively correlate with age of first MJ use.

2163. Perfusion Deficit to Cholinergic Challenge in Veterans with Gulf War Illness

Peiying Liu Wang[1], Sina Aslan[1], Xiufeng Li[2], David Buhner[3], Richard Briggs[2], Robert Haley[3], Hanzhang Lu[1]

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A highly plausible etiology for the Gulf War Illness (GWI) is that the neural damage and cognitive deficits are associated with excessive exposure to cholinesterase-inhibiting cholinergic stimulants. Our previous SPECT study provided strong indication that cerebral blood flow of veterans with Syndrome 2 GWI has reduced responses to cholinergic challenge, compared to unaffected control veterans. The present study confirmed and extended previous findings that patients with Gulf War Illness have abnormal response to an inhibitory cholinergic challenge, physostigmine infusion, when compared to age-gender-education matched control veterans. This new technique may provide a cost-effective biomarker for characterization of Gulf war illness.

2164. Cortical GABA and Glutamate Changes in Posttraumatic Stress Disorder

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We studied NAA, Glu and GABA levels in post traumatic stress disorder using magnetic resonance spectroscopy. We found lower NAA in the anterior cingulate, lower GABA in the posterior occipital cortex, and lower GABA and higher Glu in the medial temporal lobe as compared to control subjects. Metabolite levels related to PTSD symptomatology and suggest neuronal injury, perhaps associated with excitatory and inhibitory processes in cortical brain

Clinical Brain Tumor Imaging: Anatomic, MT, SWI & Perfusion MRI

Hall B Monday 14:00-16:00

2165. Potential Utility of Quantitative Magnetisation Transfer Imaging for Detection of Lesion Extent in Glioblastoma Multiforme

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Glioblastoma multiforme is an aggressive primary brain tumour, which invades preferentially along white matter tracts. Histopathological and PET evidence suggests that at the time of diagnosis, infiltrating tumour already exists at sites distant from the enhancing tumour visible on conventional anatomical MR imaging. Since MR is used to plan radiotherapy and surgery, there is

concern that infiltrating tumour may be missed, and may therefore escape optimal treatment. We provide preliminary evidence in two cases that quantitative magnetisation transfer (qMT) imaging can detect changes in white matter adjacent to glioblastoma which appear otherwise normal on conventional MR imaging.

2166. Perfusion MRI Fractional Tumor Bulk Mapping: Correlation with Multiple Stereotactic Biopsies in Recurrent GBM

Leland S. Hu[1,2], Seban Liu[3], Dilini S. Pinnaduwage[4], Kris A. Smith[5], Peter Nakaji[5], Amylou C. Dueck[6], Todd Jensen[7], Jennifer M. Eschbacher[8], Joseph E. Heiserman[2], John P. Karis[2], Josef Debbins[3], Burt G. Feuerstein[9], Kathleen M. Schmainda[10], Leslie C. Baxter[3]

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We present methods to calculate 'Perfusion MRI (pMRI) fractional tumor bulk,' which quantifies and spatially localizes areas of tumor recurrence within non-specific contrast enhanced (CE) MRI lesions. We correlate these measures with the percentage, or fraction, of tissue samples histopathologically diagnosed as tumor, in a group of recurrent Glioblastoma Multiforme (GBM) patients undergoing multiple stereotactic biopsies.

2167. Pseudo-Tumoral Response of Glioblastoma to Anti-Angiogenic Treatment Prematurely Revealed by Using Arterial Spin-Labeling (ASL) Perfusion MRI and Susceptibility Weighted Imaging (SWI).

Slim Fellah[1], Yann Lefur[1], Elisabeth Soulier[1], Céline Boucard[2], Sylviane Confort-Gouny[1], Olivier Chinot[2], Patrick J. Cozzone[1], Jean-Philippe Ranjeva[1], Virginie Callot[1]

[1]Centre de Résonance Magnétique Biologique et Médicale (CRMBM), CNRS UMR 6612, Faculté de Médecine, Marseille, France; [2]Unité de Neuro-Oncologie, CHU Timone, Marseille, France

Anti-angiogenics have become part of Glioblastoma therapeutic protocol. However pseudo-response followed by a critical recurrence may be observed. Non-responders thus need to be prematurely identified. However current imaging criteria are insufficient or late, new MR markers should therefore be investigated. In this preliminary study, we used a multimodal protocol including particularly ASL and SWI, which provide vascular information. A few weeks after the beginning of the treatment, FLAIR and post-contrast T1-WI showed partial response whereas perfusion MRI and SWI demonstrated hyperperfusion and vascularization increase. The parameters derived from such sequences should thus be considered as early indicators of tumor evolution.

2168. Longitudinal Monitoring of Low-Grade Glioma Transformation: A Fully-Automatic Method Using Quantitative DSC-MRI

Kyrre E. Emblem[1,2], Paulina Due-Tonnessen[1,3], Inge A. Rasmussen Jr[1], Atle Bjornerud[2,4]

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In this study, a fully-automatic method for longitudinal monitoring of low-grade glioma transformation by quantitative dynamic susceptibility contrast (DSC) MRI was evaluated and compared to conventional criteria for malignant glioma progression. Thirteen patients were imaged at least three times, with an average time between two consecutive MR exams of 283 days. Our results suggest that the fully-automatic method provides a sensitive marker for tumor progression at an early stage compared to conventional imaging criteria. Also, the quantitative tumor analysis and monitoring of baseline perfusion values in unaffected brain tissue, allows inter- and intra-patient comparisons across MR machines and institutions.

2169. Can Susceptibility-Weighted Imaging Determine Response to Combined Anti-Angiogenic, Cytotoxic, and Radiation Therapy in GBM Patients?

Janine M. Lupo[1], Soonmee Cha[1], Emma Essock-Burns[1,2], Nicholas Butowski[3], Sarah J. Nelson[1,2]

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This study investigated whether the unique contrast provided by SWI, which highlights heterogeneity within the post-gadolinium contrast enhancing brain tumor lesion, can predict response to treatment. Nineteen patients with newly-diagnosed GBM were imaged prior to beginning anti-angiogenic, cytotoxic, and radiation therapy and followed until progression. The volume of SWI hypointense

signal within the contrast-enhancing lesion was dramatically higher in patients who progressed after 1 year post-therapy compared to patients who progressed within 6 months of initiating treatment. These findings suggest that SWI could be advantageous for determining which patients would be the best candidates for adjuvant anti-angiogenic therapeutic strategies.

2170. Comparison of DSC-Derived Perfusion Parameters in Response to Conventional Therapy or Adjuvant Anti-Angiogenic Therapy in Patients Newly-Diagnosed with GBM

Emma Essock-Burns[1,2], Yan Li[1], Janine M. Lupo[1], Mei-Yin Polley[3], Nicholas Butowski[3], Susan M. Chang[3], Soonmee Cha, [1,3], Sarah J. Nelson[1,4]

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Adjuvant anti-angiogenic therapy may alter the presentation of contrast enhancement creating a clinical need for new methods of evaluating response. Dynamic susceptibility contrast enhanced imaging was used to assess vascular changes of patients newly diagnosed with GBM in response to either conventional (XRT+cytotoxic) or adjuvant anti-angiogenic therapy. A decrease in vascularization was observed early in adjuvant anti-angiogenic therapy. Progression-free survival status of patients receiving anti-angiogenic therapy may be dominated by an initial change in leakage, while PFS of patients receiving conventional therapy is not. This work highlights the need for further functional imaging techniques for the evaluation of response.

2171. Parametric Response Map as an Imaging Biomarker to Distinguish Progression from Pseudoprogression in High Grade Gliomas

Christina Tsien[1], Craig J. Galban[1], Thomas L. Chenevert[1], Timothy D. Johnson[1], Daniel A. Hamstra[1], Pia C. Sundgren[1], Larry Junck[1], Charles R. Meyer[1], Alnawaz Rehemtulla[1], Theodore Lawrence[1], Brian D. Ross[1]

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We have developed a reliable method for distinguishing true progression from pseudoprogression by quantifying on a voxel-wise basis therapeutic-associated hemodynamic alterations in patients with high grade glioma. The parametric response map of rCBV (PRM_{rCBV}) at week 3 during chemoradiation is shown to be a potential early imaging biomarker of response that may be helpful in distinguishing pseudoprogression from true progression in patients with high grade glioma.

2172. Quantitative Metrics Derived from DCE MRI as a Biomarker for Early Response to Radiation Therapy in Brain Metastases

Yue Cao[1], Felix Y. Feng, Diana Gomez-Hassan[2], James A. Hayman, Theodore S. Lawrence, Christina I. Tsien

[1]Radiology and Radiation Oncology, University of Michigan, Ann Arbor, MI, United States; [2]Radiology, University of Michigan, Ann Arbor, MI, United States

The response of metastatic lesions to whole brain radiation therapy (WBRT) is highly heterogeneous. In this study, we evaluated quantitative metrics derived from DCE MRI for early assessment of response of brain metastatic lesions to WBRT. We found that changes in vascular volume and perfusion at the completion of WBRT differentiated responsive lesions from non-responsive ones. These DCE metrics have the potential for early prediction of treatment response in brain metastases. This requires further validation, but may provide a means for individualizing therapy in patients with brain metastases by selecting patients requiring treatment intensification with stereotactic RT.

2173. Dynamic Contrast Enhanced and Susceptibility Based CBV Measurements Perform Equally in Grading of Cerebral Gliomas

Muftah Ahmed Manita[1], Paul Morgan[2], Keith Robson[3], Timothy Jaspan[3], Dorothee P. Auer[1]

[1]Academic Radiology, University of Nottingham, Nottingham, United Kingdom; [2]Radiology & Radiological Science, Medical University of South Carolina, United States; [3]Nottingham University Hospital, United Kingdom

Perfusion MRI DSC (T2*) has shown added values in glioma tumour differentiation with rCBVmax is the best performing metrics obtained from dynamic susceptibility contrast technique (DSC). However, this technique is susceptible to blood leak that results in rCBV overestimation. T1 MRI perfusion (DCE) is not susceptible to vascular disruption. Nineteen patients with low and high grade glioma underwent MR perfusion (T1 and T2*) was analysed with Java image software. Significant difference (P=0.000) with excellent correlation (0.81) between the two tumour grades in both techniques with accuracy of 100%. T1 based DCE is robust technique to follow postoperative cases.

2174. Enhancing Fraction and Survival in Glioblastoma Multiforme

Samantha Jane Mills[1,2], Calvin Soh[2], Gerard Thompson[1], Giovanni Buonaccorsi[1], Catherine McBain[3], Sha Zhao[1], Geoff James Martin Parker[1], Alan Jackson[1,2]

[1]Imaging Science and Biomedical Engineering, University of Manchester, Manchester, Greater Manchester, United Kingdom; [2]Department of Neuroradiology, Salford Royal Foundation Trust Hospital, Salford, Greater Manchester, United Kingdom; [3]Department of Clinical Oncology, Christie Hospital, Manchester, Greater Manchester, United Kingdom

This study describes the relationship between the DCE-MRI derived measure, Enhancing Fraction, and overall survival in patients with Glioblastoma Multiforme, with the findings of increased survival in association with elevated Enhancing Fraction.

Imaging of Brain Tumors: Techniques & Contrast Media

Hall B Tuesday 13:30-15:30

2175. Delta T1 Method: An Automatic Post-Contrast ROI Selection Technique for Brain Tumors

Devyani Bedekar[1,2], Todd Jensen[3], Scott Rand[1,4], Mark Malkin,[2,5], Jennifer Connelly,[2,5], Kathleen Schmainda,[2,6]

[1]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Translational Brain Tumor Research Program, Medical College of Wisconsin, Milwaukee, WI, United States; [3]Imaging Biometrics, Milwaukee, WI, United States; [4]Translational Brain Tumor Research Program, Medical College of Wisconsin, Milwaukee, WI, United States; [5]Neurology, Medical College of Wisconsin, Milwaukee, WI, United States; [6]Radiology & Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States

The primary approach to monitoring patients with brain tumors is to obtain pre and post-contrast T1-weighted images. Bright areas on the pre-contrast images are suggestive of blood products, which may be a result or treatment, and are therefore not to be considered as enhancing lesions on the post-contrast images. However, the difference between the brightness that exists on both the post and pre-contrast images can be quite subtle, a condition that is occurring more frequently now with the increasing use of anti-angiogenic agents. Therefore it is becoming increasingly difficult to monitor patients with brain tumors simply by visually comparing differences in enhancement. As a solution in this report we propose an automatic method, the delta T1 method (dTM), which is capable of detecting even subtle enhancing tumor free of blood products, thereby enabling the automatic creation of ROIs in a fast and reliable manner that avoids subjective variability.

2176. Analysis of Brain Tumors and Metastases by Quantitative MT Imaging with BSSFP: Initial Experiences

Meritxell Garcia[1], Monika Gloor[2], Christoph Stippich[1], Felix Jax[1], Klaus Scheffler[2], Oliver Bieri[2]

[1]Department of Neuroradiology, University of Basel Hospital, Basel, Switzerland; [2]Radiological Physics, University of Basel Hospital, Basel, Switzerland

The efficacy of quantitative MT (qMT) imaging for characterization of benign and malignant brain lesions is analyzed with balanced steady-state free precession. Eleven patients with 3 different lesions (4 glioblastoma multiforme, 4 meningeomas and 3 metastases) were investigated on a clinical 1.5T MR-scanner. MT-effects are described in terms of MTR, relaxation times (T1, T2), MT exchange rate (kf) and the macromolecular content (F). Marked divergences between contrast-enhancing regions, edema and normal-appearing brain were found within and between the different lesions, which might be attributed to differences in edema, cell infiltration and myelin properties. Thus, qMT-imaging might play a major role in adding information for diagnostic tumor characterization.

2177. Magnetic Resonance Imaging Contrast of Brain Tumors at 7 Tesla Compared to 3 Tesla

Iris-Melanie Noebauer-Huhmann[1], Pavol Szomolanyi[1,2], Claudia Kronnerwetter[1], Siegfried Trattnig[1]

[1]MR Centre - High field MR, Department of Radiology, Medical University of Vienna, Vienna, Austria; [2]Department of Imaging Methods, Institute of Measurement Science, Slovak Academy of Sciences, Bratislava, Slovakia

It is well known that the effect of MR contrast agents is influenced by the magnetic field strength. The aim of the study was to compare the diagnostic efficacy of a Gadolinium-based MRI contrast agent (gadobenate dimeglumine) in primary brain tumors at 7Tesla versus 3Tesla. Post contrast MP-RAGE sequences were evaluated by region of interest measurements. At 7Tesla, the tumor-to-brain-contrast after gadolinium administration was significantly higher (91.4) than at 3Tesla (37.3). Further studies will show if the higher tumor-to-brain-contrast post gadolinium administration at 7Tesla may be beneficial for tumors with minor contrast agent accumulation, or allow for a dose reduction.

2178. Ultra-High Field MRI of Primary Brain Tumors: Contrast and Resolution

Fernando Emilio Boada[1], Yongxian Qian[1], Frank Lieberman[2], Denise Davis[1], Ronald Hamilton[3]

[1]MR Research Center, University of Pittsburgh, Pittsburgh, PA, United States; [2]Neurooncology, University of Pittsburgh, Pittsburgh, PA, United States; [3]Department of Neuropathology, University of Pittsburgh, Pittsburgh, PA, United States

Imaging of primary brain tumors at Ultra-High Field (UHF) magnetic resonance imaging (MRI) has tremendous appeal due to the expected improvements in contrast at spatial resolution scales previously unpractical for in vivo human MRI. In this work we demonstrate the use of UHF for evaluating the microvascular structure of brain tumors and the improvements in signal quantification during sodium MRI

2179. Combined ^{31}P and ^{1}H Magnetic Resonance Spectroscopic Imaging of Phosphomono and -Diesters in Human Brain Tumors at 3T.

Jannie Petra Wijnen[1], Tom W.J. Scheenen[1], Arend Heerschap[1]

[1]Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Gelderland, Netherlands

We demonstrated the clinical feasibility of combined ^{1}H and ^{31}P MRSI with sensitivity enhancement by polarisation transfer of ^{1}H to ^{31}P spins of human brain tumours at 3T to uncover the composition of (phosphorylated)choline and phosphorylated ethanolamine compounds in the membrane. Preliminary results from 4 patients with different tumour types show potentially important differences among tumours. This opens a window on a detailed view of the levels of some key metabolites in membrane phospholipid metabolism of human tumours.

2180. Multi-Echo Time Approach for Study of Metabolic Profiles in Brain Tumors at 3T

Changho Choi[1], Ivan Dimitrov[1,2], Deborah Douglas[1], Aditya Patel[1], Hao Huang[1], Ralph Deberardinis[3], Juan Pascual[4], Robert Bachoo[5], Craig Malloy[1], Elizabeth Maher[6]

[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Philips Medical Systems, Cleveland, OH, United States; [3]Pediatrics, University of Texas Southwestern Medical Center, Dallas, TX, United States; [4]Neurology, Physiology and Pediatrics, University of Texas Southwestern Medical Center, Dallas, TX, United States; [5]Neurology, University of Texas Southwestern Medical Center, Dallas, TX, United States; [6]Internal Medicine and Neurology, University of Texas Southwestern Medical Center, Dallas, TX, United States

Echo time dependence of coupled-spin metabolites following point-resolved spectroscopy (PRESS) at 3T has been investigated with computer simulations. Three pairs of PRESS subecho times, (TE1, TE2) = (32, 22), (32, 80), and (32, 214) ms, were selected for optimum selectivity of glutamate and glutamine, and used for in vivo measurements of metabolites in brain tumors. We present preliminary in vivo results that show pronounced abnormalities of metabolic profiles, including elevated glutamine and glycine in glioblastoma multiforme and differentiation between lipids and lactate in low- and high-grade gliomas.

2181. In Vivo MRI of MR-Labeled Neural Stem Cell Migration to Gliomas

Bensheng Qiu[1], Daohai Xie[2], Piotr Walczak[3], Xubin Li, Jesus Ruiz-Cabello[3], Satoshi Minoshima, Jeff W.M. Bulte[3], Xiaoming Yang

[1]University of Washington, Seattle, WA, United States; [2]Radiology, Suzhou University School of Medicine; [3]The Johns Hopkins University

Neural stem cells (NSC) have been recognized as cellular vehicles for treatment of invasive brain tumors. MRI is a unique non-invasive tool to monitor the migration of stem cells labeled with MR contrast agents, such as superparamagnetic iron oxide (SPIO) particles. Pervious studies have confirmed that magnetosonoporation (MSP) can instantly labeled SPIO into stem cells. The aim of this study was to validate the feasibility of MRI of MSP-labeled NSC migration to gliomas in vivo.

2182. The Effect of Fiber Affinity on Predicted Cancer Cell Migration Based on MR-DTI

Anitha Priya Krishnan[1], Delphine Davis[2,3], Paul Okunieff[3], Walter G. O'Dell, [1,3]

[1]Biomedical Engineering, University of Rochester, Rochester, NY, United States; [2]Imaging Sciences, University of Rochester, Rochester, NY, United States; [3]Radiation Oncology, University of Rochester, Rochester, NY, United States

The current methods for determining the treatment margin for Stereotactic Radiotherapy of gliomas are inadequate as recurrences often occur at the boundary of the treatment margin. We developed a random walk model to determine the microscopic spread of tumor cells to facilitate in the development of anisotropic treatment margins. In this study we have shown that the affinity of cancer cells to fibers in the brain can be modeled better by the spread in the direction of migration about the Principal Diffusion Direction determined using DTI than by using a variable step-size in the random walk of cancer cells.

2183. Correlating DTI-Based Cancer Cell Migration Model Predictions with the Location of Secondary Tumors

Anitha Priya Krishnan[1], Delphine Davis[2], Paul Okunieff[3], Walter G. O'Dell[3]

[1]Biomedical Engineering, University of Rochester, Rochester, NY, United States; [2]Imaging Sciences, University of Rochester, Rochester, NY, United States; [3]Radiation Oncology, University of Rochester, Rochester, NY, United States

The current methods for determining the treatment margins for stereotactic radiotherapy of gliomas is inadequate as the tumor often recurs at the boundary of the treatment margin. The areas of high normalized cell migration predicted by our random walk model

coincide with the direction along which the tumor recurs. Here we have established that there is a statistically significant correlation between the model predictions and the recurrence site and the average normalized cell concentration in the recurrence site is higher than the normalized cell concentration in 78% of the voxels on a surface equidistant from the primary tumor surface.

2184. Decreased Cerebral Oxygen Extraction Fraction (OEF) Measured by MR QBOLD Following Stereotactic Radiosurgery (SRS) in Patients with Metastatic Brain Tumors

Parinaz Massoumazdeh[1], Xiang He[1], Sarah Jost[2], Keith Rich[3], Dmitriy Yablonskiy[1], Tammie Benzinger[4]

[1]Mallinckrodt Institute of Radiology, Washington University in Saint Louis; [2]Swedish Hospital, Seattle, WA, United States; [3]Neurosurgery, Washington University in Saint Louis; [4]Mallinckrodt Institute of Radiology, Washington University in Saint Louis, St. Louis, MO, United States

There is growing evidence that solid organ tumors with ability to grow in hypoxic conditions demonstrate resistance to conventional chemotherapy and radiation therapy. Here, we used MR qBOLD technique to measure the OEF of metastatic brain tumors before and after SRS. In this population, OEF of both the tumors and peritumoral edema prior to SRS was elevated. Following SRS, OEF decreased in the areas of lesions. This suggests that qBOLD OEF may provide a new method to monitor brain tumor response to therapy.

2185. A Comparison of Signal Intensity & DCE-MRI Based Methods for Assessing Enhancing Fraction

Samantha Jane Mills[1,2], Gerard Thompson[1], Giovanni Buonacorrsi[1], Geoff James Parker[1], Alan Jackson[1,2]

[1]Imaging Science and Biomedical Engineering, University of Manchester, Manchester, United Kingdom; [2]Department of Neuroradiology, Salford Royal Foundation Trust Hospital, Salford, Greater Manchester, United Kingdom

The established technique for measuring Enhancing Fraction utilises the initial area under the concentration curve derived from a DCE-MRI acquisition. This can be time consuming and requires complex post processing analysis. This study examines the feasibility of obtaining an measure of Enhancing Fraction from conventional, pre and post contrast T1weighted imaging and compares this to the established DCE-MRI derived technique. The two methods show good correlation but are not directly interchangeable methods of measuring Enhancing Fraction.

2186. Simultaneous Resting State FMRI and FET-PET

Irene Neuner[1,2], Joachim Bernhard Maria Kaffanke[1], Cornelius Werner[1,2], Martina Reske[1,3], Karl-Joseph Langen[1], Hans Herzog[1], N. Jon Shah[1,2]

[1]Institute of Neurosciences and Medicine 4, Medical Imaging Physics, Forschungszentrum Jülich GmbH, 52425 Juelich, Germany; [2]Faculty of Medicine, Department of Neurology, RWTH Aachen University, 52074 Aachen, Germany; [3]Department of Psychiatry, University of California San Diego, San Diego, CA, United States

For the planning of surgical intervention in human brain tumour cases, it is important to know if critical brain areas might be affected by the surgical process itself. PET imaging using radiolabelled amino acids is a valuable technique for the diagnosis of cerebral gliomas. O-(2-[18F]Fluorethyl)-L-Tyrosin (FET) is a well established amino acid tracer that delivers information about tumour extent, the optimal biopsy site and detection of tumour recurrences. In this study, FET-PET and BOLD-fMRI data were acquired simultaneously; data from a representative human brain tumour case are presented. In contrast to task-based functional studies, resting state fMRI offers the opportunity to detect a variety of cortical networks in a single experiment.

2187. Multi-Layer Appearance of Abscess Capsule on Post-Gd SWI Images: Effects of Filtering and Phase Mask

Ping-Hong Lai[1,2], Hing-Chiu Chang[3,4], Hsiao-Wen Chung[4]

[1]Department of Radiology, Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan; [2]School of Medicine, National Yang-Ming University, Taipei, Taiwan; [3]Applied Science Laboratory, GE Healthcare Taiwan, Taipei, Taiwan; [4]Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan

SWI is a novel MR technique that exploits the magnetic susceptibility differences of various tissues, such as venous structure and iron deposition. When SWI was applied to patients with abscess, we found that, compared with homogeneous rim-enhancement on post-contrast magnitude images, the capsular portion of pyogenic brain abscess on post-contrast SWI images showed a multi-layer appearance. In this work, in order to clarify whether this multi-layer characteristic is physiological or technical in it origin, we investigate the causes of this multi-layer appearance, and use a theoretical model to simulate the multi-layer appearance upon the use of different SWI processing parameters.

2188. When Does Brain Motion Interfere with the Accuracy of Stereotactic Radiosurgery? Investigation of Brain Motion in the Presence of Stereotactic Frame.

Dee H. Wu[1], Jesse Hatfield[1], Jignesh Modi[1], Genu Mathew[1]

[1]Radiological Sciences, University of Oklahoma Health Sciences Center, Oklahoma City, OK, United States

The aim of stereotactic radiosurgery is to provide accurate placement of radiation localized to targeted diseased tissues while minimizing placement of large doses of radiation into sensitive normal tissues (such as motor strip, brain stem, internal capsule, optic nerve, and other major nerve bundles). It is well known that the brain moves during the cardiac cycle in which the action of pulsatile blood flow produces brain expansion and contraction. Such movement provides a potential conflict with the objective of providing millimeter to submillimeter localization accuracy of radiation treatment. This has led to recommendations for the use of electronic

gating of radiosurgery placement. While brain motion was extensively studied in the early 1990s(1, 2), and has been a source of debate for more recent studies for the degree of head fixation required for patients for presurgical planning with fMRI (3). Such brain motion has been cited to be on the order of 0.5 mm for controlled studies over a short period of time (minutes), to 1-3 millimeters over the course of an fMRI experiment when standard to minimal head fixation is used (4). None of these studies were performed with such stringent fixation as that provided during radiotherapy. The frames such that include head fixation with the insertion of metal pins attached to the patient skull with metallic frames.

2189. Image-Guided Tissue Validation of Combined Preload Dosing and Mathematical Modeling Correction of Perfusion MRI Measures

Leland S. Hu[1,2], Leslie C. Baxter[3], Dilini S. Pinnaduwage[4], Todd Jensen[5], Amylou C. Dueck[6], Jennifer M. Eschbacher[7], Joseph E. Heiserman[2], John P. Karis[2], Josef Debbins[3], Jonathan Placencia Placencia[8], Seban Liu[3], Burt G. Feuerstein[9], Kathleen M. Schmainda[10]

[1]Radiology, Mayo Clinic, Arizona, Scottsdale, AZ, United States; [2]Radiology, Neuroradiology Section, St. Joseph's Hospital - Barrow Neurological Institute, Phoenix, AZ, United States; [3]Keller Center for Imaging Innovation, St. Joseph's Hospital - Barrow Neurological Institute, Phoenix, AZ, United States; [4]Radiation Oncology, University of California - San Francisco, San Francisco, CA, United States; [5]Imaging Biometrics, LLC; [6]Biostatistics, Mayo Clinic, Arizona, Scottsdale, AZ, United States; [7]Neuropathology, St. Joseph's Hospital - Barrow Neurological Institute, Phoenix, AZ, United States; [8]Biomedical Engineering, Arizona State University, Tempe, AZ, United States; [9]Neuro-Oncology, St. Joseph's Hospital - Barrow Neurological Institute, Phoenix, AZ, United States; [10]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States

We validate mathematical modeling correction of relative cerebral blood volume (rCBV) in regards to effectiveness of 1) minimizing T1W leakage and 2) correcting T2/T2*W residual effects, by correlating localized measures with image-guided tissue histopathology and microvascular density from stereotactic biopsies in post-treatment high-grade gliomas.

2190. Automatic Segmentation of Optic Pathway Gliomas Using Multiparametric Mri Methods

Liat Ben Sira[1], Lior Weizman[2], Leo Joskowicz[2], Ronit Precel[1], Shlomi Constantini[3,4], Dafna Ben Bashat[5]

[1]Department of Radiology , Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; [2]School of Eng and Computer Science, The Hebrew Univeristy of Jerusalem, Jerusalem, Israel; [3]The Paediatric Neurosurgery Department, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; [4]Sackler Faculty of Medicine, Tel Aviv University, Tel-Aviv, Israel; [5]The Wohl Institute for Advanced Imaging, Brain Imaging Center, Tel Aviv Sourasky Medical Center , Tel-Aviv, Israel

Accurate and consistent volumetric measurements of optic pathway gliomas (OPG), the most common tumor in the brain in patients with Neurofibromatosis, are clinically crucial. In this study we present an automatic method for segmentation of OPGs from multi-spectral MRI datasets. The method effectively incorporates prior location of the OPG, its shape and intensity and accurately identifies the boundaries in a consistent and repeatable manner. The method was tested on 15 data sets, the optimal threshold was derived from a receiver operating characteristic curve, and a significant correlation was obtained between the volume calculated using this method compared to manual measurements.

2191. Translational Methods for Retrospective Long Term Evaluation of Cancer with MRS

Dee H. Wu[1], Levi Garrett[1], Jignesh Modi[1], Bowei Han[1], Hans Cao[1]

[1]Radiological Center, University of Oklahoma Health Sciences Center, Edmond, OK, United States

We have created a procedure for retrospective review of digitized MRS images that permits fundamental baseline removal and frequency bracketing with the target of creating a user-friendly tool. This newly created clinical workflow will improve long term care for patients that may require important decisions pertaining to whether the status of a tumor has changed (such as tumor reoccurrence or remission). A central concept is that we have also conducted tolerance testing in which common confounds to artifacts that arise from shimming, electronic noise, field inhomogenity, coil sensitivities, relaxation.

2192. MR Biomarkers of Tyrosine Kinase Inhibition in Mouse Gliomas

Paul A. Schornack[1], Jia-Jean Yiin, Bo Hu, Raghvendra S. Sengar, Ken-Wei Liu, Haizhong Feng, Frank S. Lieberman, Jann N. Sarkaria[2], Erik Wiener, Hsin-I Ma[3], Shi-yuan Cheng

[1]Radiology, University of Pittsburgh, Pittsburgh, PA, United States; [2]Mayo Clinic; [3]Taiwan National Defense Medical Center

We present a comparison of MR techniques sensitive to T2, T2*, & ADC to measure mouse gliomas & correlate with histology. We compare untreated mice with mice treated with an anti-angiogenic agent, ZD6474 (Zactima, vandetanib), a dual inhibitor of VEGFR2 & EG. ZD6474 significantly inhibited growth & angiogenesis of gliomas expressing EGFRvIII by specifically blocking signaling transducers in brain, which suggests a potential application in treatments for gliomas that overexpress this factor. Our results indicate that susceptibility/T2* weighted MR along with ADC and T2 measurements can be used as a means of non-invasively quantifying the efficacy of such treatment protocols.

2193. Characterization of Brain Tumor Using High Order Diffusion Imaging

Chu-Yu Lee[1], Chris Goettl[2], Leslie C. Baxter[3], John P. Karis[3], Josef P. Debbins, [1,3]
[1]Electrical Engineering, Arizona State University, Tempe, AZ, United States; [2]College of Medicine, University of Arizona, Phoenix; [3]Barrow Neurological Institute, Phoenix

Brain neoplasms are typically characterized by contrast enhanced T1 imaging. Depending on the course of treatment, tumor reoccurrence remains a possibility, and can be difficult to distinguish from other enhancing areas, for example post-treatment radiation effects (PTRE), typically necrosis [1]. Further, detailed information about the tumor heterogeneity as detected by standard MR methods is not generally available, but can play a significant role in characterizing and grading the tumor. In this work, a simple multi-b-value DWI sequence has been developed to better understand the heterogeneity and diffusion characteristics of different types of tumors, encountered during routine clinical scanning. The signal decay is fitted with two recently developed diffusion models: a stretched exponential (£\-DWI) [2] and a cumulant expansion (DKI) [3] model, where fitted parameters £\ and Kapp were shown to correlate the diffusion heterogeneity. We expected to see differences in alpha and K when the multi-b-value DWI sequence directed to the anatomy of interest, primarily due the heterogeneity of the more advanced tumors.

2194. Tumor Enhancement in a Brain Glioma Model: An Intra-Individual Comparison of Half Dose Gadobenate Dimeglumine Vs Full Dose Gadopentetate Dimeglumine at 1.5 and 3 T

Ulrike I. Attenberger[1], Val M. Runge[2], Jonathan Williams[3], Henrik J. Michaely
[1]Department of Clinical Radiology and Nuclear Medicine, University Medical Center Manheim, Germany, Mannheim, Baden-Württemberg, Germany; [2]Scott & White Clinic and Hospital, Texas A&M University Health Science Center, Department of Radiology , Temple, TX, United States; [3]Department of Radiology, , Scott & White Clinic and Hospital, Texas A&M University Health Science Center, Temple, TX, United States

Regarding nephrogenic systemic fibrosis (NSF), the injected dose level becomes very important, since NSF is reported to be related to gadolinium chelate injection in patients with an impaired renal function, depending upon chelate stability and dose. With gadobenate dimeglumine, a chelate with transient protein binding and a higher r1 relaxivity became available. Combining a high relaxivity chelate and 3 T offers multiple opportunities for dose reduction without loss in image quality. This was proven in a rat brain glioma model at 1.5 and 3 T, comparing half dose gadobenate dimeglumine vs full dose gadopentetate dimeglumine, a standard extracellular gadolinium chelate.

2195. MRI Acceptance Protocol for the Multicenter GO Glioblastoma Project

Sylvain Ollivro[1,2], Pierre Antoine Eliat[3], Eric Hitti, [2,3], Loan Tran[1], Jacques Donald de Certaines[1,4], Hervé Saint-Jalmes[2,4]
[1]Cancéropôle Grand Ouest, Rennes, France; [2]LTSI, INSERM, U642, Université Rennes 1, Rennes, France; [3]PRISM, IFR 140/Biogenouest, Université Rennes 1, Rennes, France; [4]CRLCC, Rennes, France

We have verified thanks to a specific common quality control that 7 MRI devices included in a multicenter clinical project, had homogenous and acceptable characteristics to allow quantification and comparison between parameters extracted from different patient images acquired on different sites and to permit correlation with biopsies. This quality control was established with sequences from the MRI protocol. The studied parameters slightly varied depending on the different sites and MRI manufacturers and were in the awaiting of the project. This kind of quality control procedure should be included at the early beginning of any multicenter clinical projects involving quantitative MRI.

2196. Large Scale Comparison of Gadobenate Dimeglumine and Comparator Agents

Matthew J. Kuhn[1], Howard A. Rowley[2], Michael V. Knopp[3], Kenneth R. Maravilla[4], Zoran Rumboldt[5]
[1]Radiology, University of Illinois at Peoria, Peoria, IL, United States; [2]Radiology, University of Wisconsin, Madison, WI, United States; [3]Radiology, Ohio State University, Columbus, OH, United States; [4]Radiology and Surgery, University of Washington, Seattle, WA, United States; [5]Radiology, Medical University of South Carolina, Charleston, SC, United States

382 patients were randomized to receive 2 MR exams within 2 days to 2 weeks with equal 0.1mmo/kg doses of either gadobenate dimeglumine (N=382) or a comparator gadolinium agent. Blinded experts assessed post-contrast images for both qualitative (eg, global contrast enhancement, lesion-to-brain contrast, lesion delineation, internal lesion morphology and structure, tumor vascularization, and global image preference) and quantitative (eg, contrast-to-noise ratio [CNR]; percent lesion enhancement) efficacy parameters. In all six studies, images produced following administration of Gd-BOPTA demonstrated greater contrast enhancement, provided more diagnostic information including additional lesion detection, and were significantly preferred by experienced, blinded neuroradiologists.

Brain Tumor Imaging: Diffusion, MRS & High-Field Imaging

Hall B Wednesday 13:30-15:30

2197. **Assessment of Invasion and Recurrence in Glioblastoma Multiforme Using Diffusion Weighted MRI Edge Characteristics of Contrast Enhancing Tumor**

Peter Sherman LaViolette[1,2], Benjamin M. Ellingson,[2,3], Jennifer M. Connelly,[2,4], Mark G. Malkin,[2,4], Scott D. Rand,[2,3], Kathleen M. Schmainda[1,2]

[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Translational Brain Tumor Program, Medical College of Wisconsin, Milwaukee, WI, United States; [3]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States; [4]Neurology, Medical College of Wisconsin, Milwaukee, WI, United States

Traditionally, brain tumor recurrence is defined as new MRI contrast enhancement apparent in follow-up imaging. This study shows that diffusion weighted MRI edge characteristics of contrast enhancing tumors show measurable differences indicative of tumor invasion prior to contrast enhancing recurrence

2198. **Determination of Structural Differences Between Glioblastomas and Metastases by Diffusion Kurtosis Imaging**

Peter Raab[1,2], Elke Hattingen[2], Kea Franz[3], Friedhelm E. Zanella[2], Heinrich Lanfermann[1,2]

[1]Neuroradiology, Hannover Medical School, Hannover, Germany; [2]Neuroradiology, JW Goethe University, Frankfurt/Main, Germany; [3]Neurosurgery, JW Goethe University, Frankfurt/Main, Germany

Diffusion kurtosis imaging evaluates the non-Gaussian diffusion pattern of water and indicates tissue structure complexity. In this diffusion study we found differences between glioblastomas and cerebral metastases, that indicate more directed diffusion in glioblastomas and a higher structural complexity in metastases.

2199. **Fiber Density Mapping in Patients with Gliomas: Histopathologic Evaluation of a Novel Approach for Post-Processing of DTI Data**

Andreas Stadlbauer[1,2], Michael Buchfelder[2], Oliver Ganslandt[2]

[1]MR Physics Group, Department of Radiology, Landesklinikum St. Poelten, St. Poelten, Austria; [2]Department of Neurosurgery, University of Erlangen-Nuremberg, Erlangen, Germany

To histopathological evaluate fiber density mapping (FDM) in glioma patients for assessment of the extent of destruction of white matter structures in the center, the transition zone and the border zone of gliomas. We correlated FDM-data and histopathological findings from 78 stereotactic biopsies of 20 glioma patients. We found a negative logarithmic correlation of fiber-density with both, % tumor infiltration and tumor cell number. For a tumor infiltration of >60% no fibers are remaining. In tumor regions with <16% tumor cells functional important fiber structures may still exists. Our histopathology-fiber-density-model may be helpful for preoperative-planning to prevent post-therapeutic neurologic deficits.

2200. **Graded Functional Diffusion Maps (FDMs) Applied to the Whole Brain: A Sensitive Imaging Biomarker for Monitoring Brain Tumor Growth and Invasion**

Benjamin M. Ellingson[1,2], Mark G. Malkin[1,3], Scott D. Rand[1,2], Jennifer M. Connelly[1,4], Pete S. LaViolette[1,5], Devyani P. Bedekar[1,2], Kathleen M. Schmainda[1,2]

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Diffusion weighted imaging (DWI) measures of apparent diffusion coefficient (ADC) is believed to reflect the level of tumor cellularity in malignant gliomas. Functional diffusion maps (fDMs) were developed to examine voxel-wise changes in ADC, then stratify voxels as either increasing ADC (indicative of necrosis or "hypocellularity"), decreasing ADC (indicative of growing tumor or "hypercellularity"), or not changing within regions of contrast-enhancement or FLAIR signal abnormality. Because the particular threshold used for voxel classification dictates the sensitivity and specificity to changes in tumor cell density, we hypothesize that a graded fDM technique that stratifies voxels into varying degrees of change, applied to the whole brain, may be useful for visualizing invading and proliferating tumor with both high sensitivity and specificity. In the current study we examine graded fDMs in 120 patients and discuss how graded fDMs can be used to detect and monitor brain tumor growth and invasion beyond the traditional malignant boundary.

2201. Differentiating Malignant Glioma from Metastasis Using Regions of Interest Generated by a Novel Diffusion Tensor Segmentation Algorithm

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Difficulties can arise in clinical practice in differentiating between primary malignant glioma and brain metastasis owing to their similar appearances on conventional MRI sequences. Although previous studies have identified differences in diffusion parameters between the tumour types, the diagnostic role of diffusion tensor imaging (DTI) has yet to be fully elucidated. We propose an application of a novel whole brain DTI segmentation algorithm in generating regions of interest (tumour and oedema) from Diffusion Colour Maps (DCMs) created using our technique. We identify differences in diffusion between tumour types, compare our method with conventional manually drawn regions of interest and propose potential clinical applications for our method.

2202. Assessment of Diffusion Parameters in Scans Prior to Progression in GBM Patients Following Anti-Angiogenic Therapy

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Diffusion-weighted Imaging (DWI) is an important adjunct to standard imaging in the management of GBM patients receiving anti-angiogenic treatments. In this study, ADC values were obtained for a) areas on preprogression scans that ultimately progressed to new contrast-enhancement on progression scans (NEW_CEL), and b) new FLAIR abnormality on preprogression scans with exclusion of areas of contrast enhancement and areas that progress to new contrast-enhancement on progression scans (T2ALL_M). Results demonstrated increasing ADC values in NEW_CEL but no change in T2ALL_M in scans prior to progression. Clinical implications include interpreting new FLAIR abnormality as a consequence of anti-angiogenic treatment alone.

2203. Comparison of Glioma Sub-Populations Using In-Vivo ADC Values and Ex-Vivo ^{1}H HR-MAS Spectroscopy

Adam Elkhaled[1], llewellyn Jalbert[1], Hikari Yoshihara[1], Gaby Bourne[1], Colleen Cloyd[1,2], Joanna Phillips[3], Soonmee Cha[1], Susan M. Chang[4], John Kurhanewicz[1,5], Radhika Srinivasan[1], Sarah J. Nelson[1,5]

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Characterization of glioma recurrence and grade transformation has remained elusive. Image-guided biopsies from glioma patients were evaluated using pathology, in-vivo ADC, and ex-vivo proton HR-MAS spectroscopy. Newly diagnosed and recurrent grade IV tissue samples were found indistinguishable from one another. A comparison of recurrent grade IV to recurrent low-grade glioma revealed a significant difference in [myo-inositol] and [creatine]; recurrent low-grades which had upgraded displayed higher total choline compared to non-upgraded and high-grade glioma; the [myo-I]/[total choline] ratio differentiated non-upgraded low-grades from all other cohorts. ADC values demonstrated an inverse relationship with tumor grade and negative correlation with glutathione.

2204. Finding Early Prognostic Marker from 3D ^{1}H-MRSI and Diffusion Tensor Imaging for Newly-Diagnosed GBM Patients Receiving Radiation, Temozolomide and PKC Inhibitor

Ilwoo Park[1,2], Adam Elkhaled[2], Achuta Kadambi[2], Inas Khayal[2], Nicholas Butowski[3], Susan M. Chang[3], Sarah J. Nelson[1,2]

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The purpose of this study was to use 3D ^{1}H MR Spectroscopic Imaging (MRSI) and diffusion tensor imaging (DTI) to develop early prognostic markers for GBM patients undergoing radiation, temozolomide and PKC inhibitor. Twenty-nine patients with newly diagnosed GBM were examined using a 3T MR scanner. Conventional anatomical imaging parameters could not distinguish between progression groups at baseline or 1 month. Parameters derived from MRSI and DTI provided information at baseline and early follow-up examinations that may be valuable in predicting the time-to-progression for patients with GBM.

2205. Longitudinal MRSI Study in Newly Diagnosed Glioblastoma Multiforme

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Glioblastoma Multiforme (GBM) is the most common and malignant type of primary brain tumor, resulting in a median survival of approximately one year. Our study of 18 patients with GBM indicated that metabolic abnormalities more accurately reflect the underlying tumor burden. We found that the Cho to NAA index (CNI) values in the contrast-enhancing lesion (CEL) are elevated at 2 months prior to progression while having less changes in CEL volume at that time. Patients who have a CEL volume with high CNI values are more likely to progress compared with those who have with smaller CEL volume and lower CNI values. We also observed that the regions with high CNI values outside the CEL region could subsequently become enhancing.

2206. 31P and 1H Spectroscopic Imaging of Recurrent Malignant Gliomas

Ulrich Pilatus[1], Joerg Magerkurth[1], Oliver Bähr[2], Joachim Steinbach[2], Elke Hattingen[1]
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Proton and 31P MRSI was performed on human malignant recurrent gliomas in order to provide in vivo analysis of membrane metabolism and neuronal brain damage (tNAA). Phosphorylated components in the membrane metabolism showed clear changes indicating a shift to proliferating cell fractions. While the increase in the phosphocholine/glycerophosphocholine ratio in tumor tissue did not reach significance ($p=0.07$) the respective ratio for the ethanolamine compound was clearly significant ($p=0.02$). Further, the significant increase in the inorganic-phosphate/phosphocreatine ratio hints to limited energy supply within the tumor.

2207. Comparison of in Vivo MRS Glutamate/Glutamine Levels in Tumor-Associated Epilepsy

Christopher Steward[1], Bradford Moffat[1], Tanya Yuen[2], Terence O'Brien[2], Patricia Desmond[1], Andrew Morokoff[3], Chris Kokkinos[4]
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The pathogenesis of tumour associated seizures (TAS), a common co-morbidity with brain tumors remains poorly understood. Glutomate has been implicated in many types of epilepsy. In a pilot study the concentration of glutamate/glutamine associated with gliomas using in vivo MRS was studied, and correlated with observed pre-operative seizures. Elevated glutamate/glutamine levels were found in the peritumoral area of tumours who experienced pre-operative seizures compared to those which did not. Due to the small sample size, we are in the process of acquiring a larger MRS and ex vivo prospective data set ($N>100$) to confirm these findings.

2208. Interpreting Fractional Anisotropy in Gliomas: Correlation with 1H Spectroscopy and Consideration of SNR

Franklyn Arron Howe[1], Tom R. Barrick[2], Greg A. Fellows[3], Alan J. Wright[4]
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Metabolic information from 1H MRSI may aid image segmentation using DTI and so improve delineation of infiltrative brain tumours such as gliomas. NAA and fractional anisotropy (FA) are expected to decrease with tumour infiltration and loss of neuronal structure, but FA calculated from principal diffusion magnitude images is biased due to the contribution of noise. We have investigated the FA and NAA distribution in glioblastomas in comparison to simulated data that takes into account the effect of SNR on the measurement of low FA values. Our data provides evidence for diffusion anisotropy in glioblastomas in the absence of functional neurones.

2209. 5 Year Longitudinal Mri Follow-Up and 1H Single Voxel Mrs in 13 Patients with Gliomatosis Treated with Temodal, Radiotherapy and Antiangiogenic Therapy.

Jean-Marc Constans[1,2], François Kauffmann[3], Gabriela Hossu[4], Weibei Dou[5], Jean-Michel Derlon[6], Emmanuelle Lechapt-Zalcmann[7], Samuel Valable[8], Jean-Sebastien Guillamo[9,10]
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MRS with Cho/Cr, mI/Cr and NAA/Cr ratios, could be more sensitive than MRI and could, in some cases, be predictive of worsening in gliomatosis follow-up. These spectroscopic changes occurred well before clinical deterioration. There is a large variability, but repetition and modelisation of spectroscopic measurements during longitudinal follow-up could allow us to diminish it and to improve gliomatosis prognostic evaluation.
Studying the relationship between MRS measures, methionine PET, segmentation and perfusion parameters could lead to better understanding of therapeutic response, especially with regard to chemotherapy and antiangiogenic molecules and in the future hypoxia modulators.

2210. Prominent Citrate Predicts Malignant Progression of Low-Grade Astrocytomas in Children

Arabhi C. Nagasunder[1], Mikhail Laskov[2], Albert Joseph[2], Ashok Panigrahy[1,3], Girish Dhall[2], Jonathan L. Finlay[2], Ignacio Gonzalez-Gomez[4], Mark D. Krieger[5], Marvin D. Nelson[1], Stefan Bluml[1,6]

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Pediatric low-grade gliomas can either progress to a high-grade lesion or remain dormant for long periods of time. Currently, there is a need to identify markers that would allow pediatric neuro-oncologists to predict tumor progression. Our goal was to determine whether aggressive pediatric low-grade II astrocytoma have metabolic features that distinguishes them from stable grade II astrocytoma using in vivo MR Spectroscopy. We found that elevated citrate and low NAA may predict malignant progression of low-grade astrocytomas.

2211. Brain MR Imaging and 1H-MR Spectroscopy Changes in Patients with Extra-Hepatic Portal Vein Obstruction from Early Childhood to Adulthood

Santosh Kumar Yadav[1], Sona Saksena[1], Anshu Srivastava[2], Arti Srivastava[1], Vivek A. Saraswat[3], Michael A. Thomas[4], Ram Kishore S. Rathore[5], Rakesh K. Gupta[1]

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Sixty-three patients with EHPVO having different age groups with 47 age/sex matched controls were studied. Neuropsychological tests, MR imaging, 1H-MR Spectroscopy and blood-ammonia estimation were performed in all subjects. 40% EHPVO patients had MHE who showed significantly increased Mean diffusivity, Glx/Cr, blood-ammonia and GP T1 H in all age groups; however, mIns/Cr was significantly lower only in adults when compared to controls. Mean diffusivity positively correlated with blood-ammonia and Glx/Cr in all age groups. A significant positive correlation was observed between Glx/Cr and blood-ammonia. Increases in Mean diffusivity, Glx/Cr, blood-ammonia and GP T1 H and decrease in mIns/Cr are associated with pathogenesis of MHE in adults with EHPVO. No change of cho/Cr in EHPVO may serve as a diagnostic marker for its differentiation from cirrhosis induced MHE. A significant positive correlation among blood ammonia, Glx/Cr and mean diffusivity indicates that hyperammonia contributes to the generalized low grade cerebral edema.

2212. Repeatability of Measured Lactate and Other Metabolites in Patients with Astrocytoma

Mary McLean[1], Amy Sun[2], Radha Railkar[2], Andrea Schaeffer[2], Thomas Bradstreet[2], Haiying Liu[2], Rose-ann Blenman-Abange[2], Ilse Joubert[3], Stephen Price[3], Charlotte Hodgkin[3], John Griffiths[1]

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We implemented lactate editing at 3T using BASING pulses and assessed its repeatability in phantoms and in human brain tumours in vivo to estimate the level of lactate and other metabolites . In phantoms, a coefficient of variation of 11% was achieved for lactate with SNR similar to in vivo. In tumours, lactate was detected, and there was a non-significant trend of lower metabolite concentrations in scan 2 than scan 1. Lactate editing may provide a useful means of simultaneously monitoring lactate, choline and lipids in vivo, all of which are of interest in tumour progression and response to treatment.

2213. Differentiation Between Low and High Grade in Non-Enhancing Cerebral Gliomas and Neuronal- Glial Tumors

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Grading of non-enhancing supratentorial gliomas and neuronal-glial tumors (NEGNGT) is a diagnostic dilemma on conventional MR imaging as 45% of these tumors could be malignant. We retrospectively compared diffusion tensor imaging (DTI), MR perfusion weighted imaging (PWI) and MR spectroscopic imaging in preoperative grading of 50 patients with histology confirmed non-enhancing supratentorial gliomas and neuronal-glial tumors. The imaging parameters, included mean FA, mean FA ratio, maximal FA, minimal ADC, maximal rCBV, Cho/Cr and Cho/NAA which all were evaluated for both tumor groups. There were significant differences of mean FA, mean FA ratio and maximal FA between low and high grade NEGNGT($p<0.05$), but no significance was found for the other parameters. ROC analysis showed that the maximal FA value had a higher sensitivity and specificity than the other parameters to differentiate between low and high grade NEGNGT. This result indicates that maximal FA may be the best adjuvant tool to help differentiating between low and high grade in non-enhancing supratentorial gliomas and neuronal-glial tumors.

***2214*. MR Biomarker Profile for Infiltrative Tumor Region in Malignant Glioma**

Radhika Srinivasan[1], Joanna J. Phillips[1], Gabriela Bourne[1], Alvin Au[1], Soonmee Cha[1], Susan Chang[1], Sarah J. Nelson[1]
[1]University of California, San Francisco, San Francisco, CA, United States

This study addresses the inability of conventional imaging to delineate infiltrative tumor regions, which causes the tumor to recur within the treatment volume. These regions have normal cellularity due to diffusely infiltrating cells and cannot be located based on increased cellularity with choline and ADC. To define an MR profile of an infiltrative tumor region HR-MAS spectroscopy of image-guided biopsies in newly diagnosed and recurrent GBM were analyzed and evaluated relative their spatial location within the tumor, pathological measures of its paired sample and diffusion measures derived from the biopsy location. These results will be presented and discussed.

***2215*. Assessment of Vascularity in Malignant Glioma: Development of an Imaging Protocol at 7 T**

Lars Gerigk[1], Armin Nagel[2], Armin Biller[1], Julien Dinkel[1], Lydia Schuster[1], Thomas Hauser[1], Michael Puderbach[1], Marco Essig[1], Stefan Delorme[1], Michael Bock[2]
[1]Radiology, German Cancer Research Institute, Heidelberg, Baden-Württemberg, Germany; [2]Medical Physics in Radiology, German Cancer Research Institute, Heidelberg, Baden-Württemberg, Germany

Malignant gliomas are highly vascularized, which makes them a target for new anti-angiogenic agents. MRI therapy monitoring will require more sophisticated methods than measuring the extent of contrast enhancement, because these agents change the blood-brain-barrier. Using the advantage of 7 T, direct imaging of the tumor vasculature becomes feasible. In our newly developed clinical imaging protocol, high-resolution T2w and T1w images show the internal morphology of the lesion, whereas TOF-MRA and SWI visualize the arterial and venous intratumoral vasculature. Automatic co-registration of MRA and morphology proved to be a simple, fast and reliable method to evaluate tumor vascularization.

***2216*. Initial Experience with Ferumoxytol Dynamic Susceptibility MRI in Human Brain at 3T and 7T**

Jeffrey Moses Njus[1], Edit Dosa[2], Seymur Gahramanov[2], John W. Grinstead[3], Xin Li[1], Charles S. Springer, Jr. [1], Edward A. Neuwelt[2], William D. Rooney[1]
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MRI DSC techniques offer an efficient way to characterize brain perfusion properties. However, the use of low-molecular weight gadolinium based contrast agents (Gd) can introduce a significant confound into standard DSC analysis if extravasation is extensive; as often is the case for brain tumors. The purpose of this study was to investigate the use of an ultra-small paramagnetic iron oxide (USPIO) compound to estimate brain tumor blood volume in human subjects. To accomplish this goal, DSC acquisitions were performed using both Gd and USPIO based contrast agents in eleven human subjects at 3T and 7T.

Clinical Stroke Imaging: DWI DKI, MTC MRS & Plaque Imaging

Hall B Thursday 13:30-15:30

***2217*. Identification of Early Onset Strokes Using Multiparametric MRI as a Witness**

Ona Wu[1], Lee H. Schwamm[2], Priya Garg[1], Muhammed A. Pervez[2], Albert J. Yoo[3], Aurauma Chutinet[2], Robert Irie[1], Byeongseo Yook[1], William A. Copen[3], Pamela W. Schaefer[3], Aneesh B. Singhal[2], Karen L. Furie[2], Alma Gregory Sorensen[1]
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Approximately 25% of ischemic stroke patients have unwitnessed strokes and therefore ineligible for on label thrombolytic therapy. We investigated whether multiparametric MRI can be used for identifying patients who have early stage strokes (<=4.5 h). Acute DWI, PWI and FLAIR images from acute stroke patients imaged within 12 h since last known to be well (N=175) were analyzed. In regions that were DWI abnormal, there were significant difference in relative T2WI and FLAIR between patients seen within 4.5 h and those seen later. Multivariate logistic regression showed that T2WI, ADC, and CBV were predictive of patients with early onsets.

***2218*. Evolution of Fractional Anisotropy in Hyperacute Ischemic Stroke**

Ashley D. Harris[1,2], Linda B. Andersen, [2,3], Robert K. Kosior, [2,4], Henry Chen, [2,5], Marina Salluzzi, [2,4], Randall B. Stafford, [2,5], Bradley G. Goodyear, [2,3], Richard Frayne, [2,3]
[1]School of Psychology, CUBRIC, Cardiff University, Cardiff, United Kingdom; [2]Seaman Family MR Research Centre, Foothills Medical Centre, Calgary, Alberta, Canada; [3]Clinical Neurosciences and Radiology, Univerisity of Calgary, Calgary, Alberta, Canada; [4]Biomedical Engineering, Univerisity of Calgary, Calgary, Alberta, Canada; [5]Physics, Univerisity of Calgary, Calgary, Alberta, Canada

Diffusion-weighted images and apparent diffusion coefficient maps are widely used in ischemic stroke detection; however, additional information may be available from diffusion imaging in the assessment of hyperacute ischemic stroke. In this study, fractional

anisotropy was examined during hyperacute ischemic stroke (0–6h from onset) in a canine model. White matter shows a biphasic FA response; an initial increase followed by a decrease. Grey matter showed FA increases. The timing and magnitude of these FA changes appears to be related to stroke severity. With thorough understanding of these changes, FA may be useful in treatment decisions for stroke patients.

2219. Apparent Kurtosis and Fractional Anisotropy Potentially Predicts Tissue Outcome in Sub-Acute Stroke

Danielle van Westen[1,2], Markus Nilsson[3], Håkan Sjunnesson[1,2], Freddy Ståhlberg,[2,3], Sara Brockstedt[4], Ronnie Wirestam[3], Jimmy Lätt[1,3]

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Diffusion measurements were performed 2, 9 and 90 days after stroke onset, estimating the mean diffusivity (MD), the apparent diffusion kurtosis (ADK) and the fractional anisotropy (FA). Tissue outcome at day 90 was dependent on tissue type, i.e. white- or grey matter, as well as location. For instance, deep white matter developed gliosis, while subcortical U-fibres pseudonormalized. FA and ADK obtained at day 2 predicted the tissue outcome at day 90 in white matter.

2220. Diffusion Weighted Imaging of Carotid Atherosclerotic Plaque in Symptomatic Patients at 3-Tesla: Correlation with MRI, CT & Histopathological Predictors of Plaque Vulnerability

N Jane Taylor[1], Vicky J. Goh[1], J James Stirling[1], Ian Simcock[1], Matthew Orton[2], David J. Collins[2], Ralph Strecker[3], Leon Menezes[4], Raymond Endozo[4], Justin J. Cross[5], Richard Harvey[6], Carl W. Kotze[6], Syed W. Yusuf[6], Ashley Groves[4]

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Accurate identification of vulnerable carotid plaque influences patient treatment. Diffusion weighted imaging at 3T may potentially contribute to the identification of active plaques. This feasibility study in 14 patients with symptomatic disease assesses the correlation between plaque apparent diffusion coefficient (ADC) and imaging/histopathological features of vulnerability (thin cap, lipid core, haemorrhage, angiogenesis (CD105 or VEGF) & inflammation (CD68). Mean (SD) plaque ADC was 1.30 X10-3(0.29) mm2/s. There was no difference in ADC between patients with and without MRI features of plaque vulnerability. There was a positive trend between ADC & CD105/VEGF, markers of angiogenesis meriting further investigation.

2221. Differing Fractional Anisotropy Changes in Grey Matter and White Matter in Early Ischemic Stroke

Mohamed Mustafa Hirji[1,2], Ashley D. Harris,[2,3], Robert K. Kosior,[2,4], Cheryl R. McCreary,[2,5], Richard Frayne[2,5]

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We characterise the fractional anisotropy (FA) changes in ischemic stroke. Diffusion tensor images of 13 patients were obtained within 26 hours of stroke (acutely) and >21 days later (follow-up). FA and eigenvalues were measured in freehand regions of interest (ROIs); anatomically-matched contralateral ROIs were used for control. Acutely, FA increased in gray matter (GM) but not in white matter (WM); the eigenvalue reductions were unbalanced in GM, but balanced in WM. At follow-up, FA decreased in both GM and WM with the eigenvalue changes similar in both GM and WM. Our results give insight into microstructural changes in stroke.

2222. Intensive Blood Pressure Lowering Increases Cerebral Blood Flow in Older Subjects with Hypertension

Jiabao He[1], Dinesh Tryambake[1], Michael J. Firbank[2], John T. O'Brien[2], Gary A. Ford[1], Andrew M. Blamire[1]

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CBF determines brain tissue metabolic supply and is compromised in chronic hypertension which alters autoregulatory function. Blood pressure (BP) lowering therapy has clear clinical benefit but may risk inducing hypoperfusion. Optimal target BP in older subjects with hypertension is unclear, although guidelines recommend target BP of <130/85 mmHg and <140/80 mmHg for patients with and without previous vascular events respectively. We used ASL to determine the effect of usual (<140/85 mmHg) and intensive (<130/80 mmHg) BP lowering on CBF in older hypertensive subjects and demonstrate that intensive BP lowering increases CBF compared to usual BP lowering therapy.

2223. Correlation Study of Cerebral Blood Flow and EEG Feature Based on CO2 Stimulation

Jing Wang[1], Liu Chen[1], Bing Wu[2], Xiaoping Hu[3], Xiaoying Wang,[12], Jue Zhang[1,4], Jing Fang[1,4]

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The MR based evaluation of cerebral blood flow (CBF) plays an important role in assessment of post-stroke rehabilitation, but limits by its inconvenient and high costs. In this study, the weighted average accuracy index (WAAI), as a novel electroencephalogram (EEG) feature related index was introduced to estimate effectively the change of EEG pattern with the gradual CBF improvement due to the increase of CO2 concentration. Group results of healthy subjects showed that there existed a strong relationship between WAAI and CBF, indicating that the proposed WAAI index could be helpful to evaluate the extent of brain perfusion recovery.

2224. MRI Study of ASL, MRS and BOLD in Patients with Left Symptomatic Internal Carotid Artery

Jie Lu[1], KunCheng Li[1], Miao Zhang, XiaoYi Wang

[1]Xuanwu Hospital, Capital Medical University, Beijing, China

Arterial Spin Labeling (ASL) can quantitatively measure perfusion without the need of contrast material. 1H spectroscopy (1H-MRS) can identify cerebral abnormal metabolism. Patients with symptomatic occlusion of the internal carotid artery (ICA) with compromised cerebral blood flow (CBF) and decrease N-acetyl aspartate (NAA) are at risk for future ischemic infarcts. These patients can have different degree of cognitive impairment, especially working memory impairment2. Blood oxygenation level dependent (BOLD) is best used for studying processes that can be rapidly turned on and off like memory. In this study, we characterized CBF, MRS and BOLD changes in patients with symptomatic ICA occlusion.

2225. Is There a Relationship Between M1 Cortex Activation and Upper Extremity Motor Characteristics During Acute Stage After Stroke?

Urska Puh[1], Andrej Vovk[2], Igor Serša[3], Dusan Suput[4]

[1]University of Ljubljana, Faculty of Health Sciences, Ljubljana, Slovenia; [2]Pathophysiology, Univ. of Ljubljana Faculty of Medicine, Ljubljana, Slovenia; [3]Institut Jozef Stefan, Slovenia; [4]Pathophysiology, Univ. of Ljubljana Faculty of Medicine, Slovenia

12 patients with partially impaired function of one upper extremity 2-8 days after first ischemic stroke participated in the study. A 1.5 T scanner was used for brain fMRI during upper extremity functional tasks in the first and third week and 3 months after the stroke. Muscle strength and dexterity of the HPE were measured concomitantly. Spearman correlation coefficient was calculated to compare the M1 activation of each brain hemisphere and the motor characteristics of the HPE. Recovery of HPE function correlated well with the intensity and/or area of M1 cortex activation mainly in the ipsilesional hemisphere.

2226. Varied Vasomotor Responses Among Brain Territories in Unilateral ICA Stenosis Patients Studied Using Breath-Hold BOLD MRI

Wan Chun Kuan[1], Ting Yu Chang[2], Keh Shih Chuang[1], Ho Fai Wong[3], Tsong Hai Lee[2], Ho Ling Liu[4,5]

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Impaired cerebral vasoreactivity could be one of the predictors for hyperperfusion after carotid interventions for patients with internal carotid artery (ICA) stenosis. This study aimed to evaluate the differences of hemodynamic responses among blood-supply territories, induced by vasodilatation following a breath-holding task, in patients with unilateral ICA stenosis using BOLD MRI. The temporal correlation between bilateral vasomotor responses in the MCA territories was utilized as an index. The results showed significantly impaired responses of the lesion side as compared to the normal side ($p<0.05$) for patients exhibited hyperperfusion after the stenting (sensitivity = 100%, specificity = 92.3%).

2227. Quantitative Magnetization Transfer Imaging in Acute Stroke: A Follow Up Study Correlating Quantitative MRI with Respect of Severity of Stroke

Felix Jax[1], Monika Gloor[2], Oliver Bieri[2], Meritxell Garcia[1], Stefan Engelter[3], Felix Fluri[3], Klaus Scheffler[2], E.-W. Radue[1], SG Wetzel[1]

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Magnetisation transfer (MT) imaging can potentially serve as a marker for loss of tissue integrity. Moreover increased pathologic specificity is expected from quantitative MT (qMT) as compared to the assessment of the semi-quantitative MT ratio (MTR) images only. Here, we present an evaluation of qMTI data over three consecutive MRIs within the first 10 days for patients suffering from

middle cerebral artery stroke with different progression of symptoms. Results seem to be superior to simple MTR measurements and possibly allow for early statement of prognosis and efficacy of therapeutic methods.

2228. The Assessment of Vessel Size Index and Its Application in Patients with Ischemic Stroke

Chao Xu[1], Wolf Schmidt[1], Peter Brunecker[1], Valerij Kiselev[2], Peter Gall[2], Nils Bodammer[3], Jochen Fiebach[1]

[1]Center for Stroke Research Berlin (CSB), Charité - Universitätsmedizin Berlin, Berlin, Germany; [2]Medical Physics, Department of Diagnostic Radiology, University Hospital Freiburg, Freiburg, Germany; [3]Max Planck Institute for Human Development, Berlin, Germany

This study aims at implementation and evaluation of vessel size imaging (VSI) in patients with ischemic stroke. Stable values of vessel diameter have been observed in healthy volunteers in a good agreement with anatomic knowledge. VSI measurement is shown to be feasible for the clinical examination in stroke patients. Given the limitations of small number of patients, hypointensities on VSI maps in acute and chronic stage have been observed in areas of the final infarction. The recovered tissue showed normal VSI in the acute phase.

2229. Regional Delta-Diffusion Analysis of the Brain During Cardiac Cycle in Idiopathic Normal Pressure Hydrocephalus

Naoki Ohno[1,2], Tosiaki Miyati[2], Mitsuhito Mase[3], Hirohito Kan[2], Harumasa Kasai[4], Masaki Hara[4], Yuta Shibamoto[4], Kazuo Yamada[3], Akihiro Kitanaka[2], Tomoyuki Yamamoto[1]

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There have been many unsolved problems with this syndrome in terms of the diagnostic criteria and selection of appropriate patients for shunt surgery. To evaluate the intracranial condition of the brain in idiopathic normal-pressure hydrocephalus (I-NPH), we determined the change in the apparent diffusion coefficient of the brain during the cardiac cycle (delta-ADC). Delta-ADC analysis makes it possible to noninvasively obtain new and more detailed information on the intracranial condition in I-NPH and thereby assist in the diagnosis.

Stroke: Animal Models

Hall B Monday 14:00-16:00

2230. Enhanced Functional and Structural Connectivity in the Contralesional Hemisphere After Unilateral Stroke in Rats: A Combined Resting-State FMRI and MEMRI Study

Maurits P.A. van Meer[1,2], Wim M. Otte[1,3], Kajo van der Marel[1], Jan W. Berkelbach van der Sprenkel[2], Rick M. Dijkhuizen[1]

[1]Biomedical MR Imaging and Spectroscopy group, Image Sciences Institute, Utrecht, Netherlands; [2]Department of Neurosurgery, Rudolf Magnus Institute of Neuroscience, Utrecht, Netherlands; [3]Department of Neurology, Rudolf Magnus Institute of Neuroscience, Utrecht, Netherlands

Reorganization of neuronal networks may effectively constitute spontaneous functional recovery after stroke. However, the association between structural and functional remodelling in post-stroke brain remains unclear. In this study we combined resting-state fMRI with manganese-enhanced MRI to elucidate the relationship between functional and structural brain connectivity in presumably reorganized contralesional brain tissue in rats that have recovered from experimental unilateral stroke. We detected increased uptake of the neuroanatomical tracer manganese in the contralesional sensorimotor cortex that was significantly correlated with enhanced functional connectivity within this region. Our data suggest that improved neuroanatomical connectivity underlies enhancement of functional connectivity in reorganizing neuronal networks after stroke.

2231. Evolution of Functional Connectivity After Transient Stroke in Rats

Woo Shim[1,2], Kwangyeol Yeol Baek[1,2], Jeong Kon Kim[3], Guangping Dai[1], Jaeseong Jeong[2], Bruce Rosen[1], Young Ro Kim[1]

[1]Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States; [2]Bio and brain engineering, KAIST, Yuseong-gu, Daejeon, Korea, Republic of; [3]Radiology, Asan Medical Center, Seoul, Korea, Republic of

We monitored changes of resting-states functional connectivity using cross-correlation technique over a period of 30 days after transient cerebral ischemic damage. Averaged correlation strengths among some ROIs in stroke rats monotonically increased within the contralesional hemisphere over time, eventually matching those in control group. Despite the slight recovery, cross-correlation values measured within ipsilesional hemisphere and between bilateral hemispheres show severely impaired functional connectivity over 30 days after stroke. Although highly speculative, the data demonstrated that the initial limb dysfunction is related to the loss of brain connectivity in both ipsi- and contra-lesonal brain regions and that the restoration of function may be associated more with the increase of functional connectivity within the contralesional than the ipsilesional hemisphere.

2232. Multi-Parametric Stroke Imaging Protocol for Mice Using a 1H Cryo Probe at 9.4 T

Patrick Michael Heiler[1], Friederike Lara Vollmar[2], Melanie Heilmann[1], Andreas Lemke[1], Stephen Meairs[2], Marc Fatar[2], Lothar Rudi Schad[1]

[1]Computer Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany; [2]Experimental Neurology, Heidelberg University, Mannheim, Germany

The investigation of rt-PA therapy after MCAo in mice by means of MRI requires adequate resolution for the brain size of about 1 x 1 cm², in measurement times acceptable for follow-up studies. We present a protocol including t2-weighted imaging, diffusion weighted imaging and a TOF angiography using a 1H surface cryo coil at 9.4T. The results demonstrate that rt-PA therapy leads to reperfusion of the MCA and significantly reduces the extension of ischemia. The short measurement time makes the protocol suitable for both, detection of the MCAo success immediately after the surgery and temporal evolution studies after rt-PA therapy.

2233. High-Resolution 31P Chemical Shift Imaging of Acute Stroke at 11.7T

Andrew Bresnen[1], Fang Du[1], Qiang Shen[1], Geoffrey Clarke[2], Timothy Q. Duong[1]

[1]Research Imaging Institute, University of Texas Health Science Center at San Antonio, San Antonio, Tx, United States; [2]Radiological Sciences, University of Texas Health Science Center at San Antonio, San Antonio, Tx, United States

In vivo 31P chemical shift imaging allows direct measurements of the high energy phosphates. 31P NMR has proven useful for investigating the bioenergetics in normal brain. However, the low SNR, long scan time and low spatial resolution of 31P NMR have prevented its widespread use, particularly in the study of acute stroke. This study implemented and optimized 31P CSI on rat brain with high spatio-temporal resolution at 11.7T. This approach, along with 1H diffusion, perfusion and T2 MRI, was used to investigate changes of high energy phosphates in stroke rats at 1, 3 and 24 hrs after onset.

2234. Diffusion Tensor Echo Planar Imaging of Mouse Brain After Brief Focal Middle Cerebral Artery Occlusion at 14T

Hongxia Lei[1,2], Yohan Van de Looij[1,3], Nicolas Kunz[1,3], Carole Berthet[4], Lorenz Hirt[4], Rolf Gruetter[1,5]

[1]LIFMET, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Radiology, University of Lausanne, Lausanne, Switzerland; [3]Pediatrics, University of Geneva, Geneva, Switzerland; [4]Neurology, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland; [5]Radiology, University of Geneva, Geneva, Switzerland

Diffusion tensor imaging allowed accurately measuring ADC, which is very essential for stroke studies. We sought to establish feasibilities of EPI-version DTI of mouse brain after brief ischemia at 14T. The nearly artifact free DTI images allowed accurately measuring ADC maps and help localizing ischemic core more precisely when no abnormal T_2 contrast expressed.

2235. Cerebral Blood Flow Autoregulation in Transient Ischemic Tissue Expressed Delayed Hyperperfusion Two Days After Middle Cerebral Arterial Occlusion

Kazuhiro Nakamura[1], Yasushi Kondoh[1], Shigenori Mizusawa[1], Junko Yoshida[1], Hajime Miyata[1], Toshibumi Kinoshita[1]

[1]Akita Research Institute for Brain and Blood Vessels, Akita, Japan

Strong hyperperfusion was observed in transient ischemic tissue 48-72 h after middle cerebral artery occlusion (MCAO). To investigate a physiological reason for the phenomena, we have performed experiments for revealing cerebral blood flow (CBF) autoregulation in transient ischemic tissue using a lower body negative pressure method. Using the lower body negative pressure method, we can avoid an estimation error in CASL from a blood oxygen dependent signal change. The results show CBF in ischemic tissue is higher than normal in all blood pressure range and it should indicate the autoregulatory failure of small pial artery in the ischemic tissue.

2236. Incorporating ADC Temporal Profiles in Acute Stroke to Predict Ischemic Tissue Fate

Virendra R. Desai[1], Qiang Shen[1], Timothy Q. Duong[1]

[1]Research Imaging Institute, Ophthalmology/Radiology, UT Health Science San Antonio, San Antonio, TX, United States

Acute diffusion data has been used to predict ischemic tissue fate on a pixel-by-pixel basis. Previous predictions however were made based on acute MRI data from a single time point. This study proposes a novel approach to incorporate the temporal characteristics of acute ADC (apparent diffusion coefficient) changes to characterize tissue fate based on a pixel-by-pixel basis. This approach was tested on rat stroke models subjected to permanent and 60-min middle cerebral artery occlusion (MCAO). We concluded that there were distinct temporal patterns that determined tissue salvageability.

2237. tPA-Induced Suppression of Cerebrovascular Parameters in Acute Rat Stroke Model: Dynamic MRI Study

Young Ro Kim[1], Xiang Fan[2], Guangping Dai[1], Jeong Kon Kim[3], Bruce R. Rosen[1], xiaoying Wang[2]

[1]Radiology, Martinos Center for Biomedical Imaging / Massachusetts General Hospital, Charlestown, MA, United States; [2]Radiology, Neuroprotection Research laboratory / Massachusetts General Hospital, Charlestown, MA, United States; [3]Radiology, Asan Medical Center, Seoul, Korea, Republic of

Tissue plasminogen activator (tPA) has been frequently used for treating acute ischemic stroke based on re-canalization, reopening of occluded vessels for the reinstitution of regional blood perfusion. Despite the promising clinical outcomes, exogenous tPA may worsen the ischemia-induced blood brain-barrier disruption, elevate risks of intracranial hemorrhage, and in part consequently reduces the therapeutic time window. Therefore, it is critically important to understand the overall effects of tPA treatment on cerebrohemodynamics. In this study, we investigated the vasoreactivity in response to intravenously administered tPA and to systemic hypercapnia before and after tPA using a permanent focal stroke rat model.

2238. Validation of T2* Weight Signal Change of Oxygen Challenge as a Potential Better Penumbra Estimation

Fang Du[1], Shiliang Huang[1], Qiang Shen[1], Timothy Q. Duong[1]

[1]Research Imaging Institute, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States

Mismatch of diffusion/perfusion by MRI has been used as an estimate of the ischemic penumbra, but there are large parts of the mismatch region appear not to at risk and it was also reported that some of the apparent diffusion coefficient reduction area can be salvaged by early reperfusion. It was proposed that T2* weight signal change of oxygen challenge could be a better penumbra estimation. This study applied OC technique to a group of transient ischemia rats and proved this hypothesis.

2239. MRI of Emboli Localization and Lysis in an Embolic Model of Rat Middle Cerebral Artery Occlusion

Ronn Philip Walvick[1], Bernt Torre Bratane[2], James Bouley[2], Nills Henninger[2], Mitchell Albert[1], Marc Fisher[1]

[1]Radiology, University of Massachusetts Medical School, Worcester, MA, United States; [2]Neurology, University of Massachusetts Medical School, Worcester, MA, United States

We present a novel technique to localize and observe the dynamics of clot lysis during tissue Plasminogen Activator (tPA). Prior to fabrication of clots, blood was doped with Magnevist (Bayer, Wayne, NJ). Clots were withdrawn tubing and injected into the left common carotid artery at the base of the skull causing a middle cerebral artery occlusion. MRI consisted of diffusion, perfusion, and T1 weighted imaging for clot localization, and MR angiography. During tPA administration, serial T1 weighted and perfusion imaging was performed. Our results demonstrate the ability of this method to detect clots in a preclinical model of embolic stroke.

2240. Magnetic Resonance Imaging as an In-Vivo Tool for Evaluating Efficacy of Brain Edema Prevention Therapy in a Rat Stroke Model

Denise C. Welsh[1], Andrew Danziger[2], Theodore Detwiler[2], Hillary Regan[2], Joseph J. Lynch[2], Christopher P. Regan[2], Donald S. Williams[1], Alexandre Coimbra[1]

[1]Imaging, Merck, West Point, Pa, United States; [2]Central Pharmacology, Merck, West Point, Pa, United States

While numerous studies have used MRI techniques for studying stroke pathology, there has been limited use of MR parameters as in vivo markers of novel treatment efficacy. Here, Gd-enhanced T1-w and T2-w MR data were used to verify the efficacy of pre- and post-infarct treatment with a novel KDR kinase inhibitor (KDRi) known to reduce vascular permeability and therefore, BBB leakage. In line with previously published ex-vivo data (1), in-vivo MRI results suggest efficacy of KDRi treatment in reducing BBB leakage and edema formation, as indicated by tissue water content.

2241. Longitudinal Assessment of Brain Damage in Hypertension Rats Using Diffusion Tensor Imaging

Chien-Yuan Lin[1], Cheng-Di Chiu[2,3], Ming-Huang Lin[1], Wai-Mui Cheung[1], Teng-Nan Lin[1], Chen Chang[1]

[1]Institute of Biomedical Sciences, Academia Sinica, Taipei, Taiwan; [2]Graduate Institute of Medical Sciences, National Defense Medical Center, Taipei, Taiwan; [3]Department of Neurosurgery, Chang-Hua Hospital, Chang-Hua, Taiwan

The elevated blood pressure is considered to be the main risk factor of stroke and is highly associated with white matter lesions. This study aimed to investigate the change of white matter microstructure under various levels of blood pressures.

2242. MRI Monitoring of Endogenous Stem Cell Therapies in Animal Models of Stroke

Voytek Gretka[1], Lisa Di Diodato[1], Amy Hoyles[2], Nancy J. Lobaugh[3], Cindi Morshead[2], Greg J. Stanisz[1]

[1]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada; [2]Department of Surgery, University of Toronto, Toronto, ON, Canada; [3]Cognitive Neurology, Sunnybrook Health Sciences Centre, Toronto, ON, Canada

In animal models of stroke, endogenous neural precursor cells can be activated with growth factors such as epidermal growth factor (EGF) and erythropoietin (EPO) leading to increased neurogenesis and behavioural recovery. We demonstrated the feasibility of using MR to distinguish between regenerating and pathological tissues when using endogenous stem cell therapies in rats. Tissue growth in the lesion site has MR characteristics (T_1 and T_2) similar to that of normal brain tissue, and differs distinctly from the cavity present when animals are untreated. MRI is able to predict the outcome of the treatment as early as 2 weeks post stroke.

2243. Identifying the Ischaemic Penumbra by Probing Tissue Metabolism and Imaging Changes in Tissue Lactate.

William Matthew Holmes[1], Maria Rosario Lopez Gonzalez[2], Lindsay Gallagher[1], Graeme A. Deuchar[1], I M. Macrae[1], Celestine Santosh[3]

[1]GEMRIC, Wellcome Surgical Institute, Univeristy of Glasgow, Glasgow, United Kingdom; [2]SINAPSE, Clinical Physics, University of Glasgow, Glasgow, United Kingdom; [3]Institute of Neurological Sciences, Southern General Hospital, Glasgow, United Kingdom

One of the most important considerations when treating acute stroke patients is to establish whether potentially salvageable (penumbral) tissue is still present within the brain. Currently perfusion-diffusion mismatch MRI is used, which is an indirect measure lacking precision . Here we propose a new MRI method for imaging the ischaemic penumbra based on the brain's capacity to use lactate as a metabolic substrate. Spectroscopic imaging is used to map the changes in tissue lactate induced by giving a challenge of 100% oxygen.

2244. Estimation of the Onset Time of Cerebral Ischemia in Rats Using $T_{1\rho}$ MRI

Kimmo T. Jokivarsi[1], Yrjö Hiltunen[2], Heidi I. Gröhn[3], Olli H. Gröhn[1], Risto A. Kauppinen[4]

[1]Department of Neurobiology, A.I.Virtanen -Institute, Kuopio, Finland; [2]Department of Environmental Science, University of Kuopio, Kuopio, Finland; [3]Department of Clinical Physiology, Nuclear Medicine and Neurophysiology, North Karelia Central Hospital, Joensuu, Finland; [4]Department of Radiology, Dartmouth Medical School, Hanover, NH, United States

MRI parameters can be used to acquire information about stroke and its progression. We investigated the prediction potential of absolute $T_{1\rho}$ in cerebral ischemia in a rat stroke model. Our results show that $\delta T_{1\rho}$ can give an accurate estimate of ischemia time. Clinically this method provides an easy and fast MR method for ischemia time estimation that can be used in the absence of a priori knowledge or as an additional confirmation for the clinical estimate of stroke onset.

2245. Artificial Neural-Network Prediction of Ischemic Tissue Fate in Acute Stroke Imaging

Shiliang Huang[1], Qiang Shen[1,2], Timothy Q. Duong[1,2]

[1]Research Imaging Institute, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States; [2]Department of Ophthalmology/Radiology, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States

A flexible artificial neural network (ANN) algorithm was developed and applied to predict ischemic tissue fate on three stroke groups: 30-min, 60-min and permanent MCAO in rats. CBF, ADC and T2 were acquired during the acute phase up to 3hrs and again at 24hrs followed by histology. Infarct was predicted pixel-by-pixel using only acute (30-min) stroke data. Receiver-operating-characteristic analysis was used to quantify prediction accuracy. It was concluded that the ANN predictive model has the potential to serve as promising metrics for diagnosis, prognosis and therapeutic evaluation of acute stroke.

2246. Prolonged Post-Ischemic Hyperperfusion: A Systematic Multimodal MRI Study

Qiang Shen[1,2], Fang Du[1], Shiliang Huang[1], Timothy Q. Duong[1,2]

[1]Research Imaging Institute, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States; [2]Ophthalmology/Radiology, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States

Regional hyperperfusion after stroke is a frequent, yet poorly understood, phenomenon. In this study, multimodal MRI (diffusion, perfusion, T2, T1, pH-weighted and dynamic contrast-enhanced imaging, and MRA) were acquired in a 30-min transient MCAO in rat. Significant hyperperfusion was observed 24hrs post-occlusion and peaked at 48hrs. Hyperperfusion areas were consistent with regions with T1 and T2 increases, and early-phase pH decrease, and late-phase permeability changes. MRA showed significant vasodilatation of distal small arteries. We conclude that hyperperfusion does not appear to salvage tissue. Multimodality MRI investigation helps to gain significant insights into the underlying physiological changes associated with hyperperfusion.

NRA & CSF Studies with Clinical Applications

Hall B Tuesday 13:30-15:30

2247. **Magnetic Resonance Angiography of the Mouse Cerebrovascular System at 17.6 T**

Firat Kara[1], Alia Alia[1]
[1]Leiden Institude of Chemistry, Leiden University, Leiden, Netherlands

As magnetic field strength increase toward higher fields , it allows significant improvements in MRI techniques by enhancing contrast to noise and signal to noise ratio. The use of magnetic resonance angiography (MRA) in ultra high magnetic field to visualize cerebrovascular structure of animals, promote development of early diagnosis and treatment of human neurodegenerative diseases. In this study, an improved contrast-to-noise ratio at 17.6 T imaging contribute to visualization the smaller vessels of the mouse brain. Branches of anterior cerebral artery (ACA)are better depicted on maximum intensity projections(MIP) with 17.6 T imaging than MIPs obtained with 9.4.

2248. **Time of Flight Magnetic Resonance Angiography of the Canine Brain at 3T and at 7T - A Quantitative Comparison**

Steffen Sammet[1], Paula Martin-Vaquero[2], Rita L. Echandi[2], Ronaldo C. da Costa[2], Christina L. Tosti[1], Michael V. Knopp[3]
[1]Department of Radiology, The Ohio State University, Columbus, OH, United States; [2]Veterinary Hospital, The Ohio State University, Columbus, OH, United States; [3]Department of Radiolgy, The Ohio State University, Columbus, OH, United States

The purpose of this study was to evaluate the ability of 2D ToF-MRA to depict cerebral arteries in the canine brain and to compare the results obtained from a high field magnet (3T) with an ultrahigh field magnet (7T). ToF-MRA at high and ultra-high magnetic fields should be included in the MRI imaging protocol of dogs suspected of having cerebrovascular disease. 7T field ToF-MRA allows a better delineation of small vessels in the canine brain than 3T ToF-MRA.

2249. **Blood Contrast Agent Concentration Measured by Dynamic MRI in Intra- And Extracranial Mouse Vessels at 9.4 Tesla Using a Novel Cryogenic Probe**

Melanie Heilmann[1], Hanne Boll[2], Sebastian J. Schambach[2], Christoph Groden[2], Marc A. Brockmann[2], Lothar R. Schad[1]
[1]Computer-Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany; [2]Neuroradiology, University Medicine Mannheim, Germany

Quantitative dynamic MRI requires knowledge of contrast agent (CA) concentration in blood. Due to the small size of murine vessels, so far an arterial input function (AIF) has only been measured in mouse hearts. Using a novel cryogenic probe at 9.4 T, we measured CA kinetics in intra- and extracranial vessels. Although high inter-individual variations were observed, in average, kinetics of the superficial temporal vein provided good estimates for blood CA concentration. Smaller vessels suffered from partial volume effects but were less prone to inter-individual variations. Whether mouse perfusion studies benefit from vessel-based AIFs, remains to be studied in future.

2250. **Cerebral Blood Flow Change in One Hear Beat by CO2 Concentration Using Retrospective PC MRI Measurements**

Yi-Jui Liu[1,2], Chun-Jung Juan[3], Teng-Yi Huang[4], Hsiao-Wen Chung[5], Cheng-Yu Chen[3]
[1]Department of Automatic Control, Feng Chia University, Taichung, Taiwan; [2]Master's Program in Biomedical Informatics and Biomedical Engineering, Feng Chia University, Taichung, Taiwan; [3]Department of Radiology, Tri-Service General Hospital and National Defense Medical Center, Taipei, Taiwan; [4]Department of Electrical Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan; [5]Department of Electrical Engineering, National Taiwan University, Taipei, Taiwan

The purpose of this study was to evaluate the cerebral blood change in one cardiac cycle in different concentration of carbon dioxide inhalation. Using retrospectively gated 2D phase contrast MRI is suitable method for measuring the velocity of cerebral arteries and veins during one hear beat. It is noninvasive modality to quantify the blood flow and blood volume in one heart cycle with high spatial and temporal resolution. By this MR method, we proceeded the experiment that observe the blood flow change during the CO2 concentration change.

2251. **Quantification of Carotid Artery Blood Flow Before and After the Acetazolamide Challenge**

Josephine Mary Reeve[1], Dinesh Selvarajah[2], Nyssa Craig[1], Paul David Griffiths[1], Solomon Tesfaye[2], Iain D. Wilkinson[1]
[1]Academic Radiology, University of Sheffield, Sheffield, S Yorkshire, United Kingdom; [2]Diabetes, Royal Hallamshire Hospital, Sheffield, S Yorkshire, United Kingdom

Cerebrovascular reserve or the ability to vasodilate under stress may be a crucial physiological mechanism, providing increased arterial flux when necessary. This study quantified flow within the internal carotid artery (ICA) in 14 normal young adults before and after administration of a carbonic anhydrase inhibitor (acetazolamide). Quantitative flow assessment was based on a single-slice, multi-phase, fast-field echo sequence. Data was extracted via ROI analysis. Significant increases in velocity, flux, apparent vessel

diameter but not heart rate were observed following acetazolamide. This assessment provides an objective in-vivo marker of the functional reserve of the macrovascular supply system.

2252. Towards True Arterial Intracranial TOF-MRA at 7T: Protocol Optimization Using VERSE Pulses

Soeren Johst[1], Sebastian Schmitter[2], Armin Nagel[1], Wolfhard Semmler[1], Michael Bock[1]
[1]Medical Physics in Radiology, German Cancer Research Center (dkfz), Heidelberg, Germany; [2]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States

TOF MRA highly profits from high fields, however, SAR restrictions limit the use of high-resolution protocols. In particular, venous suppression with saturation pulses is difficult within clinically acceptable measurement times (TA ¡Ü 10min). Using the VERSE algorithm on the excitation pulses as well as on the energy-intensive saturation pulses permits an effective SAR reduction that can be used to shorten the acquisition time. With a modified TOF MRA pulse sequence high resolution intracranial MRA data sets with excellent venous suppression could be acquired in 10 min at 7 Tesla.

2253. Fast Inversion Recovery Magnetic Resonance Angiography (FIR-MRA) of the Intracranial Arteries

Ek Tsoon Tan[1], John Huston III[1], Norbert G. Campeau[1], Stephen J. Riederer[1]
[1]Radiology, Mayo Clinic, Rochester, MN, United States

Spin-labeling-based FIR-MRA can provide high resolution 3D intracranial MRA. A detailed comparison of FIR-MRA (7.7 min) to standard 3D time-of-flight (TOF) MRA (6.5 min) was performed at 3 Tesla. Superior or equal vessel conspicuity, continuity, and venous suppression were demonstrated in eight normal subjects with FIR-MRA. Three clinical studies were performed. In two patients with coiled aneurysms, FIR-MRA provided superior depiction of aneurysm remnants to TOF. In one arteriovenous malformation (AVM) patient, FIR-MRA provided a clearer depiction of the AVM nidus than TOF and contrast-enhanced MRA, and could differentiate between the arterial and venous components of the AVM.

2254. Assessment of the Supra-Aortic Vessels Using Time-Resolved Double-Bolus 3D TWIST-MRA

Andreas Korn[1], Till K. Hauser[1], Sören Danz[1], Benjamin Bender[1], Michael Fenchel[1], Thomas Nägele[1], Ulrike Ernemann[1], Uwe Klose[1]
[1]Department of Neuroradiology, University Hospital Tübingen, Tübingen, Germany

MRA of the supra-aortic vessels is usually performed in CARE bolus technique, which necessitates high operator experience and interaction with the control panel. TWIST requires less operator experience and interaction. Goal of the present work was to implement an automated and therefore robust protocol for the TWIST angiography of the supra-aortic vessels with high spatial resolution and increased likelihood of optimal arterial contrast by double bolus injection. The new double bolus injection protocol allowed for good separation of arterial vessels at least after one of the two bolus applications.

2255. High Resolution 3D Intracranial Imaging at 3.0T

Yiu-Cho Chung[1], Steven Shea[2], Ye Qiao[3], Orlando P. Simonetti[4], Bruce Wasserman[3]
[1]Siemens Medical Solutions USA, Inc., Columbus, OH, United States; [2]Siemens Corporate Research, United States; [3]Johns Hopkins University, United States; [4]The Ohio State University, United States Minor Outlying Islands

Intracranial artery imaging is usually done by 2DTSE. However, the technique has long scan time, and has very limited anatomical coverage. We propose here the use of T1w-SPACE, a variant of TSE, for 3D imaging of the intracranial vessels. Using a 32 channel head coil at 3.0T, the technique achieves a spatial resolution of (0.5mm)3, comparable to CT, in less than 11minutes. The technique can cover both sides of the tortuous ICA and MCA in one scan. SNR comparison found that the 3D technique has consistently higher SNR than 2DTSE.

2256. Utility of Susceptibility Weighted Imaging for the Detection of Arteriovenous Shunting in Vascular Malformations of the Brain

Bharathi Dasan Jagadeesan[1], Josser E. Delgado Almandoz[2], Tammie Benzinger[2], Christopher Moran[2]
[1]Neuroradiology, Washington University School of Medicine , St Louis, MO, United States; [2]Neuroradiology, Washington University School of Medicine, St Louis, MO, United States

We retrospectively evaluated the utility of susceptibility weighted imaging (SWI) in the detection of arterio-venous shunting (AVS) in 47 patients with 66 brain vascular malformations (BVM) identified on digital subtraction angiography (DSA). AVS was considered to be present if there was hyperintensity in a vein adjacent to the BVM. Overall, SWI had a sensitivity of 93%, specificity of 100% and accuracy of 97% for the detection of AVS. In the 13 BVMs associated with hemorrhage, SWI had sensitivity and specificity of 100%. In the 53 BVMs not associated with hemorrhage, SWI had a sensitivity of 92% and specificity of 100%.

2257. Comparative Study of 3.0- And 1.5-T MR in the Follow-Up of Moyamoya Disease

Qianna Jin[1], Tomoyuki Noguchi[1], Hiroyuki Irie[1], Masashi Nishihara[1], Tetsuyoshi Hirai[1], Masatou Kawashima[2], Toshio Matsushima[2], Sho Kudo[1]
[1]Radiology, Saga University Hospital, Saga, Japan; [2]Neurosurgery, Saga University Hospital, Saga, Japan

To retrospectively compare 3.0- and 1.5-T magnetic resonance (MR) findings in patients with moyamoya disease (MMD), and assess the relationship and difference between those two modalities in the follow-up of MMD. 60 (120 sides) MMD patients (15 male and 45

female patients, age range: 5 to 60 years, post/pre-operative patients: 44/ 16) were included. We got different upgrading rate among one-year interval follow-up with 1.5- and 3.0-T MR in different orders. Regardless of disease progressing, we should be careful about 1.5-T MR in evaluating steno-occlusive severity of intracranial vessels in MMD for its higher overestimating rate compared with 3.0-T MR.

2258. **Temporal Stability of Blood Flow Patterns in Cerebral Aneurysms Quantified with 2D Phase Contrast Magnetic Resonance Imaging In-Vivo**

Christof Karmonik[1], Yi J. Zhang[1], Orlando Diaz[2], Richard Klucznik[2], David Purdy[3], Robert G. Grossman[1]

[1]Neurosurgery, The Methodist Hospital Neurological Institute, Houston, TX, United States; [2]Radiology, The Methodist Hospital Neurological Institute, Houston, TX, United States; [3]Siemens Healthcare, Malvern, PA, United States

Complex flow patterns in cerebral aneurysms have been identified by computational fluid dynamics (CFD) studies to potentially be predictive of aneurysm rupture. Here, we quantified the stability of blood flow patterns in cerebral aneurysms in vivo based on flow features in 2D pcMRI images in seven aneurysms. A stability index (SI) defined as the area fraction (in percent) exhibiting sign changes of the through-plane velocity was calculated. Average SI range was 1.3%-20.6%. Average SI and aneurysm size were linearly correlated (R=0.796). Further studies are warranted to explore the potential of the average SI as a marker for aneurysm rupture.

2259. **Measurement of Deep Gray Matter Perfusion in Acute Mild Traumatic Brain Injury Using Segmented True-FISP ASL**

Elan J. Grossman[1], Yulin Ge[1], Matilde Inglese[1], Ke Zhang[1], Jing An[2], Ding Xia[1], Jian Xu[3], Niels Oesingmann[3], Kelly A. Mcgorty[1], Joseph Reaume[1], Robert I. Grossman[1], Qun Chen[1]

[1]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, United States; [2]Siemens Medical Solutions, Beijing, China; [3]Siemens Medical Solutions, Malvern, PA, United States

Conventional imaging fails to reveal evidence of damage in mild traumatic brain injury (MTBI) that accounts for its disabling impairments. The purpose of the current study is to examine if perfusion changes in thalamus and basal ganglia can be a possible indicator of pathology in acute MTBI. We have employed segmented True-FISP ASL, which we recently developed to measure perfusion in deep gray matter at high spatial resolution. Results indicate there are significant differences between patients and controls in thalamus and caudate. This suggests these regions may exhibit hypoperfusion in acute MTBI and could be biomarkers of persistent post-concussive syndrome.

2260. **Complex Flow Patterns in a Real-Size Intracranial Aneurysm Phantom: A PC-MRI Study Compared with PIV**

Pim van Ooij[1], Annetje Guédon[2], Christian Poelma[3], Joppe J. Schneiders[4], Charles B. Majoie[4], Jenny Dankelman[2], Ed vanBavel[1], Aart J. Nederveen[4]

[1]Biomedical Engineering & Physics, Academic Medical Center, Amsterdam, Noord-Holland, Netherlands; [2]Biomechanical Engineering, Delft University of Technology, Delft, Netherlands; [3]Laboratory for Aero and Hydrodynamics, Delft University of Technology, Delft, Netherlands; [4]Radiology, Academic Medical Center

To validate 4D blood flow velocity measurements in intracranial aneurysms using phase contrast MRI, a real-size glass phantom of an intracranial aneurysm was created and used for blood flow velocity measurements using PC-MRI and PIV. Resolution of PC-MRI was 0.5x0.5x0.5 mm and took 70 minutes to scan. Both steady and pulsatile flow measurements in MRI and PIV produced similar flow patterns of similar magnitude, although more noise was found in the MR results. Velocity to noise ratio will improve with more accurate velocity encoding settings. More importantly, to be able to apply the PC-MRI scan in patients, scan time needs to be shortened severely, for example by acceleration techniques.

2261. **Distribution of Cerebral Blood Flow in the Nucleus Caudatus, Nucleus Lentiformis, and Thalamus in Patients with a Carotid Artery Stenosis**

Nolan S. Hartkamp[1], Reinoud P.H. Bokkers[1], H. B. van der Worp[2], L. J. Kappelle[2], M. P.J. van Osch[3], Willem P.T.M. Mali[1], Jeroen Hendrikse[1]

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For patients with a symptomatic internal carotid artery (ICA) stenosis, it is often difficult to identify the symptomatic artery for treatment due to the variability in perfusion territories of the major cerebral arteries. For the basal ganglia, this imposes an even greater difficulty. Using selective arterial spin-labeling MRI, this study found the nucleus caudatus in patients with a symptomatic ICA stenosis was more often fed by the contralateral ICA compared to healthy control subjects ($p=0.03$). This was accompanied by reversed blood flow through the ipsilateral anterior part of the circle of Willis ($p<0.01$).

2262. **Value of Three-Dimensional Contrasted-Enhanced MR Angiography Combined with MRI in Diagnosis and Treatment of Cerebral Arteriovenous Malformations**

Qi Liu[1], Ping jian Lu[1], Fei Wang[1], li Wang[1]

[1]Radiology, Changhai Hospital, Second Military Medical University, Shanghai, China

Cerebral arteriovenous malformations are congenital vascular lesions with dilated feeding arteries and draining veins without an intervening capillary bed. Treatment is recommended for most patients because of the risk of hemorrhage, which largely dependent on

the imaging information available before treatment. Three-dimensional contrasted-enhanced MR angiography combined with MRI, as a noninvasive technique with the advantages of arterial angiography, can depict the feeding arteries, venous drainage pattern, nidus, and provide more accurate localization of the nidus, adjacent brain anatomy. These data are important for the planning of surgical resection, endovascular embolization and radiotherapy.

2263. Flow-Sensitive Black Blood Imaging : Clinical Intracranial Applications

Vijay Sawlani[1], J Spark[2], Faiza Admiraa-Behloul[3]
[1]Radiology, Morriston and Singleton hospitals ABM university NHS trust, Swansea, United Kingdom; [2]Morriston and Singleton hospitals ABM university NHS trust, Swansea,, United Kingdom; [3]MR-BU, Toshiba Meidcal Systems Europe, Zoetermeer, Netherlands

Susceptibility-weighted imaging (SWI) is sensitive to venous vasculature and is a powerful tool for evaluating vascular malformations such as venous angiomas. To enhance the visibility of small vascular structures, especially at 1,5T systems, a flow-sensitive black-blood (FS-BB) has been recently developed; The purpose of this study is to evaluate the utility of the FS-BB sequence in various intracranial lesions apart from vascular malformations.

2264. Characterization of Carotid Plaque *in-Vivo* and *ex-Vivo* Using MRI, CTA and Histology

Maria Rosario Lopez Gonzalez[1], William Matthew Holmes[2], William Stewart[3], Keith W. Muir[4], Barrie Condon, George Welch[5], Kirsten Forbes
[1]SINAPSE, Clinical Physics, University of Glasgow, Glasgow, United Kingdom; [2]GEMRIC, Wellcome Surgical Institute, Faculty of Medicine, University of Glasgow, Glasgow, United Kingdom; [3]Department of Neuropathology, Institute of Neurological Sciences, Southern General Hospital, Glasgow, United Kingdom; [4]Division of Clinical Neurosciences, University of Glasgow, Glasgow, United Kingdom; [5]Vascular surgery, Southern General Hospital, Glasgow, United Kingdom

In-vivo 3T MR and CTA images were acquired of symptomatic stroke patients. These images show that most of the patients presented high degrees of atherosclerotic carotid plaque. To help to identify unstable and vulnerable plaques, segmentation of the different plaque components was carried out by using a semiautomatic thresholding method. Half of the patients underwent surgical excision of the carotid plaque. The specimens obtained were imaged in a 7T scanner. The specimens were sectioned and stained with heamatoxylin-eosin and Elastin van Gieson. Correlation of the MRI datasets and Histology was carried out.

2265. Supraaortic MRA and Vessel Wall Enhancement with a Blood Pool Contrast Agent at 3.0T: Preliminary Results in Carotid Artery Disease and Intraindividual Comparision with Gd-DTPA

Dariusch Reza Hadizadeh[1], Guido Matthias Kukuk[1], Jürgen Gieseke[1], Arne Koscielny[2], Frauke Verrel[2], Jack Boschewitz[1], Ute Fahlenkamp[1], Hans Heinz Schild[1], Winfried Albert Willinek[1]
[1]Radiology, University of Bonn, Bonn, NRW, Germany; [2]Vascular surgery, University of Bonn, Bonn, NRW, Germany

Vessel wall enhancement may serve as a potential marker for identification of high-risk atherosclerotic plaques. 3D-MRA and plaque enhancement at the level of the carotid bifurcation were assessed after application of the blood pool contrast agent gadofosveset trisodium and Gd-DTPA at 3.0 Tesla. 24h after injection of Gd-DTPA, no remaining vessel wall enhancement was observed, whereas remaining vessel wall enhancement (10% in atherosclerotic plaque and 2% in non-diseased vessel walls) was observed after injection of Gadofosveset Trisodium. Residual vessel wall enhancement 24h after injection of gadofosveset trisodium may reflect neo-vessel density and be a predictor for future ischemic events.

2266. A Comparative Study of 3D Time of Flight MRA and Contrast-Enhanced MRA :Clinical and Phantom Studies

Yoko Saito[1], Minoru Osanai[2], Kazuhiko Oyu[2], Keito Hamada[2], Hiraku Yodono[3]
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We evaluated the stenotic degree of arteries at the skull base level which are demonstrated on both 3D-TOF MRA and CE-MRA in 139 cases (659 vessels). The discrepancy between these two technique in grading steotic degree occurred in 80 arteries. The stenotic grading were more severely estimated with CE MRA than with TOF MRA.We also performed phantom study. TOF-MRA tended to demonstrate the phantom more accurately than CE-MRA. On TOF-MRA with 1.6mm slice thickness, diameters were most accurately demonstrated. In CE-MRA, diameters of the tube were significantly more accurate with parallel imaging than with ZIP.

2267. Direct Visualization and Quantitation of CSF Flow in Shunts

Noam Alperin[1,2], Sang H. Lee[1], Leonardo Macedo[3], Daniele RigamontI[4], Ari Blitz[3]
[1]University of Miami, Miami, FL, United States; [2]Radiology, University of Miami, United States; [3]Radiology, Johns Hopkins, Baltimore, MD; [4]Nuerosurgery, Johns Hopkins, Baltimore, MD

Diversion of excessive CSF from hydrocephalic brains by shunting is, in many cases, a life saving procedure. The down side of shunting is high failure rate. Consequently, about 40% of the shunting procedures performed annually in the US are for shunt replacement. The decision for shunt replacement is challenging as there is no reliable noninvasive test for shunt function. We present the first direct visualization and quantitation of CSF flow in ventricular shunts using high temporal and spatial resolution cine phase

contrast MR and automated flow quantitation technique. Volumetric flow rate through in patent shunts were on the order of the CSF production rate.

Manganese - Enhanced MRI

Hall B Wednesday 13:30-15:30

2268. **Using Manganese-Enhanced MRI (MEMRI) to Detect the Order of Neuronal Connections in the Olfactory Pathway at the Level of Specific Layers**

Der-Yow Chen[1], Stephen J. Dodd, Daniel R. Glen, Ziad S. Saad, Alan P. Koretsky
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MEMRI can be used for neuronal tracing in the brain. Here it is demonstrated that MEMRI identifies the laminar connections of the olfactory system and traces layer-specific inputs to olfactory cortices. $MnCl_2$ was injected into nostrils or the olfactory bulb of rats, and they were imaged with this MRI technique at several time points. The dynamic changes of Mn^{2+} enhancement could be characterized by the arrival latency into each specific region. The olfactory pathway from olfactory bulb to higher-order cortex was labeled in proper, known laminar order. Mn^{2+} enhancement into the orbitofrontal cortex predicts that connections from olfactory cortex innervate superficial layer of the orbitofrontal cortex. This is a connection that has not been previously mapped. Therefore, MEMRI neural tracing is specific at the level of cortical layers in the olfactory pathway.

2269. **Evaluation of the Applicability of Manganese-Enhanced and Dynamic Gadolinium-Enhanced Imaging to Study the Role of Caveolin-1 in Blood-Retinal Barrier Integrity**

Philippe Garteiser[1], Bruce A. Berkowitz[2,3], Debbie Saunders[1], Rebecca Cranford[1], Rheal A. Towner[1], Michael H. Elliott[4]
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Mn-enhanced MRI (MEMRI) has recently emerged as an important tool in retinal function studies. Caveolin-1 (Cav-1), the principal protein member of caveolar membrane domains, is believed to be essential to blood-retinal barrier integrity and ion homeostasis of the retina. Here, we evaluate how MEMRI and other MRI techniques may detect functional disruptions induced by cell type-specific knock out of the Cav-1 gene in mice. The MEMRI signature of light and dark adaptation and the dynamic gadolinium-enhanced signal behavior of iodate-induced retinal impairments indicate that both methods have sufficient sensitivity to warrant their application to cell-type specific Cav-1 ko mice.

2270. **Layer-Specific Anatomical MRI of the Retina with Balanced Steady State Free Precession with and Without Manganese Enhancement**

Eric Raymond Muir[1,2], Bryan H. De La Garza[2], Sung-Hong Park[3], Timothy Q. Duong[2]
[1]Biomedical Engineering, Georgia Institute of Technology, Atlanta, GA, United States; [2]Research Imaging Institute, Ophthalmology/Radiology, UT Health Science Center San Antonio, San Antonio, TX, United States; [3]Research Imaging Institute, Radiology, UT Health Science Center San Antonio, San Antonio, TX, United States

Anatomical MRI of the retina has previously reported 3-4 layers in the rodent retina using conventional gradient echo (GE) and spin echo MRI. Following intraocular injection of manganese, seven layers were detected previously. This study explored balanced steady state free precession (bSSFP) MRI to image the mouse retina at 35x35x200 μm. Moreover, we compared GE and bSSFP with and without intraocular manganese injection. We demonstrated that bSSFP can reveal 7 layers without using contrast agent. Layers detected by bSSFP without manganese were consistent with those of manganese-enhanced MRI and histology.

2271. **Assessing *in Vivo* Axonal Transport Rates from Deep Brain Structures in Mouse Models of Human Disease**

Taeko Inoue[1], Robia G. Pautler[1]
[1]Dept. of Molecular Physiology & Biophysics, Baylor College of Medicine, Houston, TX, United States

Axonal transport is an important cellular mechanism necessary for the normal function and viability of a neuron. As a result, deficits in axonal transport have become associated with the development and progression of human diseases such as diabetes and neurodegenerative diseases such as Alzheimer's disease. Here we demonstrate the potential of Manganese Enhanced MRI (MEMRI) for measuring *in vivo* deficits of axonal transport in two mouse models of human disease.

2272. **The Effect of Peripheral Administration of Monosodium Glutamate on Ionotropic Glutamate Receptor Signalling in the Mouse Brain *in Vivo* Shown Through Manganese Enhanced MRI**

Mohammed Khair Hankir[1,2], James R. Parkinson[1], Stephen R. Bloom[3], Jimmy David Bell[1]
[1]Metabolic and Molecular Imaging Group, Imperial College, London, United Kingdom; [2]Investigative Medicine, Imperial College , London, United Kingdom; [3]Investigative Medicine, Imperial College, London, United Kingdom

Peripheral administration of monosodium glutamate (MSG) stimulates feeding in rodents. This may be due to the direct activation of glutamate receptors expressed in the arcuate nucleus (ARC) of the hypothalamus. We have used manganese enhanced MRI (MEMRI) to demonstrate that intraperitoneal administration of MSG dose dependently increases Mn2+ influx into the ARC and that this can be suppressed with a glutamate receptor subtype specific receptor antagonist. These results reveal that MEMRI is a sufficiently sensitive tool to detect glutamatergic signalling in vivo with high temporal and spatial resolution.

2273. **Reduced Manganese Enhancement and Flow in the Olfactory Pathway in Mice with Experimental Neuropsychiatric Lupus Demonstrated by Manganese Enhanced MRI**

Tammar Kushnir[1], Shaye Kivity[2], Eli Konen[1], David Manor[1], Nancy Agmon-Levin[2], Miri Blank[2], Joab Chapman[3], Yehuda Shoenfeld[2], Galia Tsarfaty[1]
[1]Dept. of Diagnostic Imaging, MRI Unit, The Chaim Sheba Medical Center, Tel Hashomer, Israel; [2]Center of Autoimmune Diseases, The Chaim Sheba Medical Center, Tel Hashomer, Israel; [3]Dept. of neurology, Sagol Neuroscience Center, The Chaim Sheba Medical Center, Tel Hashomer, Israel

Manganese enhanced MRI (MEMRI) allows in-vivo mapping of functional neuronal connections in the brain. The method was used to investigate the olfactory system in mice with experimental neuropsychiatric lupus (NPSLE), induced by intra-cerebro-ventricular injection of anti-ribosomal-P antibodies. MEMRI scans were performed before and 40 hours after intranasal MnCl2 administration. NPSLE induction resulted in a depression-like behavior accompanied with a significant deficit in olfactory function. MEMRI demonstrated impaired olfactory neuronal function expressed as a significant reduction in normalized manganese enhancement and flow throughout of the olfactory pathway, compared to healthy mice. Our results propose that autoimmune-CNS conditions may influence olfactory function.

2274. **Oral Manganese as an MRI Contrast Agent for the Detection of Nociceptive Activity**

Kathleen Elizabeth Jacobs[1], Deepak Behera[1], Garry Gold[1], Michael Moseley[1], Jarrett Rosenberg[1], David Yeomans[2], Sandip Biswal[1]
[1]Radiology, Stanford University, Stanford, CA, United States; [2]Anesthesia, Stanford University, Stanford, CA, United States

Manganese-enhanced magnetic resonance imaging (MEMRI) is a potentially powerful diagnostic method for identifying neural regions of pain processing for image-guided interventions. Manganese can enter nerves via voltage-gated calcium channels, which are selectively upregulated in pain. We gave manganese by oral gavage to two rat groups: one with spared injury of their sciatic nerves and a sham-operated group. We found that rats with spared nerve injury have increased manganese ion uptake and retention in their nerves compared to the nerves of sham-operated rats as shown by increased MR signal and nerve concentrations. Therefore, manganese can specifically enhance nerves associated with nociception.

MRI of Neural Plasticity

Hall B Thursday 13:30-15:30

2275. **In Vivo Detection of Axonal Plasticity in Rat Hippocampus Using DTI**

Teemu Laitinen[1], Alejandra Sierra[1], Asla Pitkänen[1], Olli Gröhn[1]
[1]A.I. Virtanen Institute for Molecular Sciences, University of Kuopio, Kuopio, Finland

The ability of in vivo diffusion tensor imaging to detect axonal plasticity in dentate gyrus sub region of hippocampus was studied in rats after kainic acid induced status epilepticus. Our results show that fractional anisotropy of dorsal dentate gurys is increased 17 months after the brain injury when compared to healthy control animals. Histological evaluation showed significant increase in the density of mossy fiber sprouting and myelinated axons the kainic acid treated animals, consistent with the DTI results. The results of this study suggest that axonal plasticity can be detected using in vivo DTI.

2276. **Short-Term Learning Induced Plasticity Visualized with Diffusion MRI**

shimrit Tzur-Moryosef[1], tamar Blumenfeld-Katzir[2]
[1]tel aviv university, tel aviv, Israel; [2]neurobiology, tel aviv university, tel aviv, Israel

Plasticity in the adult brain following learning procedure is commonly attributed to functional plasticity and restricted to the hippocampus. This study we utilize Magnetic diffusion tensor imaging (DTI) in order to characterize microstructural plasticity induced by short-term learning paradigm. Analyses were done by ADC and FA parameters in order to characterize both white and gray matter changes. Rats were scanned before and one day after a one-day version of the Morris water maze task. Paired t-test comparisons demonstrate FA increase in the cingulum bundle and FA and ADC decrease in striatum-related gray matter, motor and sesorimotor cortex.

2277. Investigation of Tissue Plasticity Following Low-Dose Amphetamine Treatment in Transient Ischemic Rat Stroke Model Using Diffusion Tensor Imaging

Hua-Shan Liu[1], Hui Shen[1], Hanbing Lu[1], Jenny Chou[1], April P. Zhu[1], William Rea[1], Yun Wang[1], Yihong Yang[1]
[1]National Institute on Drug Abuse, Baltimore, MD, United States

There is considerable evidence to suggest that amphetamine can improve functional outcome in animal model of stroke, which is involved in the mechanisms of induced axonal growth and reinnervation of brain tissues. In this study we used DTI to assess changes in perilesional tissue integrity after amphetamine treatment in a rat stroke model. We found that FA showed a significantly higher increase under the influence of amphetamine after 25 days.

2278. Learning Is Necessary for Training Induced Brain Plasticity

Jason Philipp Lerch[1], Amanpreet Badhwar[2,3], Edith Hamel[2], John G. Sled[1]
[1]Mouse Imaging Centre, Hospital for Sick Children, Toronto, Ontario, Canada; [2]McGill University, Montreal, Quebec, Canada; [3] (contributed equally to this abstract)

Here we used a mouse model of Alzheimer's Disease (AD) with impaired spatial learning to test whether a capacity to learn is necessary for training induced MRI detectable volume changes to occur. Mice were trained on two different versions of the Morris Water Maze, fixation perfused and scanned overnight at 32 µm isotropic resolution. As hypothesized, hippocampal based spatial learning was impaired in AD mice, whereas striatum dependent non-spatial learning was equivalent between AD and wild-type mice. The data presented herein thus indicates that learning is a requirement for MRI detectable plasticity.

fMRI in Brain Diseases

Hall B Monday 14:00-16:00

2279. Functional Asymmetry of Hippocampal Subfields in Tempoal Lobe Epilepsy: An Application of Postmortem Atlas

Sandhitsu R. Das[1], Dawn Mechanic-Hamilton[2], Marc Korczykowski[2], John Pluta[2], John A. Detre[2], Paul A. Yushkevich[1]
[1]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Department of Neurology, University of Pennsylvania, Philadelphia, PA, United States

We present preliminary data demonstrating the use of postmortem hippocampus atlas to study activation asymmetry in patients with unilateral temporal lobe epilepsy

2280. Spatiotemporal Network Alterations in Experimental Focal Cortical Epilepsy: MRI-Based Longitudinal Functional Connectivity and Weighted Graph Analysis

Willem M. Otte[1,2], Rick M. Dijkhuizen[2], Cornelis J. Stam[3], Kajo van der Marel[2], Maurits P.A. van Meer[1,2], Max A. Viergever[2], Kees P.J. Braun[1]
[1]Rudolf Magnus Institute of Neuroscience, University Medical Center Utrecht, Utrecht, Netherlands; [2]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands; [3]Department of Clinical Neurophysiology, VU University Medical Center, Amsterdam, Netherlands

There is increasing evidence that the topology of brain networks may be changed in epilepsy. In particular, a random topology has been suggested as an explanation for lower seizure thresholds. To test this hypothesis, we assessed focal epileptic and healthy networks over time using resting state functional MRI and weighted graph theoretical analysis in a rat model. Brain networks in focal epilepsy were globally affected, toward a more ordered network topology. Networks largely normalized at ten weeks after epilepsy induction. Graph analysis provides a promising method to explore dynamical network alterations in epilepsy.

2281. Role of Resting State Functional Connectivity Mri in Presurgical Investigation of Mesial Temporal Lobe Epilepsy

Gaelle Bettus[1,2], Fabrice Bartolomei[2], Sylviane Confort-Gouny[1], Eric Guedj[1], Patrick Chauvel[2], Patrick Cozzone[1], Jean-Philippe Ranjeva[1], Maxime Guye[1]
[1]CNRS UMR6612 CRMBM-CEMEREM, Marseille, France; [2]INSERM U751 Epilepsie et Cognition, Marseille, France

We aimed at determining the ability of resting-state functional connectivity MRI (fcMRI) to lateralize/localize the epileptogenic zone in mesial temporal lobe epilepsy (MTLE) at the individual level. Basal functional connectivity (BFC) was evaluated in 22 MTLE patients compared to 36 controls using a single shot GE-EPI sequence at rest. In patients, BFC was characterized by bilateral decreases predominant in the epileptic side, and unilateral increases almost exclusively observed in the contralateral (non-epileptic) side. We suggest that fcMRI is a useful technique that could be added to the presurgical assessment of drug-resistant partial epilepsies.

2282. Analysis of Simultaneous EEG/fMRI Data in Epileptic Patients Using ICA and GLM Based Methods.

Marco Carnì[1,2], Carlo Di Bonaventura[3], Giovanni Giulietti[4], Jinan Fattouch[5], Anna Teresa Giallonardo[6], Anna Elisabetta Vaudano[6], Valter Nucciarelli[6], Mario Manfredi[6], Massimiliano Prencipe[6], Vittorio Cannatà[1], Bruno Maraviglia[2]

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In this study we applied two different methods to analyze fMRI data, acquired simultaneously with EEG, coming from experiments involving patients with Idiopathic Generalized Epilepsy or with Cryptogenic Partial Epilepsy. We used first the data driven ICA (Independent Components Analysis) on fMRI data, while in the second approach we applied the GLM (General Linear Model) on the same data, but exploiting the EEG recording to compute the regressor. ICA and GLM analysis detected either activation areas located in agreement with presumed electroclinical hypothesis and the BOLD patterns of activation in response to synchronized ictal activity.

2283. Comparison Between 2dTCA and EEG/fMRI to Localize Interictal Activity in Temporal Lobe Epilepsy

Victoria L. Morgan[1], Xiaoyun Liang[1], John C. Gore[1], Bassel Abou-Khalil[2]

[1]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States; [2]Neurology, Vanderbilt University, Nashville, TN, United States

Functional MRI (fMRI) has the potential for non-invasively localizing interictal epileptic activity more accurately than other clinical methods. Currently the gold standard for detecting the timing of interictal activity during the fMRI scan is simultaneous electroencephalography (EEG). The objective of this work is to compare a data-driven method, 2dTCA, to EEG/fMRI in temporal lobe epilepsy. Overall, there was good qualitative agreement between the two methods with the 2dTCA maps showing more mesial temporal activation concurring with the presumed epileptogenic region in these patients, without the need for the additional hardware, software, analyses and scalp EEG spikes required for EEG/fMRI.

2284. On the Advantage of Data Driven Analysis in Aphasic Patients with Severe Language Latency

Maria Engström[1], Mattias Ragnehed[2], Peter Lundberg[3]

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Language fMRI in aphasic patients are exceptionally challenging. The patients often have latency in responding to cognitive tasks. Using a data-driven approach for analysis might enable extraction of language networks even if the task is not performed at the intended pacing. In this study, five patients with chronic aphasia were examined. Conventional analysis did not result in language activation in most patients. When using a data-driven approach, four out of five patients elicited language related networks. It was concluded that language areas in patients with aphasia could be extracted using data driven analysis even if the conventional fMRI analysis fails.

2285. Interictal Anomalies in Patients with Migraine Without Aura: Absence of Hemodynamic Refractory Effects

Benedicte Descamps[1,2], Pieter Vandemaele[1,2], Harmen Reyngoudt[1,2], Karel Deblaere[1,2], Luc Leybaert[3], Koen Paemeleire[3,4], Eric Achten[1,2]

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In this study, single subject net hemodynamic responses to paired stimuli from patients with migraine without aura and controls are fitted using inverse logit functions and compared. We demonstrate that patients with migraine without aura do not show a decrease in amplitude of their interictal hemodynamic response to a second stimulus in a pair with 1 second interstimulus interval, whereas the control group shows hemodynamic refractory effects when looking at repetitive stimuli. The finding in this patient group may be the neurovascular correlate of the absence of electrophysiological habituation.

2286. Functional Connectivity After Fronto-Occipital Impact Mild Traumatic Brain Injury

Elena Shumskaya[1,2], Teuntje Andriessen[2], David Norris[1,3], Pieter Vos[2]

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The objective of this study is to evaluate the alterations in the whole-brain functional connectivity after fronto-occipital impact mild traumatic brain injury (MTBI). We used the resting state fMRI to relate the cognitive deficits occurring after frontal-occipital impact MTBI to the disruptions in functional connectivity. We found the disintegration of prefrontal, temporal and parietal regions in resting-state networks of MTBI patients and showed that the disconnection between prefrontal regions underlies the decline in the rate of information processing.

2287. fMRI Study of Response to Semantic Cueing During Verbal Learning in TBI

Rebecca Jo Chambers[1], William M. Brooks[1], JoAnn Lierman[1], Laura E. Martin[1], Amanda Bruce[1,2], Brenda A. Kirchhoff[3], Monica Kurylo, Linda Ladesich, George Varghese, Cary R. Savage[1]

[1]Hoglund Brain Imaging Center, University of Kansas Medical Center, Kansas City, KS, United States; [2]University of Missouri - Kansas City; [3]University of Missouri - St. Louis

Following TBI, memory functioning is frequently disrupted, and patients may not benefit from cognitive rehabilitation therapy. In an fMRI study, participants' responses were measured during a verbal learning task of semantically related or unrelated word lists. They were asked to first remember the words with no further instruction, and then were cued to the semantic nature of the task. Both groups benefitted from semantic cueing, but showed differential brain responses in left DLPFC, a region implicated in working memory. This finding may suggest that after TBI, patients must compensate with additional neural processing in DLPFC to benefit from semantic cueing.

2288. Adaptive Changes in Response Inhibition BOLD Responses Following Antidepressant Treatment

Darragh Downey[1], Karen Elizabeth Davies[1], Shane McKie[2], Gabriella Juhasz[2], Ian Muir Anderson[2], John Francis William Deakin[2], Stephen Ross Williams[1]

[1]Imaging Science and Biomedical Engineering, University of Manchester, Manchester, Lancashire, United Kingdom; [2]Neuroscience and Psychiatry Unit, University of Manchester, Manchester, Lancashire, United Kingdom

We investigated adaptive changes in 5-HT signalling following sub-chronic antidepressant treatment in healthy controls performing a response inhibition paradigm. 24 healthy volunteers were provided with 20mg citalopram or placebo for 11 days and tested with a behavioural inhibition task after 14 days following a 3 day drug washout. Citalopram pre-treatment compared to placebo was associated with a reduced response bilaterally in the inferior frontal gyrus and BOLD increases in the right middle frontal gyrus, mid cingulate, precuneus and posterior cingulate when inhibiting responses. These findings suggest that chronic antidepressant treatment modifies 5-HT pathways involved in cognitive flexibility and inhibitory control.

2289. A Novel FMRI Task to Visualize Frontal Lobe Circuitry Associated with Transient Sadness

Leslie Baxter[1], Ryan Smith[1], Richard Fadok[1], Michael Purcell[1], Seban Liu[1], Josef Debbins[1]

[1]Neuroimaging, Barrow Neurological Institute, Phoenix, AZ, United States

We developed a novel functional magnetic resonance imaging (fMRI) method designed to activate the subgenual anterior cingulate cortex (sACC) and other frontal regions during transient sadness. We sought to develop a task that would show sufficient and specific activation in individuals to be useful as a potential target for deep brain stimulation treatment (DBS).

2290. Trait Anxiety and Serotonin Transporter Polymorphism Influence Amygdala Activation as Measured with FMRI During Fear Extinction at 3 T

Harald Kugel[1], Christina Sehlmeyer[2,3], Udo Dannlowski[2,3], Sonja Schoening[2,3], Martin Pyka[2,3], Astrid Veronika Rauch[2,3], Katharina Domschke[2], Bettina Pfleiderer[1], Pienie Zwitserlood[4], Walter Heindel[1], Volker Arolt[2], Carsten Konrad[3,5]

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The effect of the serotonin transporter polymorphism 5-HTTLPR and trait anxiety on amygdala activation during fear conditioning and extinction was investigated with fMRI. 32 volunteers were tested with a fear-conditioning paradigm, presenting neutral faces combined with an acoustic startle. Individual trait anxiety was determined with the State Trait Anxiety Inventory (STAI). Evaluation showed that trait anxiety and 5-HTTLPR polymorphism did not affect acquisition, but fear extinction. Trait anxious volunteers and carriers of the short s-allele showed less deactivation of the amygdala during extinction, demonstrating that they react strongly to fear stimuli, and they can extinct fear reactions less easily.

2291. Functional Differences in Mental Rotation Between Men and Transsexual Patients Before and During Hormone Therapy Studied with FMRI at 3 T

Harald Kugel[1], Sonja Schoening[2,3], Almut Engelien[2,3], Anette Kersting[2], Cornelia Roestel[2], Pienie Zwitserlood[4], Wolfgang Lehmann[5], Walter Heindel[1], Volker Arolt[2], Carsten Konrad[6,7]

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In order to investigate differences in neurobiological processes in patients with gender identity disorder, 11 male-to-female transsexual patients before, 11 patients during cross-sex hormone therapy, and 11 control males underwent fMRI while performing a sexually dimorph mental rotation paradigm. The transsexual subjects showed less activation in the left parietal cortex (BA 40). Activation patterns different from controls, i.e. distinct from their biological sex, did not change during hormonal treatment.

2292. Temporal Modulation in Connectivity Within the Salience Network in Autism Spectrum Disorder

Juha Nikkinen[1], Jukka Rahko[2], Tuomo Starck[1], Jukka Remes[1], Ahmed Abou Elseoud[1], Irma Moilanen[2], Osmo Tervonen[1], Vesa Kiviniemi[1]

[1]Department of Diagnostic Radiology, Oulu University Hospital, Oulu, Finland; [2]Department of Child Psychiatry, Oulu University Hospital, Oulu, Finland

Temporal modulation in connectivity within the salience network (SN) has been investigated in autism spectrum disorder (ASD) utilizing group independent component analysis (ICA). Using the ICA mixing matrix time courses, connectivity between the components including SN structures, anterior insula (AI) and anterior cingulate cortex (ACC), was investigated. One IC was found to be focused at AI and ACC structure was shown to be detectable in two ICs, ventral ACC and dorsal ACC. As a result we show that the temporal modulation in connectivity is altered in ASD between the AI and ventral ACC components.

2293. Attachment Model Affects Brain Responses in Areas Related to Empathy and Maternal Behaviour

Delia Lenzi[1,2], Cristina Trentini[3], Patrizia Pantano[1], Emiliano Macaluso[2], Gian Luigi Lenzi[1,4], Massimo Ammaniti

[1]Dipartimento di Scienze Neurologiche, UniversitÃ di Roma "Sapienza", Roma, Italy; [2]Neuroimaging Laboratory, Fondazione Santa Lucia, Roma, Italy; [3]Department of Dynamic and Clinical Psychology, UniversitÃ di Roma "Sapienza", Roma, Italy; [4]Centro per lo Studio delle Funzioni Mentali dellâ€™Uomo, UniversitÃ di Roma "Sapienza", Rome, Italy

Within the Attachment theory , Securely attached people tend to have positive views of themselves and their relationships. They feel comfortable with intimacy and independence, balancing the two in their relationships. Dismissive-avoidant adults tend to suppress and hide their feelings, dealing with rejection by distancing themselves from partners. Using fMRI we show that Dismissive subjects during the observation of stimuli activating attachment and maternal feelings have a overall greater reaction when compared to Secure subjects, i.e. greatly activate areas related to empathy and emotions (mirror neuron and limbic system) and inhibit areas related to maternal behaviour (anterior cingulated cortex).

2294. Differences of Functional Activation Patterns Between Subjects with Mild Cognitive Impairment and Normal Subjects

Mingwu Jin[1], Victoria Pelak[2], Tim Curran[3], Marie Banich[3], Rajesh Nandy[4], Dietmar Cordes[1]

[1]C-TRIC and Radiology, University of Colorado Denver, Aurora, CO, United States; [2]Neurology, University of Colorado Denver, Aurora, CO, United States; [3]Institute of Cognitive Science, University of Colorado at Boulder, Boulder, CO, United States; [4]Biostatistics and Psychology, UCLA, Los Angeles, CA, United States

Functional MRI (fMRI) is an important imaging modality to reveal altered function in neurodegenerative diseases. We hypothesize that functional changes in activation occur earlier and can be measured before structural degeneration is obvious. FMRI can potentially lead to an imaging marker for the early diagnosis of mild cognitive impairment (MCI) and furthermore may predict the development of Alzheimer's disease (AD). In this work, we present fMRI results of 8 MCI and 8 normal subjects using different memory paradigms.

***2295*. Functional Connectivity in Resting State CBF Mapping in Postherpetic Neuralgia**

Jing Liu[1], Yue Zhang[2], XiaoYing Wang[3], MinYi Du[4], Jue Zhang[2]

[1]Department of Radiology, Peking University First Hospital , BeiJing, China; [2]College of Engineering, Peking University, BeiJing, China; [3]Department of Radiology, Peking University First Hospital, BeiJing, China; [4]Department of Anaesthesiology, Peking University First Hospital, BeiJing, China

Given the poor specificity and reproducibility of blood oxygenation level dependent(BOLD), we use cerebral blood flow for the first time to build resting-state networks of default mode both in patients suffering from postherpetic neuralgia and healthy subjects, and compare the two groups. The results of functional connectivity in healthy subjects showed that the areas activating were the same with the parts previously described in the literatures using BOLD. The results between-groups comparison showed that some parts were in strengthened correlation of posterior cingulate cortex in patients, such as anterior cingulated cortex and insula which are related to pain.

***2296*. Identification of Hyperactive Intrinsic Amygdala Network Associated with Impulsivity in Abstinent Heroin Addicts**

Chunming Xie[1], Liping Fu[2], Lin Ma[3], Wenjun Li[1], Alex Cohen[1], Zheng Yang[2], Shi-Jiang Li[1]

[1]Medical College of Wisconsin, Milwaukee, WI, United States; [2]Beijing Institute of Basic Medical Science, Beijing, China; [3]Department of Radiology, The PLA General Hospital, Beijing, China

The purpose of this study was to investigate the neuropsychological underpinnings of impulsive network on abstinent heroin addicts using resting-state functional connectivity method. Heroin subjects showed the higher impulsive scores and abnormal amygdala networks activity. The altered amygdala network strengths significantly correlated with impulsivity, and different correlation patterns were fund in heroin subjects relative to control subjects. This finding indicated the neural constructs of impulsive network was different in these two group subjects and altered amygdala network activity in heroin subjects makes a critical contribution to the impulsive dysfunction and represents the pathological damage underlying the impulsive control.

***2297*. Changes in Glutamate Levels After an FMRI Experiment**

Paul G. Mullins[1], Niklas Ihssen[1], David Linden[1], Miles Cox[1]

[1]Psychology, Bangor University, Bangor, Gwynedd, United Kingdom

MRS measures of brain chemistry are often considered static snapshots. We present MRS data showing an increase in Glutamate levels in the anterior cingulate cortex from baseline after a cognitive fMRI task. The biologic and methodologic implications of these findings are discussed.

***2298*. Development of a 17.6T Ultra-High Field BOLD-FMRI Method for Amygdala Related Psychiatric Disorders**

Markus Friedrich Hildenbrand[1], Stephan Nauroth[2], Xavier Helluy[1], Philipp Moerchel[3], Angelika Schmitt[2], Klaus-Peter Lesch[2]

[1]Research Center Magnetic Resonance Bavaria (MRB), Wuerzburg, Germany; [2]Department of Psychiatry, University of Wuerzburg, Germany; [3]Department of Experimental Physics 5, University of Wuerzburg, Germany

For psychiatric disorders being a worldwide strain to individuals and the health care systems and still being without comprehensive therapies, the mouse as model organism is a very promising research approach. Based on the development of a 17.6T ultra-high field BOLD-fMRI method for targeting the amygdala in the mouse brain, an access to serotonin mediated psychiatric diseases has been accomplished. By the usage of predator odor the activation of the amygdala shows a high sensitivity and specificity which yields a very good observation of the location and time devolution of the stimulus in the amygdala over a specified time period.

***2299*. Short-Long Functional Polymorphism of Serotonin Transporter Gene Modulates the Acute Citalopram Challenge PhMRI Response**

Darragh Downey[1], Gabriella Juhasz[2], Shane McKie[2], Karen Elizabeth Davies[1], Emma Jane Thomas[2], Diana Chase[2], Rebecca Elliott[2], John Francis William Deakin[2], Ian Muir Anderson[2], Stephen Ross Williams[1]

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We investigated whether citalopram-challenge phMRI, as a probe of serotonin transporter function, would detect functional variants of the serotonin transporter gene and how this may influence normal serotonergic function. 42 normal volunteers underwent phMRI with intravenous 7.5mg citalopram. Homozygous Short/Short allele carriers had reduced BOLD responses bilaterally in the caudate, mid-cingulate gyrus and parietal cortex and increases in the superior frontal gyrus compared with the Long/Long carriers. The results offer the first direct evidence that the short and long variants of the 5HTT promoter region indeed influence synaptic 5HT function in the living human brain.

***2300*. Occupational Solvent Exposure and Working Memory Function**

David Matthew Carpenter[1], Emily L. Eaves[1], Cheuk Ying Tang[1], Gudrun Lange[2,3], Johnny Ng[4], Nancy L. Fiedler[5]

[1]Radiology, Mount Sinai School of Medicine, New York, United States; [2]Psychiatry, UMDNJ-New Jersey Medical School, Newark, NJ; [3]Radiology, UMDNJ-New Jersey Medical School, West Orange, NJ, United

States; [4]Radiology, City Colege ofl New York, Bronx, NY, United States; [5]Environmental and Occupational Medicine, UMDNJ- Robert Wood Johnson Medical School, Piscataway, NJ, United States

In this report BOLD fMRI to investigate the functional deficits of subjects with long-term occupational solvent exposure. Subjects underwent fMRI while performing a Sternberg task and N-back working memory task. We used an exploratory voxel-wise and an ROI analysis to test the hypothesis that the occupationally exposed subjects show hypo-activation in regions associated with working memory when compared to a carefully matched control group. the results suggest that prolonged occupational solvent exposure is related to a decreased activation in regions associated with working memory.

2301. **Can Resting State Measurements Supplement Task Based FMRI for Presurgical Motor Cortex Mapping? a Test-Retest Reliability Study**

Peter Mannfolk[1], Markus Nilsson[1], Ronnie Wirestam[1], Freddy Ståhlberg[1,2], Peter Fransson[3], Andreas Weibull[4], Johan Olsrud[1,5]

[1]Dept. of Medical Radiation Physics, Lund University, Lund, Sweden; [2]Dept. of Diagnostic Radiology, Lund University Hospital, Lund, Sweden; [3]Department of Clinical Neuroscience, Stockholm Brain Institute, Karolinska Institute, Stockholm, Sweden; [4]Dept. of Medical Radiation Physics, Lund University, Malmö, Sweden; [5]Center for Medical Imaging and Physiology, Lund University Hospital, Lund, Sweden

Clinical BOLD fMRI of children or in patients showing severe disease-related impairment can be difficult as active participation is required. Therefore, the possibility of using resting state data would be of great value. The aim of this study was to evaluate the test-retest reliability in detecting the intrinsic motor network from resting state data as compared to activation maps based on a bilateral finger tapping task. The test-retest reliability of resting state data was found to be comparable to what is seen for a typical task based fMRI-experiment within a subject. However, large differences between subjects were also found.

2302. **Correcting for EPI Distortion at Very High Field Using the Fieldmap Method with Multi-Channel Coils: Effectiveness in Presurgical Planning FMRI at 7 T**

Simon Robinson[1], Alexander Geissler[2], Siegfried Trattnig[1], Roland Beisteiner[2]

[1]High Field MR Centre, Department of Radiology, Medical University of Vienna, Vienna, Austria; [2]Clinical fMRI Study Group, Departments of Neurology, Neurosurgery, and Radiology, Medical University of Vienna, Austria

We assess the effectiveness of a fast MGE sequence and postprocessing steps for fieldmapping with multichannel coils in correcting for EPI distortions in presurgical planning fMRI at 7T. Complex conjugate phase combination, unwrapping, denoising and fieldmap thresholding (for maximum achievable remapping) are described. Four patients underwent multiple runs of motor area localisation. Without distortion correction, primary foci for hand activation were mislocalised by 5-7mm, which could give rise to serious postoperative impairment of function. No residual distortions were observed after distortion correction, allowing fMRI results to be reliably registered to structural images and imported into neurosurgical planning systems.

2303. **An Objective Approach to FMRI Assessment of Language Lateralization**

David F. Abbott[1,2], Anthony B. Waites[1,2], Graeme D. Jackson[1,3]

[1]Brain Research Institute, Florey Neuroscience Institutes (Austin), Melbourne, Victoria, Australia; [2]Department of Medicine, The University of Melbourne, Melbourne, Victoria, Australia; [3]Departments of Medicine & Radiology, The University of Melbourne, Melbourne, Victoria, Australia

Language lateralization based on fMRI is often used in clinical neurological settings. With most conventional methods, the laterality determined can be dependent on the quality of a particular study and chosen statistical threshold. We present an objective threshold-independent method of assessing when individual patients have statistically atypical language lateralization. We illustrate the method using fMRI of verbal fluency in 34 healthy controls. One could also apply the method to other paradigms or regional assessments; for example the assessment of lateralisation of a different task, or to the assessment of anterior-posterior distribution rather than laterality.

High Resolution Brain Imaging

Hall B Tuesday 13:30-15:30

2304. **Patch Structure in White Matter Detected by Microscopic MRI at High Field Strength**

Tie-Qiang Li[1], M. Fukunaga[2], K Shmueli1[2], S Dodd[2], J H. Duyn[2]

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T2*-weighted MRI at high magnetic field strength has recently been used to reveal cortical layer structures and white matter heterogeneity in vivo. Magnetic susceptibility differences have been widely thought to give rise to most of the contrast but the precise mechanisms underlying the contrast is still poorly understood. Here, we report an interesting finding from microscopic MRI and histological studies of white matter specimens of the human brain, which may provide further clues for better understanding of the mechanisms underlying the T2*-weighted contrast.

2305. MR Contrast in Post-Mortem Brain Remains After 6 Decades of Storage: Imaging in Cerebellar Agenesis

Stephen J. Sawiak[1,2], Guy B. Williams[1], T Adrian Carpenter[1], S A. Edgley[3]
[1]Wolfson Brain Imaging Centre, University of Cambridge, Cambridge, United Kingdom; [2]Behavioural and Clinical Neurosciences Institute, University of Cambridge, Cambridge, United Kingdom; [3]Department of Physiology, Development and Neuroscience, University of Cambridge, Cambridge, United Kingdom

Cerebellar agenesis is a condition where the cerebellum fails to develop normally. Here we present data from two individuals acquired post-mortem from brains extracted in the 1940s showing high resolution anatomical and structural data with MPRAGE and DTI sequences.

2306. Measuring Cortical Thickness of the Human Brain Using Ultra High Resolution Data

Falk Lüsebrink[1], Astrid Wollrab[2]
[1]RheinAhrCampus, Remagen, Germany; [2]Biomedical Magnetic Resonance, Otto-von-Guericke-Universität, Magdeburg, Germany

The analysis of the human cerebral cortex and the measurement of its thickness based on MRI data provide insight into normal brain development and neurodegenerative disorders. Accurate and reproducible results of the cortical thickness measurement are desired. In addition to data processing tools, the quality (i.e. resolution) of the imaging data is evaluated. We thus compare ultra high resolution data acquired at 7T with 3T data for measuring the cortical thickness of the human brain.

2307. Effect of Head Motion on the MRI Visibility of Cortical Layers in Human Primary Visual Cortex

Jessica Schulz[1], Miriam Wähnert[1], Robert Trampel[1], Robert Turner[1]
[1]Max-Planck-Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

There is increased interest in using ultra-high-field brain MRI to map intracortical structures. We simulated the effect on layer structure of small in-plane motions during data sampling, using 200 micron resolution ex vivo brain images. Such motions can easily introduce illusory structures, shown in images and cortical intensity profiles of human primary visual cortex, without and with motion corruption. Our simulations emphasize the crucial importance of appropriate motion correction of high resolution brain data.

2308. Sub-Millimeter Isotropic Ocular-Dominance Mapping at 7T Using 3D EPI

Natalia Petridou[1], Ben M. Harvey[2], Serge O. Dumoulin[2], S F.W. Neggers[3], Tjerk Gutteling[3], Peter Luijten[1], Hans Hoogduin[1]
[1]UMC Utrecht, Utrecht, Netherlands; [2]Psychology, Utrecht University, Utrecht, Netherlands; [3]Rudolf Magnus Institute for Neuroscience, UMC Utrecht, Utrecht, Netherlands

The advent of high fields has made it possible to reconstruct the functional organization of ocular-dominance columns in the human cortex with sub-millimeter in-plane (2D) resolution. However, 2D-based imaging techniques necessarily use anisotropic spatial resolution and are restricted to subjects that have relatively flat regions of cortex. Using 3D EPI with sub-millimeter isotropic resolution at 7T and a differential ocular stimulation we found alternating activation patterns in V1 which may relate to the expected ocular-dominance column distribution. This suggests that at 7T, 3D EPI can offer an avenue for sub-millimeter isotropic mapping not limited by the underlying anatomy.

2309. Optic Nerve Characterisation by Isotropic High-Resolution MRI

Sandro Romanzetti[1], Petra Stoerig[2], Ana Maria Oros-Peusquens[1], N. Jon Shah[1,3]
[1]Institute of Neuroscience and Medicine 4, Medical Imaging Physics, Forschungszentrum Juelich, Juelich, Germany; [2]Institut für Experimentelle Psychologie, Heinrich-Heine-Universität, Duesseldorf, Germany; [3]Faculty of Medicine, Department of Neurology, RWTH Aachen, Aachen, Germany

Many ophthalmological and neurological pathologies affect the optic nerve which provides the brain with retinal information. Revealing their manifestations with isotropic, high-resolution imaging of the optic nerve, the orbit and the chiasm may allow early and direct diagnosis of diseases that result in loss of visual function, partial or complete blindness. In this pilot study, we present isotropic, high-resolution optic nerve images which may be suitable for clinical applications.

2310. Detection of Cortical Layers Via Magnetization Transfer Imaging at 7T

Olivier E. Mougin[1], Alain Pitiot[2], Penny A. Gowland[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, School of Physics & Astronomy,University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]School of Psychology, Institute of Neuroscience, Nottingham, Nottinghamshire, United Kingdom

Variations in magnetization transfer (MT) ratio across the cortex have been detected using high resolution MT scans at 7T and are assumed to correspond to variations in myelination, and variations in MT corresponding to the stria of Gennari have been detected on MT maps.

2311. Improved Direct Localization of the Human Pedunculopontine Nucleus (PPN) by 3D FLASH MRI at Sub-Millimeter Resolution

Tobias M. Lindig[1,2], Sorin Breit[1], Ludger Schöls[1], Thomas Nägele, Uwe Klose[2], Gunther Helms[3]

[1]Department of Neurology and Hertie-Institute for Clinical Brain Research, University Hospital Tuebingen, Tuebingen, Germany; [2]Section of experimental MR of the CNS, Department of Diagnostic and Interventional Neuroradiology, University Hospital Tuebingen, Tuebingen, Germany; [3]MR-Research in Neurology and Psychiatry, University Medical Center Goettingen, Goettingen, Germany

The pedunculopontine nucleus (PPN) is a potential target for deep brain stimulation to address symptoms of gait freezing and postural instability in Parkinson's disease. Proton density-weighted (PD-w) MRI has been recommended to locate its position. Contrast and delineation of the PPN area in healthy subjects were improved by multi-echo 3D MRI at an increased resolution of 0.8 mm^3, and by using signal amplitude maps S0. These were calculated from a dual-angle FLASH protocol, thus eliminating the residual influence of T1 from the PD-w images. Usefulness for stereotactic planning was verified on two patients at 3T using a protocol of 4x4minutes.

2312. Ammon's Horn Sclerosis Detected in Temporal Lobe Epilepsy with 7 T MRI

Thomas R. Henry[1], Marie Chupin[2], Stéphane Lehéricy[3], Kamil Ugurbil[4], Frederick Ott[5], Zhiyi Sha[1], Pierre-Francois Van de Moortele[5]

[1]Neurology, University of Minnesota, Minneapolis, MN, United States; [2]Universite Pierre et Marie Curie-Paris, Paris, France; [3]Neuroradiology, Universite Pierre et Marie Curie-Paris, Paris, France; [4]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States; [5]Radiology, University of Minnesota, Minneapolis, MN, United States

Increased contrast and spatial resolution at 7 T permitted the reliable detection of internal architecture of the hippocampal formation. Submillimetric T2w images at 7 T consistently resolved the continuous white matter band, which separates deep portions of CA1-3 from CA4 and the dentate hilus. The resulting accuracy permitted intrahippocampal (subregional) volumetry. These preliminary results strongly support expectations that brain imaging at very high magnetic field may allow for a more accurate patient classification based on qualitative and quantitative information that is difficult or impossible to collect reliably at lower field.

2313. In Vivo Imaging of Human Hippocampal Subfields at 7 Tesla

Caitlin Judith Hardy[1], Vasthie Prudent, Songtao Liu, Graham Wiggins, Dolores Malaspina[2], Oded Gonen

[1]Radiology, NYU School of Medicine, New York, NY, United States; [2]Psychiatry, NYU School of Medicine

Using a combination of 7 T field, B0-shim, high count receive-coil arrays and heavy T2* weighting we were able to depict hippocampal subfields down to 100 micron in 10/10 young adults in a clinically acceptable time of 14 minutes.

2314. Delineation of Human Primary Auditory Cortex on the Basis of a Combined T1 and T2 Weighted MR Contrast

Christian Wasserthal[1], Karin Engel[2], Jörg Stadler[1], Bruce Fishl[3,4], Patricia Morosan[5], Andre Brechmann[1]

[1]Special-Lab Non-Invasive Brain Imaging, Leibniz-Institute for Neurobiology, Magdeburg, Germany; [2]Department of Simulation and Graphics, Otto-von-Guericke University of Magdeburg, Germany; [3]Department of Radiology, Harvard Medical School, Charlestown, MA, United States; [4]Computer Science and AI Lab, Massachusetts Institute of Technology, Cambridge, MA, United States; [5]Institute of Medicine, Research Center Jülich, Germany

In the visual system the primary cortex area can robustly be identified by retinotopic mapping. In the auditory modality, a routine method to delineate the primary auditory cortex (PAC) area in individual human subjects is not available.
We developed a method to anatomically identify the PAC area on the basis of myelin content in single subjects by creating an artificial contrast using conventional T1 and T2 weighted imaging at 3 Tesla. Results show a region on the medial two thirds of Heschl's gyrus that is very consistent to the probability map of the PAC defined in post-mortem brains.

2315. Differences in the Proportional Volume of Different Brain Regions Relative to the Whole Brain Size

Marcus Belke[1], David H. Salat[2], Enno Wehrmann[1], Katja Menzler[1], Ulrike Lengler[3], Wolfgang H. Oertel[1], Felix Rosenow[1], Karsten Krakow[3], Susanne Knake[1]

[1]Department of Neurology, Philipps-University Marburg, Marburg, Germany; [2]Athinoula A. Martinos Center for Biomedical Imaging, Harvard Medical School, Boston, MA, United States; [3]Brain Imaging Center Frankfurt, University of Frankfurt, Frankfurt, Germany

We investigated association between total intracranial volume (TIV) and the volume of several cortical, subcortical and white matter regions. After an automated parcellation of the brain, a slope was calculated, representing the proportional volume of each structure relative to the TIV. Cortical regions were particularly associated with TIV. The greatest slope of the subcortical regions was found for the brainstem. In a second test gender differences were investigated. Large differences were found between men and women when uncorrected volumes were compared. After correction for the influence of the TIV, no gender differences were found in any of the investigated regions.

2316. Trigeminal Autonomic Cephalalgias Characterized by Similar Structural Differences in the Anterior Hypothalamus

Enrico Arkink[1], Nicole Schmitz[1,2], Guus Schoonman[3], Jorien van Vliet[3,4], Gisela Terwindt[3], Mark van Buchem[1], Michel Ferrari[3], Mark Kruit[1]

[1]Radiology, Leiden University Medical Center, Leiden, Netherlands; [2]Psychiatry, Amsterdam Medical Center, Amsterdam, Netherlands; [3]Neurology, Leiden University Medical Center, Leiden, Netherlands; [4]Neurology, Medisch Centrum Haaglanden, Den Haag, Netherlands

Trigeminal autonomic cephalalgias include cluster headache, paroxysmal hemicrania and SUNCT. An earlier voxel-based morphometry (VBM) study pointed at the posterior inferior hypothalamus to be involved in CH, but results were never reproduced. In the current study we used state of the art whole-brain and regional VBM, and manual segmentation of the hypothalamus, in analyzing the brains of 151 subjects with TACs (n=70), migraine patients (n=33) and controls (n=48). We found the anterior part (but not the posterior part) of the hypothalamus, including the suprachiasmatic nucleus ("the biological clock"), to be larger in TACs compared to migraineurs and controls. Our results seem to be specific for TACs, and question the validity and/or relevance of the earlier finding, including its role in deep brain stimulation as treatment for intractable cluster headaches.

2317. Clinically-Driven Fast and High-Resolution Mapping of T1, M0, and B1 with Whole Brain Coverage

Mohammad Sabati[1], Baranavasi Govindaraju[1], Andrew Maudsley[1]

[1]Radiology, University of Miami, Miami, FL, United States

Quantitative MR techniques, such as accurate mapping of the longitudinal relaxation time and water content, have become more important in neurological research. The current T1 mapping methods are generally lengthy and not adequate in a clinical environment. Also, further acquisitions are usually required to obtain the brain tissue water content. Several factors, including RF field inhomogeneities and low SNR impair the accuracy of these methods. In this study, we present a modified two-acquisition SPGR method for simultaneous B1, T1, and M0 mapping with a 1-mm isotropic spatial resolution that covers the entire human brain in a clinically acceptable time.

2318. Orientation Selectivity of Individual Voxels in Early Visual Areas Using 7 Tesla

Geoffrey Ghose[1,2], Cheryl Olman,[2,3], Kamil Ugurbil[2], Essa Yacoub[2]

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Using 1.5 mm isotropic GE imaging of BOLD activation to a continuously rotating stimulus, we find individual voxels with significant orientation selectivity in human visual areas V1, V2, and V3.

2319. Layer-Specific MRI of the Rat Retina with Intraocular Injection of Gadolinium-DTPA

Eric Raymond Muir[1,2], Timothy Q. Duong[2]

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The retina can be divided into seven cellular and synaptic layers. It has been shown that intraocular injection of manganese enhances contrast in the rat retina, revealing 7 layers with MRI. Gadolinium-DTPA is a T1 shortening contrast agent like manganese, but the localization of the two within in a tissue could be expected to be to differ, potentially leading to different layer-specific enhancement. In this study we used intraocular injection of gadolinium to provide unique layer enhancement in the rat retina. Gadolinium-enhanced MRI clearly resolved six retinal layers at 25x25 μm.

2320. Contrast at Ultra-High Field: Relaxation Times in the Rat Brain at 16.4 T

Rolf Pohmann[1]

[1]Magnetic Resonance Center, Max Planck Institute for Biological Cybernetics, Tübingen, Germany

Knowledge of the relaxation times is not only necessary for sequence optimization; it may also be decisive to judge the advantages for ultra-high field MRI. Here, T_1, T_2 and T_2^* in the rat brain were measured at 16.4 T with a spatial resolution of 180 μm inplane. The relaxation times were quantified with high accuracy for 20 anatomical structures and maps were generated to display the spatial distribution of the relaxation times over the brain.

2321. New Approaches to the Study of Comparative Neuroanatomy in Marine Vertebrates Using MRI: The Whale Shark, Rhincodon Typus, as a Case Study

Kara E. Yopak[1], Lawrence R. Frank[1]

[1]Center for Scientific Computation in Imaging, UCSD, La Jolla, CA, United States

The study of species with unique behavioral and morphological specializations is critical when teasing apart evolutionary trends, yet becomes difficult, as often these species are extremely rare and invasive methodologies are impractical. This paper examines the use of MRI to obtain high-resolution image data in an important but damaged brain specimen of the whale shark, Rhincodon typus, wherein digital reconstruction allowed for non-invasive quantification of its brain organization. We will discuss the effectiveness of MRI as investigative tool for non-invasive visualization and quantification of the internal anatomy of fishes.

2322. Detection of Amyloid-Beta Plaques Using Phase Imaging at 9.4 Tesla

Wen-Tung Wang[1], In-Young Choi[1,2], Jieun Kim[1], Sang-Pil Lee[1]
[1]Hoglund Brain Imaging Center, University of Kansas Medical Center, Kansas City, KS, United States; [2]Neurology, Molecular & Integrative Physiology, University of Kansas Medical Center, Kansas City, KS, United States

Magnetic resonance imaging is the only modality that can provide sufficient spatial resolution and image contrast to visualize Alzheimer's amyloid plaques noninvasively. Previously Alzheimer's amyloid plaques have been visualized in images acquired using spin-echo and gradient echo sequences at 7 T and 9.4 T. At high fields, it has been reported that the increased susceptibility-related contrast resulted in additional anatomical information, such as delineation of veins and iron-rich regions in human brain. In this study, we show that the susceptibility-induced contrast in gradient-echo phase images can improve detection of amyloid plaques.

2323. Automatic Detection of Amyloid Plaques on Ex Vivo APP/PS1 Mouse Brain Using a Zoom T2-Weighted Spin Echo Sequence

Benjamin Marty[1], Céline Giraudeau[1], Julien Flament[1], Sidi Mohamed Ahmed Ghaly[1], Franck Lethimonnier[1], Fawzi Boumezbeur[1], Julien Valette[1], Sébastien Mériaux[1]
[1]CEA/DSV/I2BM/Neurospin, Gif-Sur-Yvette, France

Amyloid plaques are a marker of Alzheimer's disease which are traditionally detected as hypointense signals on T2*-weighted images due to the presence of iron. This study proposes a comparison between the images of an ex vivo APP/PS1 mouse brain obtained using a conventional T2* gradient echo sequence and a zoom adiabatic T2 spin echo sequence. This comparison, based on the ability of both sequences to allow successful plaques detection using an automatic home-made procedure, reveals that T2 contrast allows resolving amyloid plaques with a better specificity than T2* contrast, which is disturbed by the hypointense signals coming from blood vessels.

2324. Anatomical Phenotyping of Rett Syndrome in the Mouse

Jacob Ellegood[1], Jason P. Lerch[1], R Mark Henkelman[1]
[1]Mouse Imaging Centre, Hospital for Sick Children, Toronto, Ontario, Canada

Rett Syndrome is an X-linked disorder, which primarily affects females, and is caused by mutations to the Mecp2 gene. A commonly used mouse model of RTT involves a truncation of the Mecp2 gene at codon 308. The purpose of this study was to examine the volume changes in the $Mecp2^{308}$ Rett syndrome mouse model with high resolution MRI. Volume changes were found in many regions, for example, significant decreases were found in the cerebral cortex as well as increases in the cerebellar cortex and ventricles.

2325. A Transversal and Longitudinal MRI Study in Patients with Cervical Dystonia Using VBM Analysis.

Porzia Totaro[1], Eytan Raz, Gian Marco Contessa, Francesca Tona, Giovanni Fabbrini, Alfredo Berardelli, Carlo Colosimo, Luigi Bozzao, patrizia pantano[2]
[1]Department of Neurological Sciences, Sapienza University of Rome, Rome, Italy; [2]Sapienza University of Rome, Rome, Italy, Italy

A transversal and longitudinal MRI study in patients with cervical dystonia using voxel-wise comparison of the local Gray Matter concentration.

2326. MRI of the Lumbar Spine at 7 Tesla in Healthy Volunteers and a Patient with Spina Bifida

Astrid Ellen Grams[1,2], Oliver Kraff,[1,2], Lale Umutlu[1,2], Stefan Maderwald,[1,2], Philipp Dammann,[2,3], Mark E. Ladd,[1,2], Michael Forsting[1,2], Elke Ruth Gizewski[1,2]
[1]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, NRW, Germany; [2]Erwin L. Hahn Institute for Magnetic Resonance Imaging, University Hospital Essen, Essen, NRW, Germany; [3]Department of Neurosurgery, University Hospital Essen, Essen, NRW, Germany

In the present study the feasibility of imaging of the lumbar spine and its adjacent structures under healthy and under pathological conditions at 7 Tesla was investigated. A combination of a 3D-CISS and a 3D-VIBE sequence comprehended imaging of the vertebrae, the intervertebral discs, the bony neural foramina, the facet joints, the dural sac and the intraspinal portions of the spinal nerves.

2327. Voxel-Based Morphometric Analysis of Gray and White Matter in Perinatally HIV-Infected Youth

Manoj Kumar Sarma[1], Rajakumar Nagarajan[1], Michael Albert Thomas[1], Judy Hayes[2], Jaime Deville[3], Karin Nielsen[3], David Michalik[4], Whitney B. Pope[1], Margaret A. Keller[2]
[1]Radiological Sciences, UCLA, Los Angeles, CA, United States; [2]Pediatrics, Harbor-UCLA Medical Center, Torrance, CA, United States; [3]Pediatrics, UCLA, Los Angeles, CA, United States; [4]Miller's Children's Hospital, Long Beach, CA, United States

Voxel-based morphometry was used to compare both gray and white matter volume in perinatally human immunodeficiency virus (HIV)-infected youth versus healthy controls. HIV patients had reduced gray matter volume in the bilateral caudate nucleus, left parietal lobe, but an increase of gray matter volume in the frontal lobe, posterior temporal lobe, and parietal lobe. Striking white matter volume reductions were found in the temporal lobe, pons, right pre-frontal area, corpus callosum and the junction of the

thalamus and mid brain. These findings suggest the sensitivity of VBM in evaluating GM and WM abnormalities in perinatally HIV-infected youth.

2328. The Effects of Voxel Size and Image Smoothing on R2* Measurements of the Human Brain

Christian Denk[1], Alexander Rauscher[1]
[1]UBC MRI Research Centre, University of British Columbia, Vancouver, BC, Canada

Quantitative imaging of the R2* relaxation rate employing multiple echoes can be used to assess blood oxygenation and iron content in neural structures. However, R2* is not a strictly intrinsic tissue property, as it also depends on the spatial relationship between voxel geometry and background field inhomogeneities. These background field inhomogeneities cause additional signal decay. To investigate the influence of spatial resolution and smoothing on R2* values, we acquired images with high spatial resolution and applied spatial smoothing to the complex data, which simulates acquisition at lower spatial resolution, and to the magnitude data. We found that both changes in spatial resolution and spatial smoothing of magnitude of high resolution data leads to strong changes in R2*, which suggests that R2* values should be interpreted in the light of data acquisition parameters as well as data smoothing.

2329. Direct Visualization of Surgical DBS Targets Using High-Field (7T) MRI

Noam Harel[1], Essa Yacoub[2], Kamil Ugurbil[2], Aviva Abosch[3]
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Deep brain stimulation (DBS), a surgical treatment involving the implantation of an electrode in the brain, is used for the treatment of patients with movement disorders. The success of this surgical technique is critically dependent on precise placement of the DBS electrode into the target structure. However, current clinical imaging methods lack the sensitivity for resolving and visualizing of the DBS target.
Here, using a combination of high magnetic field (7T) with susceptibility-weighted contrast resulted in a dramatically improved ability to identify and delineate anatomical architecture of deep brain structures that are FDA-approved DBS targets.

2330. Human T_2* and Phase Imaging at 9.4 T

Juliane Sabine Budde[1], Gunamony Shajan[1], Jens Hoffmann[1], Frank Muehlbauer[1], Kâmil Ugurbil[2], Rolf Pohmann[1]
[1]Max Planck Institute for Biological Cybernetics, Tuebingen, Germany; [2]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, United States

Ultra-high static magnetic field causes higher susceptibility effects which yield shorter T2* values and larger variations of the image phase. In this work, we acquired highly detailed T2* maps showing internal structures. Mean T2* values for GM were estimated as 28ms±6ms and 20ms±4ms for WM. Phase images were post-processed to yield images with high tissue contrast between grey and white matter throughout the brain at a resolution of 200µm x 200µm x 1mm. Signal gain at ultra-high field allows for high resolution surface phase images of 130µm x 130µm in-plane resolution. In these, differences within grey matter are visible.

2331. Ultra-High Field MRI at 7.0 Tesla in Patients with Ischemic or Hemorrhagic Stroke: A Preliminary Study

Anja Gwendolyn van der Kolk[1], Jaco JM Zwanenburg[1], Geert Jan Biessels[2], Fredy Visser[1,3], Peter R. Luijten[1], Jeroen Hendrikse[1]
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Seven patients with clinically and standard imaging-based proven ischemic or hemorrhagic stroke were scanned with magnetization prepared 3D FLAIR, combined time-of-flight inflow and multi-echo fast field echo (meFFE), T_1 3D TFE, and DTI. 7.0 Tesla results were comparable to results of similar 1.5 Tesla sequences, but with better resolution and – in 3 out of 7 patients – additional information regarding underlying pathology. Furthermore, meFFE with 3 echoes was valuable in identification of microbleeds, microinfarcts and thrombus.

General Brain Imaging: Technique Development

Hall B Wednesday 13:30-15:30

2332. Multicontrast 3D Structural Imaging to Improve Automatic Brain Extraction and Segmentation

Bradley P. Sutton[1,2], Anh Tu Van[3]
[1]Bioengineering, University of Illinois, Urbana, IL, United States; [2]Beckman Institute, University of Illinois, Urbana, IL, United States; [3]Electrical and Computer Engineering, University of Illinois, Urbana, IL, United States

Currently many structural neuroimaging studies rely only on a T1-weighted image for brain extraction. Additional image contrast like T2 may improve the performance of the automatic brain extraction procedure. In this work, a previously proposed multiparametric 3D structural imaging sequence that provides several volumes with varying contrast in a multi-echo acquisition is used to assist in automatic brain segmentation. Two 3D volumes (one T1-weighted and one T2-weighted) with 1.2 mm isotropic resolution and a low

resolution 3D field map were obtained simultaneously within 6.5 minutes. Improvement in brain extraction utilizing the additional contrast was observed.

2333. PROPELLER Using Parallel Imaging with Across Blade Calibration for T1 FLAIR

James H. Holmes[1], Philip J. Beatty[2], Howard A. Rowley[3,4], Zhiqiang Li[5], Ajeetkumar Gaddipati[6], Xiaoli Zhao[6], Reed F. Busse[1], Jean H. Brittain[1]

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A novel parallel imaging technique for PROPELLER that utilizes external calibration data as well as a small amount of internal calibration data per blade is demonstrated for T1 FLAIR imaging. Short echo trains, which are optimal for T1 imaging, are maintained while the effective blade width is increased by reducing the number of internal calibration lines. Wider blades enable motion to be detected and corrected more reliably, improving robustness in uncooperative patients. The method is validated in studies of volunteers instructed to move their head during the acquisition.

2334. The Inter-Scan Variations of Flow Quantifications on Human Basilar Artery: A Study Controlled the Scan Conditions with Automatic Slice Positioning and the Automatic Lumen-Area Segmentation.

shiun-ying Ju[1], Yu-Wei Tang[1], Teng-Yi Huang[1], Hsu-Hsia Peng[2]

[1]Department of Electrical Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan; [2]Department of Biomedical Engineering and Environmental Sciences, National Tsing Hua university, Hsinchu, Taiwan

The MR flow quantification of the vessels can be used to evaluate the response of the vessel-related surgeries. However, for the conventional longitudinal studies of blood flow, manual slice selection in different days can cause measurement variation and thus degrade the accuracy of evaluation. In our study, in order to solve this problem, an automatic slice positioning method combined with previously implemented automatic ROI selection method were proposed to reduce the inter-scan variation. Furthermore, GPU-accelerated computation was applied to speed up the image registration. The flow variation of the human study was reported.

2335. MRI Estimation of Global Brain Oxygen Consumption Rate

Varsha Jain[1], Michael Langham[1], Felix Wehrli[1]

[1]University of Pennsylvania, Philadelphia, PA, United States

The human brain is extremely sensitive and vulnerable to even small alterations in oxygen supply, making a measure for assessing global cerebral metabolic rate of oxygen consumption (CMRO2) very important. We propose a method for estimating CMRO2 by simultaneous quantification of oxygen saturation by MR oximetry and cerebral blood flow by phase-contrast MRI in the major vessels draining (superior sagittal sinus) and feeding the brain (internal carotid and vertebral arteries), respectively. Our results demonstrate that the proposed technique is robust and reproducible, yielding temporally stable measurements at a temporal resolution 30 seconds.

2336. Improved Image Contrast and Scan Efficiency for Fat Suppressed T1-Weighted Imaging at 3T with a Spin Echo Two-Point Dixon Technique

Jingfei Ma[1], Ken-Pin Hwang[2], Ashok Kumar[3], Lawrence Ginsberg[3]

[1]Department of Imaging Physics, University of Texas MD Anderson Cancer Center, Houston, TX, United States; [2]Applied Science Lab, GE Healthcare Technologies, Houston, TX, United States; [3]Department of Diagnostic Radiology, University of Texas MD Anderson Cancer Center, Houston, TX, United States

Inclusion of fat suppress (FS) pulses in a spin echo acquisition substantially reduces scan efficiency. At 3 Tesla, the incidental magnetization transfer and dielectric effects from the FS pulses also degrade the image contrast and image uniformity. In this study, we developed a spin echo two-point Dixon technique for fat-suppressed T1-weighted imaging. In comparison to the conventional spin echo with FS pulses, we demonstrated in vivo that the new technique was 40% more efficient and had much better image contrast, better FS and overall image uniformity for fat-suppressed T1-weighted imaging of head & neck at 3 Tesla.

2337. A Design of Head Holder for Calculation of Susceptibility Through Multiple Orientation Sampling (COSMOS)

Hsiao-Wei Peng[1], Chao-Chun Lin[2,3], Yi-Jui Liu[1,4], Chien-Kuo Chen[1], Kuo-Fang Shao[4], Wu-Chung Shen[2,5], Hing-Chiu Chang[6,7]

[1]Department of Automatic Control Engineering, Feng Chia University, Taichung, Taiwan, Taiwan; [2]Department of Radiology, China Medical University Hospital, Taichung, Taiwan; [3]Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan; [4]Master's Program in Biomedical Informatics and Biomedical Engineering, Feng Chia University, Taichun, Taiwan; [5]School of Medicine, China Medical University, Taichung, Taiwan; [6]Applied Science Laboratory, GE Healthcare Taiwan, Taipei, Taiwan; [7]Institute of Biomedical Electronics & Bioinformatics, National Taiwan University

We aimed to design a head holder for calculation the susceptibility through multiple orientation sampling (COSMOS). Different brain tissues with different susceptibility result in the changes of focal magnetic fileds. Quantitative susceptibility imaging of brain are obtained by measurement of the focal magnetic field changes.. It is a promising approach for exploring various brain pathological conditions. For clinical application, the challenging problem is to rotate the head of patient along the Y axis only and fix the head in the degree through the MR scan. Our results show great control of the rotation in three axes with the facilitation of head holder.

2338. A Study Specific Brain Template in MNI Space for an Aged Population with Aortic Stenosis

Ping Wang[1], Elizabeth Strambrook[2], Thomas Floyd[3]
[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Anesthesiology & Critical Care, University of Pennsylvania, Philadelphia, PA, United States; [3]Anesthesiology & Critical Care, and Neurology, University of Pennsylvania, Philadelphia, PA, United States

The MNI standard template is ideal for healthy subjects. To improve the accuracy of normalization and the further analysis (such as statistical analysis), we created a study specific template in MNI space for an aged population with mild to critical aortic stenosis. This study specific template is approximately in MNI template space, but accommodates some characteristics of this particular study population, especially incorporating the increased ventricular volume.

2339. Use of Opposed Shim Currents for Infold Reduction on a UHF MRI System with Head Gradient

Christopher John Wiggins[1], Marion Caillat[1], Denis Le Bihan[1], Franz Schmitt[2], Eva Eberlein[2]
[1]CEA/NeuroSpin, Gif-Sur-Yvette cedex, France; [2]Siemens AG, Healthcare Sector Imaging & IT Division, Magnetic Resonance, Erlangen, Germany

The use of a head gradient set within a wholebody magnet can lead to significant artifacts. Signal arising from the shoulders is encoded in such a way that it aliases into the main image. Such artifacts are particularly pronounced at higher field, where B1 effects cause the sensitive region of volume coils to extend out into the chest and shoulder region. Previous approaches have tried to diminish the RF penetration in this area (through the use of RF shielding materials) or to disrupt the local field through using ferromagnetic material shown into a jacket that the subject wears. This study shows that with the use of both the wholebody and head gradient shim sets the signal from the shoulders could be dephased without affecting the signal from the head itself.

2340. A Qualitative Comparison of Magnetic Resonance Images of Brain Acquired Using Phased-Array Head Coils with 32 and 12 Array Elements at 1.5 Tesla

Pankit Parikh[1], Gurpreet Singh Sandhu[1,2], Kristine A. Blackham[1], Michael D. Coffey[1], Daniel P. Hsu[1], John A. Jesberger[2], Kecheng Liu[3], Mark A. Griswold[1,4], Jeffrey L. Sunshine[1,2]
[1]Radiology, University Hospitals of Cleveland, Case Western Reserve University, Cleveland, OH, United States; [2]Case Center for Imaging Research, Case Western Reserve University, Cleveland, OH, United States; [3]Siemens Healthcare, Malvern, PA, United States; [4]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States

Phased-array coils with increasing number of array elements have been developed and employed for clinical MR imaging. A phased-array head coil with 32 array elements provides quantitatively better brain images as compared to commercially available head coil with lower number of array elements. In this study, we investigate if application of this coil would improve the anatomic and pathologic analysis from the resultant brain images by qualitatively comparing MR images obtained using this coil with those obtained using a commercially available phased-array head coil with 12 array elements.

2341. Looking at Magnetization Exchange in Human White Matter Structures in Vivo

Saeed Kalantari[1], Cornelia Laule[2], Thorarin Bjarnason[3], Alex MacKay[1,2]
[1]Department of Physics and Astronomy, University of British Columbia Hospital, Vancouver, BC, Canada; [2]Department of Radiology, University of British Columbia Hospital, Vancouver, BC, Canada; [3]Department of Electrical and Computer Engineering, University of Calgary

The objective of this study was to measure the cross relaxation exchange time between the myelin water and intra/extracellular water pools in healthy human white matter in vivo. Five different white matter structures were investigated. Bloch equations were solved analytically and cross relaxation exchange times were extracted. Due to the ambiguity in the literature on spin-lattice relaxation times in white matter, three T1 scenarios were developed. The extracted cross relaxation times were then used to estimate the exchange corrections for myelin water fraction (MWF) measurements. The choice of T1 scenario had a significant effect on cross relaxation times and consequently on MWF corrections.

2342. A Head Mimicking Phantom for 7T, Matched for Tissue Parameters, B1+ Behavior, and Coil Loading Effects

Andrew T. Curtis[1,2], Lauren E. Villemaire[2], Kyle M. Gilbert[1], Ravi S. Menon[1,2]
[1]Centre for Functional and Metabolic Mapping, Robarts Research Institute, London, Ontario, Canada; [2]Medical Biophysics, The University of Western Ontario, London, Ontario, Canada

An agarose gel and saline solution phantom was developed to mimic properties of the human brain at 7T. This design provides many parameters matched to the behaviour seen in vivo including: grey matter/white matter contrast for sequence development, matched B1+ interference (RF wavelength) behaviour, and coil loading effects.

2343. **Simple and Efficient Image Processing Techniques to Improve the Registration Between the MR and Light Microscopy Images**

Xia Li[1,2], Ann Choe, [2,3], Yurui Gao[3,4], Iwona Stepniewska[3], Adam Anderson[3,4]
[1]Radiology, Vanderbilt University, Nashville, TN, United States; [2]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States; [3]Biomedical Engineering, Vanderbilt University; [4]Institute of Imaging Science,, Vanderbilt University, Nashville, TN, United States

The light microscopy images have a high spatial resolution and are usually co-registered to the corresponding MR images in order to make the comparison. However, there are artifacts, such as tearing, deformation, or disappearance of tissue fragments, in the stained slices. Those artifacts make the registration among MR, blockface, and light images more difficult. In this study, two image post-processing techniques are introduced, which can provide a better initialization to the nonrigid registration algorithm.

General Neuroimaging

Hall B Thursday 13:30-15:30

2344. **Inter-Reader Reproducibility for Carotid Territory Cerebral Vascular Infarcts: A 3.0T Magnetic Resonance Imaging Study**

Wei Yu[1], Li Dong, [12], Lu Zhou[1], Dan Hipper[2], Marina Fergurson[2], Guangrui Liu[1], Dean Shibata[2], Chun Yuan[2], Zhaoqi Zhang[1]
[1]Beijing Anzhen Hospital, Capital Medical University, Beijing, China; [2]University of Washington, Seattle, WA, United States

We determined the inter-reader reproducibility in the assessment of carotid territory brain lesions. In a carotid study, two reviewers reviewed brain images of 134 hemispheres from 67 subjects independently. The inter-reader agreement was substantial for the lesion presence ($\kappa = 0.67$; 0.54-0.80) and the lesion size ($\kappa = 0.75$; 0.60-0.92), and there was complete agreement ($\kappa = 1.0$) for age. Some disagreements on the presence or absence of lesions may be due to their location near the boundary of the carotid territory. It is important to point out small old lesions were the primary factor that reduced reproducibility.

2345. **Quantitative Measurements of Cerebral Oxygen Extraction Fraction for Rabbits with Carotid Occlusion Using MRI**

Xiaodong Zhang[1], Chao He[2], Lihong Hui[3], Xiaoying Wang, [1,3], Sheng Xie[3], Jiangxi Xiao[3], Hongyu An[4], Jue Zhang[1,2], Jing Fang[1,2]
[1]Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China; [2]College of Engineering, Peking University, Beijing, China; [3]Dept.of Radiology, Peking University First Hospital, Beijing, China; [4]Dept. of Radiology, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

Cerebral oxygen extraction factor (OEF) provides critically important information to assess the brain oxygen metabolism in both normal and disease states. It has been reported that the OEF could be evaluated for healthy human volunteers using MRI. In this study, a based gradient echo sampling of the spin echo (GESSE) sequence implemented on GE 3.0T scanner to evaluate the cerebral OEF distribution of rabbits before and after carotid artery occlusion operation. Our study demonstrated a consistent and significant increase of OEF in rabbits post carotid artery occlusion, suggesting that this MR based method can be utilized to detect pathophysiological changes in cerebral oxygenation.

2346. **Myelin Water Imaging of Children with Diverse Reading Ability**

Eugene Yip[1], Pauline Low[2], Burkhard Mädler, [1,3], Catherine Lebel[4], Christian Beaulieu[4], Linda Siegel[2], Alex Mackay[1]
[1]Department of Physics and Astronomy, University of British Columbia, Vancouver, British Columbia, Canada; [2]Department of Education and Counselling Psychology, and Special Education, University of British Columbia, Vancouver, British Columbia, Canada; [3]Philips Medical Systems; [4]Department of Biomedical Engineering, University of Alberta, Edmonton, Alberta, Canada

Magnetic resonance imaging provides a mean to non-invasively investigate the neurological cause of dyslexia, a learning disability that affects one's ability to read despite adequate intelligence. Myelin water imaging, based on calculating the myelin water fraction from multi-echo T2 relaxation curves, can be used to quantitatively assess white matter. In this study, myelin water imaging and cognitive and reading assessments were performed on children with a wide range of reading ability in order to investigate the relationship between dyslexia and white matter development in the brain.

2347. **Improving Characterization of Traumatic Brain Injury by Synergistic Use of Multi-MRI Techniques**

Zhifeng Kou[1], Robin Hanks, Scott Millis, Randall Benson, Ramtilak Gattu, E Mark Haacke[1]
[1]Radiology, Wayne State University School of Medicine, Detroit, MI, United States

There is no treatment of TBI partially due to the current clinical classification system cannot effectively identify the pathoanatomical information of the brain. We propose that a synergistic use of multi-imaging techniques may capture much of the heterogeneity and complexity of brain injury in individual patients therefore result in improved accuracy and detail in prognostic models and improved

efficiency of clinical trials. In this study, we report our preliminary observations regarding the synergistic use of these three MRI techniques in an improved characterization of TBI.

2348. 4D Flow Measurement of Cerebrospinal Fluid Pulsation at the Craniocervical Junction and Cervical Spine and Its Clinical Potential

Alexander Christian Bunck[1], Wolfram Schwindt[1], Jan-Robert Kröger[1], Alena Jüttner[1], Angela Brentrup[2], Barbara Fiedler[3], Gerard Crelier[4], Walter Heindel[1], David Maintz[1], Thomas Niederstadt[1]

[1]Department of Clinical Radiology, University hospital of Muenster, Muenster, Germany; [2]Department of Neurosurgery, University hospital of Muenster, Muenster, Germany; [3]Department of Paediatrics, University hospital of Muenster, Muenster, Germany; [4]Institute for Biomedical Engineering, ETH Zurich, Zurich, Switzerland

Time resolved 3D-phase contrast imaging allows to assess cerebrospinal fluid pulsation at the craniocervical junction and cervical spine. Using state-of-the-art visualization techniques it helps to identify and differentiate between pathological and physiological cerebrospinal fluid flow pattern. As such it may add valuable information for the analysis of pathologies associated with altered cerebrospinal fluid flow like in Chiari malformations and may promote a better understanding of the underlying pathophysiology of these diseases.

2349. Differentiating Haematoma with the R_2' Relaxation Rate

Gopal Varma[1], Prakash Saha[2], Matt Waltham[2], Stephen Keevil[1,3], Alberto Smith[2], Tobias Schaeffter[1]

[1]Imaging Sciences, King's College London, London, United Kingdom; [2]Academic Department of Surgery, King's College London, London, United Kingdom; [3]Medical Physics, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom

Subdural haematoma (SDH) is an emergency when acute, and management is often guided by imaging. Distinguishing between the different phases of SDH may be possible by the presence and position of methaemoglobin. In this study, we create an in vitro system of SDH and examine the relationship between intra- and extracellular methaemoglobin at various concentrations, using R2, R2* and R2â€™ parameters. R2â€™ relaxation rate appears to be the most sensitive marker of methaemoglobin concentration and can readily differentiate between when it is intra- or extracellular. This parameter could therefore be used to stage the phase of SDH.

2350. Hyperintense Carotid Plaque on T_1-Weighted TFE MRI in Symptomatic Patients with Low Grade Carotid Stenosis and Carotid Occlusion

Anja Gwendolyn van der Kolk[1], Gert Jan de Borst[2], Anne G. den Hartog[2], M Eline Kooi[3], Willem PThM Mali[1], Jeroen Hendrikse[1]

[1]Department of Radiology, University Medical Center, Utrecht, Netherlands; [2]Department of Vascular Surgery, University Medical Center, Utrecht, Netherlands; [3]Department of Radiology, University Medical Center, Maastricht, Netherlands

The carotid MR hyperintense (vulnerable) plaque is associated with a higher morbidity and mortality. We investigated the prevalence of this plaque and its clinical correlates on T_1-weighted turbo-field echo (T_1w-TFE) MRI in patients with ischemic symptoms and varying degrees of stenosis. 153 patients with TIA or ischemic infarct were retrospectively examined. 18% showed one or more hyperintense plaques. Half of all hyperintense plaques occurred in symptomatic patients with either 0-69% stenosis or occlusion; more than ⅓ of patients with 50-69% stenosis presented with this plaque. This subgroup of patients could in future possibly benefit from aggressive medicinal therapy or revascularization.

2351. Comparing Magnetic Susceptibility Mapping with SWI for Targeting Structures for Deep Brain Stimulation

Karin Shmueli[1], Ruth O'Gorman[2,3], David Lythgoe[4], Michael Samuel[5], Richard Selway[6], Keyoumars Ashkan[6], Jozef Jarosz[2]

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Susceptibility-Weighted Imaging (SWI) improves the visibility of target structures (globus pallidus (GP) and subthalamic nucleus (STN)) for deep brain stimulation (DBS). However, because phase contrast is non-local and orientation dependent, SWI contains artifacts that may result in targeting errors. Susceptibility maps, which have shown promise for overcoming such artifacts, were calculated from clinical 1.5-T phase data acquired at a single orientation. 2-mm shifts in the superior borders of the red nuclei and GP in the SWI relative to the susceptibility maps were observed in several volunteers and DBS patients showing that susceptibility mapping may help reduce SWI targeting errors.

***2352*. Aqueduct CSF Flow Measured Objectively with PC-MRI**

Anders Wåhlin[1], Khalid Ambarki[1], Anders Garpebring[1], Jan Malm[2], Richard Birgander[1], Anders Eklund[1]

[1]Radiation Sciences, Umeå University Hospital, Umeå, Västerbotten, Sweden; [2]Clinical Neuroscience, Umeå University Hospital, Umeå, Västerbotten, Sweden

Aqueductal cerebrospinal fluid flow, measured with motion sensitive phase contrast MRI, is subject to typical imperfections in flow imaging such as partial volume effects and difficulties in lumen delineation. In this study we abandoned graphically represented vessel delineations. Instead we used complex data generated by the PC-MRI in a method with the potential of objective and absolute measurement of CSF velocity and area, without restrictions by matrix resolution. We compared the complex value methodology with conventional manual segmentation for the determination of aqueduct CSF stroke volume in a group of 42 healthy elderly.

***2353*. MR-Based, Subject-Specific Computational Fluid Dynamics Modeling of the Vertebro-Basilar System**

Amanda Kathleen Wake[1], John C. Gore[1], J. Christopher Gatenby[1]

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In this study high field MR and phase contrast (PCMR) data were used to construct a subject-specific model of flow in the vertebro-basilar system. Wall shear stress (WSS) data from the model yield insight into artery bypass graft design.

Animal Models of Brain Disease

Hall B Monday 14:00-16:00

***2354*. Decreased ADC Precedes Cellular Swelling in N-Methyl-D-Aspartate (NMDA) Treated Mouse Retina**

Chia-Wen Chiang[1], Junjie Chen[2], Sheng-Kwei Song[3]

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Apparent diffusion coefficient (ADC) is a widely used neuronal injury marker for early detection of various brain disorders. In the current study, we investigated the timing of decreased ADC vs. the detectable tissue swelling resulting from N-methyl-D-aspartate (NMDA) induced cytotoxic edema in mouse retina *in vivo*. Results suggest that decreased ADC is a biomarker of cytotoxic edema providing an early measure of retinal excitotoxic injury before detectable retinal swelling.

***2355*. Acute & Sub-Chronic Neuronal Effects of NMDA Receptor Antagonist, Memantine Using Pharmacological Magnetic Resonance Imaging**

Sakthivel Sekar[1], Marleen Verhoye[1], Johan Van Audekerke[1], Koen Tahon[2], Koen Wuyts[3], Claire Mackie[3], Michele Giugliano[2], Thomas Steckler[3], Annemie Van Der Linden[1]

[1]Bio-Imaging Lab, University of Antwerp, Antwerp, Belgium; [2]Theoritical Neurobiology, University of Antwerp, Antwerp, Belgium; [3]Johnson & Johnson Pharmaceuticals Research & Development, Beerse, Belgium

The present study reports on the acute and sub-chronic neuronal effects of the NMDA antagonist memantine on the rat brain measured as BOLD (blood oxygenation level dependent) contrast changes in a pharmacological magnetic resonance imaging (phMRI) study. Corroborative investigations include recording the spontaneous local field potential (LFP) activity in key brain regions (through electrophysiology) and the pharmacokinetics of acute and sub-chronic memantine treatment in blood plasma and the brain.

***2356*. Early Pathological Changes in the Optic Nerves of Type-I Diabetic Rats Revealed by Directional Diffusion-Weighted MRI**

Lifeng Gao[1], Mingming Huang[1], Hao Lei[1]

[1]Wuhan Institute of Physics & Mathematics, The Chinese Academy of Sciences, Wuhan, Hubei, China

Type-I diabetes was induced in rats by a single injection of streptozotocin (STZ). Directional diffusion-weighted imaging on the optic nerves were performed at 4 weeks and 10 weeks on a 4.7 T scanner to monitor the early pathological changes induced by diabetes. Water diffusivities parallel and perpendicular to the axonal tracts were measured by the apparent diffusion coefficients $ADC_{//}$ and ADC(perpendicular), respectively. Compared to the control animals, the STZ-treated animals showed a trend of reduced ADC(perpendicular) in the optic nerves at 4 weeks, and significantly decreased ADC(perpendicular) at 10 weeks, but insignificant changes in $ADC_{//}$ at these time points.

***2357*. Abnormalities in the Visual Pathway of Rats Subjected to Early Bilateral Enucleation Revealed by Diffusion Tensor Imaging**

Xuxia Wang[1], Fuchun Lin[1], Tingzhu Lin[1], Hao Lei[1]

[1]Wuhan Institute of Physics & Mathematics, The Chinese Academy of Sciences, Wuhan, Hubei, China

In this study, diffusion tensor imaging and high resolution rapid-acquisition relaxation-enhancement (RARE) imaging were used to detect the morphological and structural changes in the brain of rats subjected to early bilateral enucleation at postnatal day 4. Profound atrophy was observed in the ON and OCH of the enucleated rats, likely a manifestation of transneuronal degeneration induced by

deafferentation. The optic tract of the enucleated rats did not appear to be atrophic, but exhibited water diffusion abnormalities resembling those found in Wallerian degeneration. The primary visual cortex of the enucleated rats showed no changes in water diffusivity.

2358. Developmental in Vivo 1H NMR Spectroscopy at 14.1 T in Mice with Genetic Redox Dysregulation: An Animal Model with Relevance to Schizophrenia

Joao MN Duarte[1], Anita Kulak[2], Kim Q. Do[2], Rolf Gruetter[1,3]

[1]Center for Biomedical Imaging (CIBM), Lausanne, Vaud, Switzerland; [2]Centre for Psychiatric Neuroscience, Lausanne Univ. Hosp., Lausanne, Switzerland; [3]Department of Radiology, Universities of Lausane and Geneva, Lausanne, Switzerland

The present study reports alterations of the neurochemical profile in the cortex of a mouse model of redox deregulation induced by genetic reduction of glutathione synthesis. The observed metabolic alterations suggest impaired mitochondrial metabolism and eventually altered neurotransmission, both possibly triggering degeneration.

2359. An Automated Method to Optimize the Contrast of Small Structures

Ryan Chamberlain[1], Thomas M. Wengenack[2], Joseph F. Poduslo[2], Clifford R. Jack[3], Michael Garwood[1]

[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States; [2]Departments of Neurology, Neuroscience, and Biochemistry/Molecular Biology, Mayo Clinic College of Medicine, Rochester, MN, United States; [3]Department of Radiology, Mayo Clinic College of Medicine, Rochester, MN, United States

Many MRI applications require visualizing structures on the order of a few pixels in size. In these applications the CNR ratio of the small structures is more important than the SNR of the image. The CNR can be affected dramatically by the image resolution relative to the size of the structure, but the exact relation of resolution and CNR depends on the specific structure and pulse sequence. This work describes an automated method to determine the acquired image resolution to optimize the CNR of small structures. It is demonstrated as applied to imaging amyloid plaques in transgenic mouse models of Alzheimer's disease.

2360. MR Elastography of the Brain in a Mouse Model of Alzheimer's Disease

Matthew C. Murphy[1], Geoffrey L. Curran[2], Kevin J. Glaser[1], Phillip J. Rossman[1], John Huston, III[1], Joseph F. Poduslo[2], Clifford R. Jack[1], Joel P. Felmlee[1], Richard L. Ehman[1]

[1]Department of Radiology, Mayo Clinic College of Medicine, Rochester, MN, United States; [2]Department of Neuroscience, Mayo Clinic College of Medicine, Rochester, MN, United States

Magnetic resonance elastography was performed in 5 wild-type (WT) mice and 5 Alzheimer's disease (AD) mice. The AD model is a double mutation in amyloid precursor protein and presenilin-1 (APP-PS1), which leads to the extracellular deposition of amyloid protein and the formation of plaques with age. The AD mice were found to have a significantly lower mean stiffness compared to age-matched WT mice with a p-value of less than 0.01. The decrease in stiffness may result from mechanical changes in the extracellular matrix following amyloid deposition.

2361. Cerebral Amyloid Angiopathy in Transgenic Mice Modelling Alzheimer's Disease Studied Non-Invasively by MRI

Nicolau Beckmann[1], Catherine Cannet[1], Christelle Gerard[1], Dorothee Abramowski[2], Matthias Staufenbiel[2]

[1]Global Imaging Group, Novartis Institutes for BioMedical Research, Basel, BS, Switzerland; [2]Nervous System Department, Novartis Institutes for BioMedical Research, Basel, BS, Switzerland

MRI detected effects of cerebral amyloid angiopathy (CAA) in several lines of Alzheimer's mice differing by amyloid-ß-40 (Aß40) contents. SPIO was administered i.v. 24h before MRI. Signal attenuations became apparent in multiple foci throughout the brain cortex and in thalamic regions of APP23 mice displaying high Aß40. At sites of MRI signal loss, iron was localized in microglia cells/macrophages in/or around damaged vessels. The small number of attenuated signal foci in the brains of APP24 and APP23xPS45 mice characterized by low Aß40 was consistent with histology showing significantly less vascular amyloid compared to APP23 animals. These results agree with Aß40 predominating in CAA-related vascular amyloid.

2362. MR Biomarkers of Neurodegeneration in a Transgenic Mouse Model of Alzheimer's Disease

Ryan Chamberlain[1], Malgorzata Marjanska[1], Gregory Preboske[2], Linda Kotilinek[3], Thomas M. Wengenack[4], Joseph F. Poduslo[4], Karen H. Ashe[3], Michael Garwood[1], Clifford R. Jack[2]

[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States; [2]Department of Radiology, Mayo Clinic, Rochester, MN, United States; [3]Department of Neurology, University of Minnesota, Minneapolis, MN, United States; [4]Departments of Neurology, Neuroscience, and Biochemistry, Mayo Clinic, Rochester, MN, United States

The histological abnormalities that characterize Alzheimer's disease are commonly divided into three major classes: amyloid plaques, neurofibrillary tangles and neurodegeneration. Much work has been done to image amyloid plaques using the APP/PS1 mouse model. However, the APP/PS1 model was developed to study amyloid plaques, and neurodegenerative changes are minimal in this model. The Tg4510 mouse model recapitulates neurodegeneration mediated through over expression of mutant human tau. In this work we

compare the ability of various MR techniques (volume, T1ρ, T2ρ, ADC, FA) to detect neurodegeneration in the Tg4510 mouse model compared to wild-type mice.

2363. Regional Metabolic Alteration of Alzheimer¡¯s Disease in the Mouse Brain Expressed as Mutant Human APP-PS1 Using 1H HR-MAS

Dong-Cheol Woo[1], Sung-Ho Lee[2], Do-Wan Lee[1], Sang-Young Kim[1], Goo-Young Kim[1], Hyang-Shuk Rhim[1], Chi-Bong Choi[3], Hwi-Yool Kim[2], Chang-Wook Lee[1], Bo-Young Choe[1]

[1]The Catholic University of Korea, Seoul, Korea, Republic of; [2]Konkuk university of Korea; [3]Kyung-Hee University of Korea, Seoul, Korea, Republic of

This study was to investigate the regional neurochemical profile of APP-PS1 in the mouse brain of early-stage Alzheimer¡¯s disease (AD) using 1H HR-MAS. Compared to the wild-type mice, the memory index (MI, behavioral test result) of the APP-PS1 mice at 18 weeks was not significantly different; however, the MI of the APP-PS1 mice at 35 weeks was significantly lower. The results of 1H HR-MAS showed that the [NAA+ Acet] level of the APP-PS1 mice decreased in the hippocampus and temporal cortex, mIns and sIns level was increased in the entire brain which are frontal, occipital, parietal cortex, hippocampus and thalamus.

2364. Magnetic Resonance Microscopy and Micro Computed Tomography of Brain Phenotypes of Two FGFR2 Mouse Models for Apert Syndrome.

Thomas Neuberger[1], Kristina Aldridge[2], Cheryl A. Hill[2], Jordan A. Austin[2], Timothy M. Ryan[3], Christopher Percival[3], Neus Martinez-Abadias[3], Yingli Wang[4], Ethylin Wang Jabs[4], Andrew G. Webb[5,6], Joan T. Richtsmeier[3]

[1]The Huck Institutes of the Life Sciences, Pennsylvania State University, University Park, PA, United States; [2]University of Missouri-School of Medicine; [3]Department of Anthropology, Pennsylvania State University, University Park, PA, United States; [4]Department of Genetics and Genomic Sciences, Mount Sinai School of Medicine; [5]Department of Bioengineering, Pennsylvania State University, University Park, PA, United States; [6]Department of Radiology, Leiden University Medical Centre, Leiden, Netherlands

Apert syndrome (AS) is one of at least nine disorders considered members of the FGFR-1,-2, and -3-related craniosynostosis syndromes. Nearly 100% of individuals diagnosed with AS have one of two neighboring mutations on Fgfr2. The cranial phenotype associated with these two mutations includes coronal suture synostosis. Brain dysmorphology associated with AS is thought to be secondary to cranial vault or base alterations, but the variation in brain phenotypes within Apert syndrome is unexplained. Here we present novel MRM and μ-CT 3D data on brain phenotypes of mice each carrying one of the two Fgfr2 mutations associated with AS. Our data suggest that the brain is primarily affected, rather than secondarily responding to skull dysmorphogenesis.

2365. A Multimodal Imaging Approach for Phenotyping of Dynein Heavy Chain Mutant Mice Cra1 Using MRI and PET/CT

Detlef Stiller[1], Thomas Kaulisch[1], Selina Bucher[1], Julia Tillmanns[1], David Kind[1], Heiko G. Niessen[1], Krisztina Rona-Vörös[2], Kerstin E. Braunstein[2], Hans-Peter Müller[2], Luc Dupuis[3], Albert C. Ludolph[2]

[1]In-Vivo Imaging, Dept. of Drug Discovery Support, Boehringer Ingelheim Pharma GmbH & Co. KG, Biberach, BW, Germany; [2]Dept. of Neurology, University of Ulm, Ulm, BW, Germany; [3]ISERM U692, Strasbourg, France

A mouse with a point mutation in the gene encoding the motorprotein dynein is characterized by abnormal reflexes and by progressive motor and behavioral abnormalities without motor neuron degeneration. Even though previous studies showed age-dependent striatal astrocytosis and dysfunction, no in-vivo characterization of the brain has been performed yet. To investigate structural and functional alterations in the mouse brain, longitudinal MRI and [18F]-Fallypride PET were performed. In mutant mice the striatum size was significantly decreased, that of the ventricles significantly increased. PET imaging revealed a significantly reduced striatal uptake of Fallypride, supporting the theory of cell loss in the structure.

2366. Gliogenesis in Live Animals Using Targeted MRI: Detecting Neural Progenitor Cells in Vivo

Philip K. Liu[1], Christina H. Liu[1]

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Recruitment of specific cells is associated with tissue repair. Cell typing especially at the level of the DNA or RNA, has long depended on tissue biopsy of affected organs or postmortem investigation. The ability to evaluate therapies that might overcome such perturbations by using genes or cells (gene or stem cell therapies) in a host has been significantly limited. We have developed probes for specific cell type detection using mRNA targeting antisense DNA and contrast-enhanced MRI in live animals. Examples of detecting neural progenitor cells during brain repair after cerebral ischemia using targeted MRI in vivo will be presented.

2367. Metabolic Profiling to Characterise Brain Tissues from a New Animal Model of Neurodegeneration with Lewy Body Pathology

Philippine Camilla Geiszler[1,2], Lynn Bedford[3], R John Mayer[3], Dorothee P. Auer[1], Clare A. Daykin[2]

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University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [3]School of Biomedical Sciences, University of Nottingham, Nottingham, Nottinghanshire, United Kingdom

This NMR spectroscopy-based metabolic profiling pilot study was conducted to examine the ability to characterise early effects of neurodegeneration in ubiquitin proteasome-depleted mice. In specific brain areas, these animals develop pyknotic nuclei preceding Lewy body-like neuronal inclusions and extensive neuronal loss. Cortices and hippocampi were extracted at the pyknotic nuclei stage. Liquid-state spectra, recorded at 400MHz, showed significant metabolic alterations (N-acetylaspartate, taurine, choline) in both areas indicative of substantial neuronal cell remodelling before neuronal death. The investigation demonstrated clearly the ability of NMR-based metabolic profiling techniques to aid in the characterisation of early neurodegeneration.

2368. Assessing Lysosomal Pathology Using Magnetic Resonance Imaging

Yuan Mei[1], Robia G. Pautler[2]

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There are many neurodegenerative diseases that cause lysosomal pathology including Alzheimer's and Sandhoff disease. In these disorders, cellular irregularities disrupt the lysosomal membrane and cause the organelle to lose its internal acidity. Using a convertible T1 contrast agent sensitive to acidity, we hypothesize that magnetic resonance imaging (MRI) can be used to detect lysosome membrane permeabilization and loss of acidity in mouse models with lysosomal pathology. If successful, this methodology can potentially be applied in vivo and used as a tool to improve current diagnostic methods for neurological disorders such as Alzheimer's disease.

2369. Tract-Based Spatial Statistics (TBSS) Analysis Reveals Novel Changes in Lateral Thalamic Nuclei of Kainic Acid Treated Rats - Comparison of DTI and Histology

Alejandra Sierra[1], Kimmo Lehtimäki[1,2], Teemu Laitinen[1], Lassi Rieppo[3,4], Asla Pitkänen[1,5], Olli Gröhn[1]

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Diffusion tensor imaging (DTI) in combination with tract-based spatial statistics (TBSS) analysis provides valuable anatomical information about changes in brain areas contributing to epileptogenic process. Lateral thalamic nuclei are one of the areas highlighted in TBSS showing increased FA 6 months after status epilepticus in rats. The present work is focused to characterize the interrelationship of histopathological changes and *ex vivo* DTI in combination with TBSS analysis using several histological stainings and polarized light microscopy.

2370. Brain Behavior Relationship in Wild-Type Mice and a Mouse Model of Huntington's Disease

Jurgen Germann[1], Jeffrey B. Carroll[2], Christine Laliberte[1], R. M. Henkelman[1], Michael R. Hayden[2], Jason P. Lerch[1]

[1]The Mouse Imaging Centre, The Hospital for Sick Children, Toronto, Ontario, Canada; [2]Centre for Molecular Medicine and Therapeutics, Child and Family Research Institute, University of British Columbia, Vancouver, British Columbia, Canada

We examined brain-behavior correlations in mice using MRI and 4 behavioural tests: Rotarod, Forced-Swim, Pre-pulse-Inhibition and Open Field test. Secondly, we investigated how these relationships are altered in a Huntington's disease (HD) mouse model. Strong correlations were found in the wild-type mice identifying functional networks related to motor function, stress and anxiety, cortical gating and memory. The correlations are an expression of learning induced structural changes and provide insight into the study of brain networks controlling behavior; their absence in the HD mice could provide some insight into disease processes as they interfere with the changes normally induced by learning.

2371. Diffusion Kurtosis in a Symptomatic Rat Model of Huntington's Disease: Selective Grey and White Matter Pathology

Ines Blockx[1], Marleen Verhoye[1], Dirk Poot[2], Johan Van Audekerke[1], Huu Phuc Nguyen[3], Stephan Von Hörsten[4], Jan Sijbers[2], Annemie Van der Linden[1]

[1]Bio Imaging lab - University of Antwerp, Antwerp, Belgium; [2]Vision Lab - University of Antwerp, Antwerp, Belgium; [3]Department of Medical Genetics - University of Tübingen, Tübingen, Germany; [4]Experimental Therapy - Friedrich-Alexander University, Erlangen, Germany

Diffusion Kurtosis Imaging (DKI) quantifies the well known non-gaussianity of the diffusion process in biological tissue and is therefore an indicator of microstructural complexity. HD is a progressive late-onset neurodegenerative disorder and is characterized by the formation of huntingtin aggregates and degeneration of the corticostriatal network. In the present study, we used the microstructural sensitivity of DKI, to detect neurodegeneration in symptomatic tgHD rats at the age of 16 months. Region of interest analyses revealed significant differences of DT and DK parameters in grey (caudate putamen) and even in white matter (external capsula) structures.

2372. Areas of Susceptibility of the Predisposed Immature Rat Brain to Hyperthermic Seizures and Resultant Neurodevelopment Delay : An MRI and PET Study

Olivier Clerk-Lamalice[1], Pierre Gravel[2], Luc Tremblay[1], Roger Lecomte[1], Lionel Carmant[3,4], Martin Lepage[1]

[1]Centre d'imagerie moléculaire de Sherbrooke, Université de Sherbrooke, Sherbrooke, Quebec, Canada; [2]Département de radiologie, Hôpital Notre-Dame du Centre Hospitalier de l'Université de Montréal, Montreal, Quebec, Canada; [3]Centre de recherche de l'hôpital Sainte-Justine, Université de Montréal, Montreal, Quebec, Canada; [4]Groupe de recherche sur le système nerveux central, Université de Montréal, Montreal, Quebec, Canada

A new animal model has been developed to study the relation between cortical dysplasia, hyperthermic seizure (HS) and temporal lobe epilepsy (TLE). In this study, volumetric MRI, T2-weighted signal intensity and PET were used to better understand the neurodevelopmental changes that occur after HS in a predisposed brain and a possible link with the development of TLE. Our results suggest a causal relationship between a T2-weighted signal change resulting from metabolism/vascularisation imbalance after HS and a consequent developmental delay of the hippocampus.

2373. Cerebral Blood Volume Mapping of Macro- And Microvasculature in Mouse Brain with 3D Gradient Echo MRI

Valerio Zerbi[1], Diane Jansen[1], Andor Veltien[2], Amanda Kiliaan[1], Arend Heerschap[2]

[1]Anatomy, UMC St. Radboud, Nijmegen, Netherlands; [2]Radiology, UMC St. Radboud, Nijmegen, Netherlands

Impaired cerebral macro- and microvascular perfusion play an important role in the development of Alzheimer's disease(AD). Here, a post-processing method is evaluated to distinguish and quantify cerebral blood volume(CBV) in macro- and microvasculature with contrast-enhanced MRI in a transgenic mouse model for AD. A comparison between steady-state CBV computations is presented, and histogram analysis is used to separate between vascular compartments. Results showed a decrease in hippocampal microvascular CBV as consequence of aging and genotyping that is not visible without separation of vascular compartments for macro- and microvasculature perfusion.

2374. Correlation of Fractional Anisotropy and Mean Diffusivity in Rhesus Monkey with Age and Parkinson's Disease

Megan P. Phillips[1], David K. Powell[2], Zhiming Zhang[3], Richard Grondin[3], Peter A. Hardy[3]

[1]Center for Biomedical Engineering, University of Kentucky, Lexington, KY, United States; [2]MRISC, University of Kentucky; [3]Anatomy and Neurobiology, University of Kentucky

Parkinson's Disease (PD) is a common neurodegenerative disease characterized by loss of motor control. PD results from the loss of dopamine-producing neurons in the substantia nigra (SN). Depletion of the dopamine neurons in the SN affects white matter tracts connecting the SN to the putamen. Using diffusion tensor imaging (DTI) , the goals of our research are first to identify the white matter tracts between the SN and putamen effected by the depletion of dopamine and second, identify the effects of age on white matter, specifically, fractional anisotropy (FA) and mean diffusivity (MD).

2375. Evaluation of Inflammatory Process in Parkinson's Disease Model: Magnetization Transfer Image Histogram Parameter and 1H Magnetic Resonance Spectroscopy

Moon-Hyun Yoon[1], Hyun-Jin Kim[2], Jin-Yeung Jang[2], Bo-Young Choe[1]

[1]Biomedical Engineering, Medical College, The Catholic Univ. of Korea, Seoul, Metro of Seoul, Korea, Republic of; [2]Lee Gil Ya Cancer and Diabetes Institute, GACHON University of medicine and Science, Seoul, Korea, Republic of

We found that inflammatory process was significantly associated with the highest peak height value of MTR histogram in the striatum and the SN. A possible explanation for this could be the early phase of the influence of specific neurotransmitters on the mean MTR values. The higher peak height of the MTR histogram in the striatum and SN was significantly associated with higher Glx/Cr ratios after MPTP intoxication suggesting neuronal dysfunction. The pathological studies in PD model clearly demonstrate the presence of disseminated activated microglial-like inflammatory cells in the central nervous system.

2376. Longitudinal Magnetic Resonance Spectroscopy and T2 Measurements in a Mouse Model of Niemann-Pick Type C Disease

John Totenhagen[1], Ivan Borbon[2], Eriko Yoshimaru[1], Christine Howison[3], Robert P. Erickson[2], Theodore P. Trouard[1]

[1]Biomedical Engineering, University of Arizona, Tucson, AZ, United States; [2]Pediatrics, University of Arizona, Tucson, AZ, United States; [3]Arizona Research Laboratories, University of Arizona, Tucson, AZ, United States

Results are presented from a longitudinal study of T2 and MRS measurements in a mouse model of Niemann-Pick Type C (NPC) disease to examine T2 measurements and MRS as possible indicators of disease progression and response to therapy in NPC disease.

2377. Sub-Type Specific Hippocampal Glutamate Levels in the Chronic Mild Stress Rat Model for Depression

Adriaan Campo[1], Ove Wiborg[2], Helene Benveniste[3], Annemie Van Der Linden[1]
[1]Bio-Imaging Lab, University of Antwerp, Antwerp, Belgium; [2]Center for psykiatrisk forskning, Århus Universitetshospital Risskov, Risskov, Århus, Denmark; [3]Medical Department, Brookhaven National Laboratory, Upton, NY, United States

MR spectroscopy was used to assess neurochemical changes in the hippocampus of the CMS rat model for depression. Besides the well known anhedonic phenotype, and control animals, a third group of animals was included: so-called stress resilient animals. These animals show different symptoms when subjected to prolonged stress. We suppose that these different sings of depression are due to different modulation of the HPA axis, as assessed by glutamate levels in the hippocampus: normal stressed animals show higher glutamate concentration, while the abnormal subgroup shows similar glutamate concentration as the control animals.

2378. Effects of Continuously High Levels of Corticosteroids on Mouse Hippocampus – a Longitudinal in Vivo MRI Study

Dana Suciu[1], Alize E. H. Scheenstra[2], Jouke Dijkstra[2], Melly Sylvana Oitzl[3], Louise van der Weerd, [1,4]
[1]Radiology, LUMC, Leiden, Netherlands; [2]Radiology - Image processing, LUMC, Leiden, Netherlands; [3]Medical Pharmacology, LACDR, Leiden, Netherlands; [4]Anatomy, LUMC, Leiden, Netherlands

We report a longitudinal MRI investigation on mice chronically exposed to stress hormones (hypercorticism) to investigate hippocampal morphology. The mice were implanted with a continuous corticosterone-releasing pellet (n=10) or a placebo cholesterol pellet (n=10). T2W MRI scans of the mouse brain were taken over several weeks. Volumetric analysis by manual delineation using SPSS analysis and quantitative group-wise comparison using deformation fields and a 3D Moore-Rayleigh test with Bonferroni correction were employed. Our study demonstrated that chronic hypercorticism in mice indeed leads to volume loss in the hippocampus, which is at least partially reversible after recovery.

2379. Combined Vegf and Angiopoietin-1 Gene Transfer Using Aav Vectors After Spinal Cord Injury

Juan Jose Herrera[1], Ponnada A. Narayana[1]
[1]Diagnostic and Interventional Imaging, The University of Texas Health Science Center at Houston, Houston, TX, United States

A consequence of spinal cord injury is the disruption of spinal vasculature, and it is this disruption that contributes to the initiation of cascade of biochemical events leading to secondary damage from the ischemic and inflammatory responses Using adeno-associated viral vectors engineered to express Ang-1 and or VEGF may stimulate angiogenesis and vessel maturation after spinal injury. Our study indicates that the syngeristic effect of both agents reduces spinal vascular permeability and lesion volume determined by MRI leading to functional recovery.

2380. Characterization of Inner Ear Inflammation in Rodents Using in Vivo Dynamic Contrast Enhanced Magnetic Resonance Imaging and Ex Vivo Light Microscopy

Johann Le Floc'h[1], Beau Pontré[2], Winston Tan[1], Srdjan M. Vlajkovic[1], Peter R. Thorne[1]
[1]Physiology, The University of Auckland, Auckland, New Zealand; [2]Centre for Advanced MRI, New Zealand

Inner ear inflammation is thought to be a major contributor to the development of hearing loss and balance disorders. We report the results of the *in vivo* characterization of cochlear tissues inflammation induced by noise exposure or injection of bacterial lipopolysaccharide in two rodent species. The anaesthetized animals were scanned using a 4.7T MRI system. The calculated signal enhancement due to the observed uptake of a contrast agent was greater on inflamed than normal cochleae. MR findings correlated well with immunohistochemistry. We suggest that increase in gadodiamide uptake occurred as a consequence of increased vascular permeability.

2381. Cerebral Metabolite Assessment in Low and High Capacity Running Rats Using 1H-MRS

Steven R. Roys[1,2], Anjaneyulu Murugundla[3], Su Xu[1], Aurora Anderson[3], Jiachen Zhuo[1], Mark Limsam[3], J Choi[3], Lauren Koch[4], Steve Britton[4], Krish Chandrasekaran[3], Paul Yarowsky[5], James Russell[3], Rao P. Gullapalli[1,2]
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Very little is understood regarding CNS changes that lead to various cognitive impairments among people with impaired glucose tolerance. Even less is understood regarding the differences between high performing diabetic patients versus the low performing diabetics. The purpose of this study was to examine the neurochemical profile differences between low capacity runner rats (LCR) and high capacity runner rats (HCR) using proton magnetic resonance spectroscopy at 7.0 Tesla. Findings suggest that LCR rats have elevated taurine, myo-inositol, glutamate and choline containing compounds compared to HCR rats consistent with similar findings in diabetic patients.

2382. Effect of Lactate on FMRI Responses Under Hypoglycemia

Lihong Jiang[1], Basavaraju G. Sanganahalli[1], Peter Herman[1], Raimund Herzog[1], Robert Sherwin[1], Fahmeed Hyder[1], Douglas Rothman[1], Kevin Behar[1]
[1]Yale University, New Haven, CT, United States

We investigated BOLD responses to forepaw stimulation under insulin-induced acute hypoglycemic condition, as well as effect of lactate infusion under hypoglycemia condition. All high field fMRI experiments were conducted in α-chloralose anesthetized rats. The magnitude of the BOLD response in primary somatosensory ($S1_{FL}$) region decreased from euglycemic to hypoglycemic conditions. Upon lactate infusion, under hypoglycemic condition, transiently increased S1 activities, but also recruited regions beyond $S1_{FL}$. These results will benefit the understanding of brain function and metabolism, as well as the role of alternative fuels under hypoglycemic condition.

MRS of Animal Brain

Hall B Tuesday 13:30-15:30

2383. Simultaneous Detection of Metabolism of Different Substrates in the Carboxylic/amide Region Using in Vivo ^{13}C MRS

Yun Xiang[1], Jun Shen[1]
[1]National Institute of Mental Health, Bethesda, MD, United States

In the carboxylic/amide region, brain ^{13}C signals can only have one one-bond ^{13}C-^{13}C homonuclear coupling. As such only doublets (with a ^{13}C-^{13}C coupling of ~50 Hz) and singlets exist in this region. The large one-bond ^{13}C-^{13}C J coupling and the lack of interference from other isotopomers provide a unique condition for simultaneous detection of metabolism of different substrates. Examples of co-infusion of [$^{13}C_6$]-D-glucose and [1-^{13}C] acetate as well as co-infusion of [$^{13}C_6$]-D-glucose and [1,3-$^{13}C_2$] hydroxybutyrate are shown to demonstrate in vivo simultaneous detection of different metabolic pathways in the brain using ^{13}C MRS of the carboxylic/amide region.

2384. Alcohol as a Substitute for Acetate in ^{13} C MRS Study of Brain Metabolism

Yun Xiang[1], Jun Shen[1]
[1]National Institute of Mental Health, Bethesda, MD, United States

Acetate is a glia-specific subtract and has been used to study brain metabolism. Potential risk in intravenously infusing sodium acetate to patients is unknown in many disorders. The effect of alcohol (ethanol) consumption is well understood. Alcohol is predominantly metabolized into acetate in the liver. In the present study, steady sate ^{13}C spectra of rat brain acquired after administration of [1-^{13}C] ethanol were found to be highly similar to spectra obtained using [1-^{13}C] acetate, suggesting that oral administration of [1-^{13}C] alcohol could replace intravenous infusion of sodium [1-^{13}C] acetate in certain studies when the direct effect of alcohol is unimportant for the subject of the study.

2385. Neurochemical Profile of the Rat Lateral Septum Investigated with 1H-MRS

Nathalie Just[1,2], Maria-Isabel Cordero Campana[3,4], Guillaume Poirier[3], Hongxia Lei[1,2], Carmen Sandi[3], Rolf Gruetter[1,5]
[1]LIFMET, CIBM, EPFL, Lausanne, Switzerland; [2]Department of Radiology, UNIL, Lausanne, Switzerland; [3]Laboratory of Behavioural Genetics, EPFL, Brain and Mind Institute, Lausanne, Switzerland; [4]Department of Child and Adolescent Psychiatry, HUG, Geneve, Switzerland; [5]Department of Radiology, UNIL and HUG, Lausanne and Geneva, Switzerland

The rat lateral septum has been shown to be involved in the expression of anxiety-behaviors such as those involved in conflict procedures. The neurochemical profile of the lateral septum has however never been characterized using proton magnetic resonance spectroscopy in the rat. In the present work, the neurochemical profile of the rat lateral septum was measured at 9.4T using 1H-MRS demonstrating significant changes compared to similar data measured in unspecific rat brain regions. It appears essential to characterize the metabolic profile of specific brain areas with accuracy using 1H MRS.

2386. Lesions of Ventral Tegmental Area in the Mouse and Consequences on Glutamate, Gaba and Glutamine Levels Assessed Using Proton 1H Mrs.

Carine Chassain[1,2], Guy Bielicki[1], Yildiz Zengin[2], Jean-Pierre Renou[1], Franck Durif,[2,3]
[1]NMR plateform, INRA, Saint Genes Champanelle, France; [2]EA 3845, University of Auvergne, Clermont-Ferrand, France; [3]service Neurology, CHU Clermont-Ferrand, Clermont-Ferrand, France

Parkisnon's disease, 1H MRS, Glutamte, Glutamine, GABA, nucleus accumbens

2387. NMR Investigations of Excitatory and Inhibitory Neurotransmission in Mouse Brain

Anant Bahadur Patel[1], Vivek Tiwari[1], A.L. Susmitha[1], K.S. Varadarajan[1]
[1]NMR Microimaging and Spectroscopy, Centre for Cellular and Molecular Biology, Hyderabad, Andhra Pradesh, India

Knowledge of neurotransmitter metabolism is very important for understanding the pathophysiology of neurological disorders. In the present study we have investigated neuronal TCA cycle and neurotransmitter cycle flux in different brain regions of C57BL6 mouse.

Mice were infused with [1,6-$^{13}C_2$]glucose for different time ranging from 7 to 90 min or [2-^{13}C]acetate for ~90 min. Brain metabolite levels and ^{13}C labeling of amino acids were measured with ^{1}H-[^{13}C]-NMR spectroscopy at 14T NMR spectrometer. The metabolite levels were distinct in different regions of the brain. Glutamatergic rate was higher in cortex while GABAergic was more in cerebellum and olfactory bulb.

2388. **Regional Absolute Quantification in Neurochemical Profile of the Canine Brain: Investigation by Proton Nuclear Magnetic Resonance Spectroscopy and Tissue Extraction**

Dong-Cheol Woo[1], Chi-Bong Choi[2], Sung-Ho Lee[3], Eunjung Bang[4], Sang-Soo Kim[1], Hyang-Shuk Rhim[1], Sang-Young Kim[1], Bo-Young Choe[1]

[1]The Catholic University of Korea, Seoul, Korea, Republic of; [2]Kyung-Hee University of Korea; [3]Konkuk university of Korea; [4]Korea Basic Science Institute

This study was to characterize the regional neurochemical profiles of canine brain using NMRS, tissue extraction, and external simulated phantom concentration quantification. The occipital, frontal, and temporal lobes, thalami, cerebellar cortices, and spinal cords of adult beagles were obtained, and NMR samples were prepared using M/C extraction method. The metabolite concentrations in canine brain tissues were measured and compared with those found in human and rat brain. In addition, the cross peaks of brain metabolites were identified using 2D-COSY. This study demonstrated the absolute quantification of canine neuronal parts using MRS, with tissue extraction used to measure metabolite concentrations.

2389. **In Vivo Evidence for Ketamine-Induced Neurochemical Changes in Rat Prefrontal Cortex: An Animal Model of Schizophrenia**

Sang-Young Kim[1], Hyun-Sung Lee[2], Eunjung Bang[2], Hyun-Ju Kim[2], Sung-Ho Lee[3], Do-Wan Lee[1], Dong-Cheol Woo[1], Chi-Bong Choi[4], Bo-Young Choe[1]

[1]Department of Biomedical Engineering, The Catholic University of Korea, Seoul, Korea, Republic of; [2]Korea Basic Science Institute, Korea, Republic of; [3]Department of Veterinary Surgery, Konkuk University, Seoul, Korea, Republic of; [4]Department of Radiology, Kyunghee University Medical Center, Seoul, Korea, Republic of

The ketamine, a NMDA receptor antagonist, impair prefrontal cortex (PFC) function in the rat and produce symptoms similar to schizophrenia. In this study, we used in vivo and in vitro 1H-NMR spectroscopy to examine the brain metabolism of rat treated with subanesthetic dose of ketamine. In vivo data for Glu/Gln abnormalities in ketamine-treated rats may support the hypotheses of glutamate dysfunction for schizophrenia. In addition lower metabolic level of NAA in rats treated with ketamine may indicate reduced neuronal viability. Therefore our findings suggest that the neurochemical alterations induced by ketamine may provide the foundation for pathophysiological models of schizophrenia.

2390. **In Vitro Proton MRS of Cerebral Metabolites in a Mouse Model of Alzheimer's Disease**

Duncan Forster[1], Steve Williams[2], Mike James[3], Jill Richardson[3]

[1]University of Manchester, Manchester, United Kingdom; [2]University Of Manchester; [3]GlaxoSmithKline

An in vitro proton MRS study was carried out on mice ranging from 3 to 18 months in order to investigate cerebral metabolic differences between TASTPM Alzheimer's mice and their wild type base strain. An effect of genotype was observed for myo-inositol, with concentration being higher in TASTPM mice, myo-inositol may therefore be an Alzheimer's marker. Lower levels of succinate were observed in TASTPM mice, being an effect of both age and genotype. This may indicate impaired neuronal energy production or mitochondrial dysfunction. The results also call into question the use of creatine as a reference metabolite.

2391. ***In Vivo* ^{1}H MRS Measurements of Acetate in Mouse Striatum After Permanent Focal Middle Cerebral Artery Occlusion**

Hongxia Lei[1,2], Lijing Xin[1], Carole Berthet[3], Lorenz Hirt[3], Rolf Gruetter[1,4]

[1]LIFMET, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Radiology, University of Lausanne, Lausanne, Switzerland; [3]Neurology, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland; [4]Radiology, University of Geneva, Geneva, Switzerland

^{1}H MRS of permanent focal middle cerebral occlusion (pMCAO) in mice could be feasible at high magnetic field. However, one of hydrolytic metabolites of NAA, acetate (1.9ppm), was heavily overlapped by accumulated GABA (1.89ppm) after pMCAO. In this study, we demonstrated that short echo time ^{1}H MRS of measuring acetate was feasible at ultra short echo time using LCModel analysis when comparing to the measurements with minimal GABA contributions at a moderate echo time.

2392. ***In Vivo* ^{1}H MR Studies of Cortical Metabolic Response During Insulin-Induced Hypoglycemia**

Hongxia Lei[1,2], Arthur W. Magill[1,2], Vladimir Mlynarik[1], Rolf Gruetter[1,3]

[1]LIFMET, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Radiology, University of Lausanne, Lausanne, Switzerland; [3]Radiology, University of Geneva, Geneva, Switzerland

Understanding hypoglycemia became very essential for treating diabetes in clinical. We explored ^{1}H MR studies, including cerebral blood flow and neurochemical profile of cortical tissue under insulin-induced hypoglycemia in rats.

2393. Elevated Brain Lactate Measured by ^{1}H-MRS Is an Early Phenotype Due to Mitochondrial Dysfunction in the Prematurely Ageing MtDNA Mutator Mouse

Jaime M. Ross[1,2], Johana Öberg[3], Stefan Brené[4], Giuseppe Coppotelli[5], Mügen Terzioglu[6], Karin Pernold[1], Rouslan Sitnikov[3], Jan Kehr[7], Alexandra Trifunovic[6], Nils-Göran Larsson[6,8], Barry J. Hoffer[2], Lars Olson[1]

[1]Neuroscience, Karolinska Institutet, Stockholm, Sweden; [2]National Institute on Drug Abuse, National Institutes of Health, Baltimore, MD, United States; [3]Clinical Science, Intervention and Technology, Karolinska Institutet, Stockholm, Sweden; [4]Neurobiology, Health Sciences and Society, Karolinska Institutet, Stockholm, Sweden; [5]Cell and Molecular Biology, Karolinska Institutet, Stockholm, Sweden; [6]Laboratory Medicine, Karolinska Institutet, Stockholm, Sweden; [7]Physiology and Pharmacology, Karolinska Institutet, Stockholm, Sweden; [8]Max Planck Institute for Biology of Ageing, Cologne, Germany

The prematurely ageing mtDNA mutator mouse was used to study mitochondrial dysfunction in the brain. ^{1}H-MRS detected a 2-fold increase in cortical and striatal lactate levels as early as 6-9 weeks and continued throughout the lives of mtDNA mutator mice (average life span 45-48 weeks). Increased brain lactate levels were confirmed postmortem by high-performance liquid chromatography (HPLC). These methods revealed that abnormally high lactate levels in the CNS are an early phenotype of premature ageing in the mtDNA mutator mouse. Our data support the hypothesis of abnormal metabolism in ageing due to mitochondrial dysfunction.

2394. Mouse Brain Structure and Metabolic Stability Follows Focused Beam Microwave Irradiation

Michael D. Boska[1], Erin McIntyre[1], Melissa Lynn Mellon[1], Howard E. Gendelman[2]

[1]Radiology, University of Nebraska Medical Center, Omaha, NE, United States; [2]Pharmacology and Experimental Neurosciences, University of Nebraska Medical Center, Omaha, NE, United States

Mouse brain structural and metabolic stability were determined by T_1 and T_2 mapping and DTI at 0.7 and 0.9 s of 4 kW FBMI and by quantitative single voxel PRESS, respectively. Measures were taken in-vivo before and repetitively, at 1.17 hour intervals, after FBMI. Analysis continued for a total duration of 16 hours at room temperature. The longer FBMI duration was best for maintaining metabolite levels in the mouse brain; whereas T_1, T_2, and DTI metrics were best maintained by shorter duration FBMI.

2395. Coupling of Cerebral Phosphoethanolamine and Nucleotide Triphosphate Levels and Mitochondrial-Respiration Modulation During Perinatal "secondary Energy Failure"

Ernest Brunton Cady[1], Osuke Iwata[2], Alan Bainbridge[1], John Wyatt[2], Nikki Jayne Robertson[2]

[1]Medical Physics & Bioengineering, UCLH NHS Foundation Trust, London, United Kingdom; [2]Institute for Women's Health, University College London, London, United Kingdom

Phosphoethanolamine concentration ([PE]) is high in neonatal brain. [PE] reduction increases mitochondrial respiration. We aimed to elucidate PE's metabolic role following hypoxia-ischaemia (HI). Thirty-three piglets were studied by 31P MRS (27 HI; 6 controls). For severe cerebral injury [PE]/[exchangeable phosphate pool] fell below controls but later recovered: however, [PE]/[nucleotide triphosphate (NTP; mainly ATP)] was almost constant suggesting strong PE to NTP coupling. In cells stressed after HI reduced [ATP] may inhibit ethanolamine phosphokinase resulting in [PE] reduction and stimulation of ATP generation by surviving mitochondria. High neonatal [PE] may be a factor evolved to counter mammalian cerebral birth trauma.

2396. Protective Actions of L-Carnitine in Ammonia-Precipitated Hepatic Encephalopathy

Jane Missler[1,2], Wenlei Jiang[3], Dieter Leibfritz[2], Claudia Zwingmann[1]

[1]Département de médicine, Centre de Recherche, Hôpital Saint-Luc, Université de Montréal, Montréal, Quebec, Canada; [2]Department of Chemistry, University of Bremen, Bremen, Germany; [3]Département de médicine , Centre de Recherche, Hôpital Saint-Luc, Université de Montréal, Montréal, Quebec, Canada

Hepatic Encephalopathy is associated with hyperammonemia and energetic changes in brain. In animal models and patients with mild HE, L-carnitine has been shown to be protective. In order to investigate the effect of L-carnitine on brain energy-metabolism, multinuclear NMR was used to measure metabolic pathways in brain following administration of [U-13C]glucose in ammonia-treated rats with PCA. In ammonia-precipitated encephalopathy, L-carnitine considerably delayed the time to coma, concomitantly to enhanced ammonia detoxification via astrocytic glutamine synthesis and attenuation of lactate accumulation. These results indicate to cell-specific actions of L-carnitine which might explain its therapeutic effect in ammonia-precipitated HE in cirrhotic patients.

2397. Effects of Desipramine Pretreatment on Behavioral and Regional Neurochemical Responses in the Mouse Forced Swimming Test: A High Resolution in Vivo 1H-MRS Study at 9.4 Tesla

Sang-Young Kim[1,2], Chi-Bong Choi[3], Yun-Jung Lee[4], Hyeonjin Kim[4], Do-Wan Lee[1,2], Dong-Cheol Woo[1,2], Jeong-Ho Chae[5], Bo-Young Choe[1,2]

[1]Department of Biomedical Engineering, The Catholic University of Korea, Seoul, Korea, Republic of; [2]Research Institute of Biomedical Engineering, Seoul, Korea, Republic of; [3]Department of Radiology, Kyunghee University Medical Center, Seoul, Korea, Republic of; [4]Gachon University of Medicine and Science, Incheon, Korea, Republic of; [5]Department of Psychiatry, The Catholic University of Korea, Seoul, Korea, Republic of

Until recently, no data are available about the behavioral and simultaneous non-invasive measurements of neurochemial responses following antidepressant treatment in mice FST model. In this study, in vivo 1H-MRS at 9.4 T was used to examine the effects of desipramine (DMI) pretreatment on behavioral and regional neurocheimal responses of C57BL/6 mice brain. We found significant behavioral changes as well as metabolic alterations of glutamate and myo-inositol by the DMI pretreatment. Our results suggest that glutamatergic activity and glial cell dysfunction contribute to pathophysiological mechanisms underlying depression and that modulation of synaptic neurotransmitter concentrations represent invaluable targets for antidepressant drug development.

2398. Implication of Myo-Inositol Metabolic Level in an Animal Model of Depression

Sang-Young Kim[1,2], Chi-Bong Choi[3], Hyun-Sung Lee[4], Sung-Ho Lee[5], Dong-Cheol Woo[1,2], Bo-Young Choe[1,2]

[1]Department of Biomedical Engineering, The Catholic University of Korea, Seoul, Korea, Republic of; [2]Research Institute of Biomedical Engineering, Seoul, Korea, Republic of; [3]Department of Radiology, Kyunghee University Medical Center, Seoul, Korea, Republic of; [4]Korea Basic Science Institute, Korea, Republic of; [5]Department of Veterinary Surgery, Konkuk University, Seoul, Korea, Republic of

Animal models for depression are indispensable tools in the search to identify new antidepressant drugs. The forced swimming test (FST) is the most widely used tool for assessing antidepressant activity in rodents. Few studies have been performed proton spectroscopy to assess antidepressant effects on brain metabolism of rat exposed to the FST. The in vivo proton spectra quantified by LCModel revealed that myo-inositol metabolic level in left dorsolateral prefrontal cortex of rat was significantly altered in both FST and desipramine treated group. Our findings suggest a possible role of myo-inositol within the left DLPFC of rat model for depression.

2399. Effect of Morphine Exposure on Developing Rat Hippocampus

Christopher M. Traudt[1], Kathleen M. Ennis[1], Raghu Rao[1], Ivan Tkac[2]

[1]Dept. of Pediatrics, University of Minnesota, Minneapolis, MN, United States; [2]University of Minnesota, Center for Magnetic Resonance Research, Minneapolis, MN, United States

In vivo ^{1}H NMR NMR spectroscopy at 9.4T was used to investigate effects of morphine on the neurochemical profile of the developing rat hippocampus. Significant differences between pup exposed to the morphine (2 mg/kg/, twice a day, P3 – P7) and their littermate controls were observed for multiple brain metabolites on postnatal day 8. These changes had resolved by P29. Biochemical changes indicated effects of morphine on inhibitory neurotransmission (GABA, Tau), glial development and myelination (Gln, myo-Ins), osmoregulation (myo-Ins, Tau) and antioxidant processes (GSH).These results indicate that morphine exposure during hippocampal development may lead to hippocampal-dependant cognitive deficits in premature infants.

2400. NAA as a Non-Invasive Biomarker in Traumatic Brain Injury: Neuroprotective Effects of Cyclosporine A

Janna L. Harris[1], Henry Yeh[2], Nancy E. Berman[3], William M. Brooks[1]

[1]Hoglund Brain Imaging Center, University of Kansas Medical Center, Kansas City, KS, United States; [2]Department of Biostatistics, University of Kansas Medical Center, Kansas City, KS, United States; [3]Department of Anatomy & Cell Biology, University of Kansas Medical Center, Kansas City, KS, United States

N-acetylaspartate (NAA), a metabolite synthesized in neuronal mitochondria and detected by proton magnetic resonance spectroscopy (MRS), might serve as a non-invasive biomarker of mitochondrial integrity after traumatic brain injury (TBI). Previous studies in human survivors of TBI have linked NAA with cognitive recovery, although the specific mechanism has not been elucidated. We have examined a time course of changes in NAA and behavioral impairment after TBI in a well-characterized animal model. We then investigated whether these NAA changes are sensitive to manipulation of mitochondrial status by cyclosporine A (CsA), an experimental neuroprotective agent that inhibits mitochondrial permeability transition after TBI.

2401. Increased Brain Lactate Transport and Metabolism During Hypoglycemia in Rats Fed a Ketogenic Diet

Henk M. De Feyter[1], Kevin Behar[1], Lester R. Drewes[2], Robin A. de Graaf[1], Douglas L. Rothman[1]

[1]Diagnostic Radiology, Yale University, New Haven, CT, United States; [2]Biochemistry & Molecular Biology, University of Minnesota, Duluth, MN, United States

Repetitive iatrogenic hypoglycemic events lead to brain adaptations resulting in failing counterregulatory response and lack of warning symptoms (hypoglycemia unawareness) normally associated with low blood glucose levels. Increased blood-brain barrier lactate transport via upregulated monocarboxylic acid transporter 1 (MCT1) has been suggested as an adaptation induced by repetitive hypoglycemia. Increased lactate uptake and oxidation could (partially) replace glucose thereby contribute to hypoglycemia unawareness and failing counterregulatory response. We used ^{1}H-[^{13}C] MRS combined with [3-^{13}C]-lactate infusion during

hypoglycemia to investigate the role of increased lactate transport and/or metabolism in the brain of a rat model with ketogenic diet-induced upregulation of MCT1.

2402. Acute Flupirtine Administration Reduces Glutamate/glutamine Ratio in Rat Hippocampus

Renuka Sriram[1], Robert J. Mather[2], Serguei Liachenko[1]
[1]BioImaging CoE, Pfizer Inc, Groton, CT, United States; [2]Neuroscience, Pfizer Inc, Groton, CT, United States

Neurotransmitter levels of glutamate and glutamine are tightly coupled with modulation of one resulting in a corresponding opposing change in the other. Since glutamate is implicated in a variety of neurological disorders, the observation of an endogenous pool of glutamate (Glu) and glutamine (Gln) and/or its ratio can serve as a strong mechanistic biomarker and measure of efficacy. Flupirtine, a potassium channel opener, has been shown to cause decrease in Glu and a relative increase in Gln in the rat hippocampus.

2403. 1H MRS Profiling at 9.4T in Prefrontal Cortex and Hippocampus of Ethanol Dependent Rats During Intoxication, Withdrawal and Protracted Abstinence

Wolfgang Weber-Fahr[1], Gabriele Ende[1], Alexander Sartorius[1], Rainer Spanagel[2], Claudia Falfan-Melgoza[1], Dirk Cleppien[1], Wolfgang H. Sommer[2]
[1]Neuroimaging, Central Institute of Mental Health, Mannheim, NA, Germany; [2]Dept. Psychopharmacology, Central Institute of Mental Health, Mannheim, NA, Germany

Out of a group of 17 animals eight were made dependent by 7 weeks ethanol vapor exposure with peak levels up to 4 g/l blood alcohol concentration. We assessed metabolic profiles in two brain regions with functional importance for dependence, i.e. medial prefrontal cortex and hippocampus, using in vivo single-voxel 1H magnetic resonance spectroscopy at TE=10 ms on a 9.4T scanner. Animals were measured up to 5 times before during and after ethanol exposure. Reduced myoinositol and N-acetylaspartate levels as well as increased choline-containing compounds were found during intoxication. Raised glutamate levels were found during early withdrawal.

2404. Brain Neurochemical Effects of Long-Term Sleep Fragmentation Investigated in Mice at 14.1T Using 1H-MRS

Nathalie Just[1,2], Maxime Baud[3], Jean-Marie Petit[3], Pierre Magistretti[3,4], Rolf Gruetter[1,5]
[1]LIFMET, CIBM, EPFL, Lausanne, Switzerland; [2]Department of Radiology, UNIL, Lausanne, Switzerland; [3]Laboratoire de neuroénergétique et dynamique cellulaire, EPFL, Lausanne, Switzerland; [4]Brain and Mind Institute, Lausanne, Switzerland; [5]Department of Radiology, UNIL and HUG, Lausanne and Geneva, Switzerland

The present study examined the effects of sleep fragmentation (SF) in the hippocampus and the cortex of mice using proton MR spectroscopy at 14.1T. Disruptions in brain sensory processing and cognitive performance were seen during sleep fragmentation. Moreover, there is evidence that SF negatively affects memory and learning. Here, significant decreases in GABA and Lactate concentrations were detected in the hippocampus of mice following sleep fragmentation indicating decreased synaptic function in the hippocampus.

2405. Regional Variations of Metabolite Concentrations in the Rat Brain Assessed with *in Vivo* ^{1}H MR Spectroscopy at 16.4T

Sung-Tak Hong[1], Dávid Zsolt Balla[1], Gunamony Shajan[1], Changho Choi[2], Rolf Pohmann[1]
[1]High-Field Magnetic Resonance Center , Max-Planck Institute for Biological Cybernetics, Tuebingen, Baden-Wuerttemberg, Germany; [2]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States

Regional differences of metabolites in the rat brain were investigated by using localized in vivo 1H MR spectroscopy at 16.4T. Three regions, thalamus, striatum and hippocampus, were investigated with an ultra-short TE STEAM sequence. The results demonstrated significant variations in all metabolites except aspartate and NAA. The remarkable variation of spectra was the substantially decreased level of the Tau methylene signal at 3.25 ppm in thalamus. The significant increase of the GABA methylene signal at 1.89 ppm was also observed in thalamus.

2406. Measurement of the Effects of Different Anesthetics in the Rat Thalamus by *in Vivo* ^{1}H NMR Spectroscopy at 16.4T

Sung-Tak Hong[1], Chi-Bong Choi[2], Rolf Pohmann[1]
[1]High-Field Magnetic Resonance Center , Max-Planck Institute for Biological Cybernetics, Tuebingen, Baden-Wuerttemberg, Germany; [2]Department of Radiology, Kyung Hee University Medical Center, Hoekidong, Seoul, Korea, Republic of

The effect of different anesthetic agents was investigated in the rat brain by using in vivo 1H NMR spectroscopy. A volume-of-interest was placed in thalamus under two different anesthesia, isoflurane and ketamine/xylazine. The significant increase of glucose was observed in a deep ketamine/xylazine anesthesia while additional metabolic variations on ascorbate, aspartate, glutathione and lactate were detected.

2407. Differential Neurochemical Responses in the Rat Striatum with Isoflurane or Ketamine/xylazine Anesthesia: In Vivo Proton MRS Study at 16.4 T

Chi-Bong Choi[1], Sung-Tak Hong[2], Sang-Young Kim[3], Dong-Cheol Woo[3], Bo-Young Choe[3], Kyung-Nam Ryu[1], Eun-Hee Kang[1], Sung-Vin Yim[1], Do-Wan Lee[3], Rolf Pohmann[2]
[1]Kyung Hee University of Korea, Seoul, Korea, Republic of; [2]Max Planck Institue for Biological Cybernetics; [3]The Catholic University of Korea

This study was to evaluate alterations in striatum metabolites of rats between anesthetized with isoflurane and ketamine/xylazine in vivo 1H-MRS at 16.4T, and to investigate the appropriateness of anesthetic agents. The concentrations of Ala, Asc, Asp, GABA, Gly and PCr were significantly different between isoflurane and ketamine/xylazine induced groups at the striatum. We demonstrated that metabolites in specific brain region can be differentially influenced according to anesthetic agents. This study showed that the choice of anesthetic is significant in the setting of 1H-MRS. Appropriate anesthetic choice should be pursued to exclude the effect of anesthetic agents on the target area.

Head & Neck Imaging: Normal to Cancer

Hall B Wednesday 13:30-15:30

2408. Movement-Artefact-Free Measurement of T_1 in the Human Eye to Determine Oxygenation of the Vitreous Humour

Nicholas G. Dowell[1], Edward H. Hughes[2], Paul S. Tofts[1]
[1]Brighton and Sussex Medical School, Brighton, United Kingdom; [2]Sussex Eye Hospital, Brighton, United Kingdom

Accurate and precise T_1 mapping of the eyeball is difficult due to eye movement and image distortions. An accurate measure of T_1 could provide a non-invasive determination of eye oxygenation since T_1 times are subtly increased by reduced partial pressure of oxygen (pO_2) of the vitreous humour in the eye. Poor oxygenation leads to retinopathy and, in patients with low pO_2 at the retina, a vitrectomy may be performed, where the vitreous humour is extracted and replaced by saline. However, there is no clear evidence that an increase in pO_2 is actually achieved by this procedure and MRI would provide an important validation for ophthalmologists. We have developed a technique, using a TrueFISP acquisition sequence, which provides eye images with no movement artefacts, no image distortion and good SNR. This permits the measurement of T_1 (and hence pO_2) from the vitreous humour of the human eye. Furthermore, we show that asking a subject to fixate on a single point can control eye movement but the need to blink limits fixation to < 5 s. Consequently, we will provide an audio/visual cue that warns the subject when they must fixate. This approach to eye imaging could dramatically improve imaging of the eye and retina.

2409. Ultrashort Echo Time Imaging of the Middle Ear Ossicle: A Pilot Study

Koji Yamashita[1], Takashi Yoshiura[1], Akio Hiwatashi[1], Hironori Kamano[1], Yukihisa Takayama[1], Eiki Nagao[1], Hiroshi Honda[1]
[1]Radiology, Kyushu university, Fukuoka, Japan

Our purpose was to assess the feasibility of ultrashort echo-time (uTE) imaging for visualization of middle ear ossicles in normal subjects. Twelve volunteers with normal hearing levels were scanned at a 3.0T clinical unit using a dual-echo uTE sequence at TE1/TE2 = 0.14 ms/1.8 ms. In all subjects, the middle ear ossicles were clearly visualized as a high signal intensity spot on short TE images bilaterally, while they were not visible in long TE images in any of the subjects. To our knowledge, this is the first report of MR visualization of middle ear ossicles.

2410. Automatic Segmentation of Laryngeal Cartilages Using Support Vector Machines

R. Reeve Ingle[1], Berhane H. Azage[1], Joëlle K. Barral[1], Kie Tae Kwon[1], Edward G. Damrose[2], Nancy J. Fischbein,[2,3], Dwight G. Nishimura[1]
[1]Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Otolaryngology, Stanford University, Stanford, CA, United States; [3]Radiology, Stanford University, Stanford, CA, United States

MR is critical in the staging of laryngeal cancer. However, the presence and extent of cartilage invasion is difficult to assess. In this work, automatic intensity correction is integrated in a support vector machine algorithm, which is used to segment the cartilages from high-resolution MR images of the larynx.

2411. Dynamic MRI of the Temporomandibular Joint at 3 Tesla Using a Gradient Echo Sequence

Yoon-Chul Kim[1], John L. Go[2], Sara Banerjee[2], Meng Law[2], Houchun Harry Hu[1], Krishna S. Nayak[1,2]
[1]Ming Hsieh Department of Electrical Engineering, University of Southern California, Los Angeles, CA, United States; [2]Keck School of Medicine, University of Southern California, Los Angeles, CA, United States

Dynamic MRI may be useful for assessing temporomandibular joint (TMJ) dysfunction. This application requires sub-millimeter resolution and adequate contrast between the articular disc and surrounding tissue. A gradient echo sequence was optimized by first measuring the T_2* values and then calculating the parameters of flip angle, TE, and TR that maximize the CNR efficiency. The dynamics of the TMJ disc was visualized with a 3.2 second temporal resolution, 0.5×0.5 mm^2 in-plane spatial resolution using a 6-channel Carotid coil at 3 Tesla.

2412. Chemical Shift Imaging in the Head and Neck at 3T: Initial Results

David K W Yeung[1], Devin K. Fong[1], Queenie Chan[2], Ann D. King[1]
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Proton MRS is useful to probe tissue metabolism in vivo and its application yields considerable information about tissue biochemistry. In the head and neck, the detection of choline peak using single voxel spectroscopy has been found useful in confirming malignancy and treatment response. CSI is desirable for the study of large heterogeneous lesions, but shimming a large volume in the head and neck is challenging due to large susceptibility differences. We employed an anti-susceptibility device to improve the local field homogeneity. We examined 13 patients using this technique and we showed that CSI is feasible in the head and neck.

2413. 3D Mapping of Vocal Fold Geometry During Articulatory Maneuvers Using Ultrashort Echo Time Imaging at 3.0 T

Tobias Frauenrath[1], Andreas Goemmel[2], Christoph Butenweg[2], Mario Otten[3], Thoralf Niendorf[1,4]
[1]Berlin Ultrahigh Field Facility, Max-Delbrueck Center for Molecular Medicine, Berlin, Germany; [2]Chair of Structural Statics and Dynamics, RWTH, Aachen, Germany; [3]Erich-Thienhaus-Institute, Hochschule für Musik, Detmold, Germany; [4]Experimental and Clinical Research Center (ECRC), Charité Campus Buch, Humboldt-University, Berlin, Germany

Even if some spatial insight can be obtained by stereoscopy imaging from classical optical methods or ex-vivo experiments, real 3D in-vivo measurements of vocal fold geometry are still elusive. Magnetic resonance imaging (MRI) is conceptually appealing for the pursuit of 3D imaging since it affords sub-millimeter spatial resolution and versatile tissue/muscle/cartilage image contrast. However, MRI comes with the penalty that it requires relatively long scan times. Hence, imaging of moving organs requires consideration of physiological motion. For the phonating vocal folds, periodic oscillation is superimposed by breathing movements (abduction and adduction). While for the first, synchronization cannot be obtained yet, the second can be handled by a customized explicit synchronization technique. The imaging protocol consisted of segmented 3D gradient-echo imaging and segmented 3D ultra-short TE. In vivo imaging on male and female subjects was conducted using a 3.0T in modal and head register. 3D MRI data were included into segmentation to derive boundary conditions for finite-element models of vocal fold oscillation. Thereby, the segmented air volume of the larynx is transformed in splines at different positions in the anterior-posterior axis of the vocal folds.

2414. MR Elastography of the Ocular Vitreous Body

Daniel V. Litwiller[1], Yogesh Mariappan[1], Richard L. Ehman[1]
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The gradual liquefaction of the ocular vitreous body with age can lead to retinal detachment and loss of sight. Although retinal detachment is a simple condition to diagnose, historically, means to evaluate the mechanical properties of the vitreous body have been invasive and technically challenging. The development of a reliable, noninvasive measurement technique would improve our understanding of the underlying physiology of this condition, and aid in evaluating patients and potential treatments. The purpose of this work was to investigate the utility of MR elastography as a noninvasive means to quantify the viscoelastic properties of the vitreous body.

2415. Parotid Sparing Volume-Dependent Perfusion Characteristics of Acute Radiation Injury: Investigated by Fat-Saturated Dynamic Contrast-Enhanced MRI

Cheng-Chieh Cheng[1], Chun-Jung Juan[2], Hsiao-Wen Chung, [2,3], Yee-Min Jen[2], Su-Chin Chiu[1], Hing-Chiu Chang, [1,4], Hui-Chu Chiu[5,6], Cheng-Hsien Hsu[2,7], Guo-Shu Huang[2], Cheng-Yu Chen[2]
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Parotid glands are highly radiosensitive, while the utilization of parotid sparing technique decreases the irradiation, and thus may reduce radiation therapy damage. In this study, we demonstrate a graded alteration in the perfusion characteristics of parotid glands, with the respect of parotid-sparing volume provided by the intensity modulated radiotherapy (IMRT) technique.

2416. High-Resolution Imaging of the Laryngeal Cartilages: Volunteer and Cancer Patient Studies

Joëlle Karine Barral[1], R. Reeve Ingle[1], Edward J. Damrose[2], Nancy J. Fischbein[2,3], Dwight G. Nishimura[1]
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Current staging of laryngeal cancer and choice of optimal treatment are hindered by the difficulty of accurately assessing cartilage invasion. The use of a dedicated three-channel array instead of the conventional eight-channel neuro-vascular array allows a reduction in voxel size by a factor of 20. A low-order polynomial fitting approach is used to compensate for the coil sensitivity profile. In healthy volunteers, the increased resolution makes visible the delineation of non-ossified cartilage, otherwise indistinguishable from muscle. The dedicated array is also used in cancer patients, and improvement in image quality is demonstrated.

2417. Brain Structural Changes Underlying Cognitive Disabilities in Patients with Obstructive Sleep Apnea Syndrome (OSAS): A VBM Study

Giovanni Giulietti[1,2], Federico Torelli[1,3], Marco Bozzali[1], Girolamo Garreffa[1,2], Nicola Moscufo[4], Silvana Zannino[1,5], Laura Serra[1], Fabio Placidi[5], Fabrizio Fasano[1], Gisela Hagberg[1], Bruno Maraviglia[1,2], Ina Djonlagic[6], Julian Saboisky[6], Atul Malhotra[6], Maria Grazia Marciani[1,5], Charles Guttmann[4]

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This VBM study aims at investigating GM and WM changes which might account for clinical disabilities in patients with OSAS. Sixteen patients with OSAS (grouped in moderate and severe clinical stage) and 14 healthy controls were investigated. Neuropsychological assessment and MRI scanning were obtained from each subject. Patients reported a selective impairment of verbal memory. Subjects with severe OSAS showed a bilateral GM atrophy of the hippocampus and some volumetric reductions in the contiguous WM. These findings suggest that both regional GM atrophy and WM disconnection might, at least parially, explain cognitive deficits detectable in patients with OSAS.

2418. Oral Tongue Squamous Cell Carcinoma Evaluated by PROPELLER and Echoplanar Diffusion-Weighted Imaging

Chun-Jung Juan[1], Hing-Chiu Chang[2,3], Cheng-Yu Chen[1], Hung-Wen Kao[1], Chun-Jen Hsueh[1], Chih-Wei Wang[1], Cheng-Chieh Cheng[1,3], Su-Chin Chiu[1,3], Hsiao-Wen Chung[1,3], Guo-Shu Huang[1]

[1]Department of Radiology, Tri-Service General Hospital, Taipei, Taiwan; [2]Applied Science Laboratory, GE Healthcare Taiwan, Taipei, Taiwan; [3]Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan

In this study we aimed to verify the imaging quality of fast spin-echo PROPELLER diffusion weighted imaging (FSE-PROP-DWI) and echoplanar DWI (EP-DWI) in oral cavity and to investigate the apparent diffusion coefficient (ADC) of pathological proven oral tongue squamous cell carcinoma (OTSCC). Our results show that FSE-PROP-DWI is superior to EP-DWI with less imaging distortion and is satisfactory for measurement of ADC of OTSCC.

2419. Improved Head and Neck Contrast Enhanced Imaging Using High Resolution Isotropic 3D T1 SPACE: A Feasibility Study

Magalie Viallon[1], Karen Masterson[1], Minerva Becker[1]

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Post Gadolinium MR head and neck examinations remain challenging due to the need for a large anatomic coverage in minimum acquisition time. For cranial nerves and skull base investigation, 3D acquisitions are very useful not only to better visualize and analyze the nerves but also to provide large head and neck coverage of often extended or multi focal pathology. Until recently, 3D acquisitions implemented to image the head and neck area were based on gradient echo imaging kernel (T1 3D Vibe FS, T1 MP-RAGE. Unfortunately, fast 3D T1w gradient echo imaging is limited by the presence of air-tissue interfaces and inherent susceptibility artefacts. Nevertheless, to study the whole course of nerves and localize focal or global contrast enhancement, a fat saturated spin-echo 3D T1 sequence seems more adequate. We investigate here the utility of 3D T1 FS Space (Sampling Perfection with Application optimized Contrasts using different flip angle Evolutions) for head and neck imaging at 3T and its clinical relevance in various pathologies of this region.

2420. Tumor Metabolism and Perfusion in Head and Neck Squamous Cell Carcinoma: Pretreatment Multimodality Imaging with 1H-MRS, DCE MRI and 18F-FDG PET: An Exploratory Study

Jacobus FA Jansen[1], Heiko Schoder[1], Nancy Lee[1], Hilda Stambuk[1], Ya Wang[1], Matthew Fury[1], Snehal Patel[1], David Pfister[1], Jatin Shah[1], Jason Koutcher[1], Amita Shukla-Dave[1]

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The study aims to correlate pretreatment multimodality (MM) imaging data obtained with 1H-MRS, DCE-MRI and 18F-FDG PET in patients with head and neck squamous cell carcinoma (HNSCC) with neck nodal metastases for more precise assessment of the tumor metabolism and perfusion. Additionally, pretreatment MM imaging data was evaluated for its efficacy in prediction of short term response to treatment. In 29 HNSCC patients, Cho/W, Ktrans, ve, kep, 18F-FDG SUV measures were correlated. It was found that pretreatment MM imaging is valuable for the precise assessment of tumor biology, and maybe a predictive marker for short term response.

DTI Brain & Spine - Clinical Applications

Hall B Thursday 13:30-15:30

2421. MR Visualization of Ventral Thalamic Nuclei

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Ventrointermediate nucleus of the thalamus is located adjacent to and medial to the pyramidal tract and it can be identified on anisotropy maps of diffusion tensor imaging as well as inversion recovery sequences.

2422. Distance Between Meyer's Loop Anterior Tip and Temporal Pole in Southern Chinese Measured with Diffusion Tensor Tractography Using BrainLAB and Philips FiberTrak Software

Yi Xiang Wang[1], X L. Zhu[2], M Deng[1], Y W. Siu[1], C S. Leung[3], Q Chan[4], T M. Chan[2], W S. Poon[2]

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Using Diffusion tensor tractography, the relationship of Meyer¡¯s loop to temporal lobe was investigated in 16 Southern Chinese subjects. Operator A is a neurosurgeon and BrainLAB software (Feldkirchen, Germany) was used. Operator B is a radiologist and Philips FiberTrak Software (Best, The Netherlands) was used. The results demonstrated a neurosurgeon and a radiologist using different DTT tools reached similar results on Meyer¡¯s loop to temporal pole (ML¨CTP) distance, suggesting BrainLAB and Philips FiberTrack software are able to provide comparable results. ML¨CTP distance from southern Chinese population was similar to literature data of Caucasian and Japanese population.

2423. Diffusion Tensor Imaging Correlates of Cognitive Impairment and Fatigue in Multiple Sclerosis

Gunja P. Parikh[1], Maxim Bester[1,2], Mariana Lazar[1], James S. Babb[1], Hina Jaggi[1], Laura Miles[1], Robert Grossman[1], Matilde Inglese[3,4]

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Diffusion tensor tractography provides the possibility to reconstruct fiber bundles and to focus on regions that might play a major role in the development of clinical deficits in patients with multiple sclerosis (MS). We used tractography to determine whether tissue damage in the corpus callosum (CC) and in the anterior-thalamic tracts (AT) is associated with cognitive dysfunction and fatigue in patients with benign MS (BMS) and clinically isolated syndrome (CIS). Differences from controls were observed in the CC and AT tracts of BMS and CIS patients. A significant association was found between DTI metrics in the CC and cognitive deficits.

2424. The Effects of HIV and Aging Using Diffusion Tensor Imaging

Huiling Peng[1], Joseph Mettenburg[2], Avi Snyder[1], David Clifford[1], Tammie Benzinger[2], Beau Ances[3]

[1]Neurology, Washington University in St. Louis, St. Louis, MO, United States; [2]Radiology, Washington University in St. Louis, St. Louis, MO, United States; [3]Neurology, Washington University in St. Louis, St. Louis, MO , United States

HIV can lead to chronic inflammation. We investigated the relationship between aging and HIV status and white matter integrity using DTI in four groups of participants (HIV younger (20-25 years old) (n=8), HIV- older (50-65 years old) (n=12), HIV+ younger (20-25 years old) (n=9), and HIV+ older (50-65 years old) (n=9)). Regions-of-interest corresponding to the genus, middle, and splenium were selected. HIV- older subjects had significant decreases in mean diffusivity, axial diffusivity (AD), and radial diffusivity (RD) compared to other all groups. While HIV led to a reduction in DTI measures these decreases were not significant.

2425. Differences in White Matter Fiber Orientation in Three Clinical Groups of Children: Reading Disability, NF-1 and Reading Disability, and Controls

Daniel Jon Peterson[1], Sheryl L. Rimrodt[2,3], Laurie E. Cutting[4]

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DTI was used to investigate differences in white matter fiber orientation between three groups: children with reading disability (RD), children with neurofibromatosis type 1 and reading disability (NF1+RD), and typically developing controls. A voxel-wise statistical test that detects differences in fiber orientation revealed bilateral differences in the anterior limb of the internal capsule. In this region, the fiber orientation of controls and RD subjects were similar, while those of the NF1+RD subjects clearly differed, with minimal overlap.

2426. Voxel-Based Morphometric Analysis of Brain Volumetry and Diffusivity in Hepatitis C

Manoj Kumar Sarma[1], Rajakumar Nagarajan[1], Charles H. Hinkin[2], Steven A. Castellon[2], Jason P. Smith, Homayoon Khanlou[3], Laveeza Bhatti[3], Jonathan Truong[4], E Singer[5], Jiah Jang[6], Michelle Kim[6], Gabe Waterman[6], Rakesh Kumar Gupta[7], Michael Albert Thomas[1]

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We investigated mean diffusivity (MD) and fractional anisotropy (FA) value changes along with white matter and gray matter volume in patients with hepatitis C compared to healthy controls using voxel based morphometry (VBM). Extensive increased MD values were observed in bilateral frontal gray and white matter, bilateral external capsule, temporal white matter, and right occipital gray matter. FA values decreased in the corpus callosum, right frontal and occipital white matter. Widespread gray matter volume reduction was seen in the frontal, parietal and temporal regions. White matter volume decreases were observed in the right frontal, corpus callosum and mid brain.

2427. DTI Detects Progressive Neurodegeneration in the Brain and Cervical Spinal Cord in ALS

Govind Nair[1], John D. Carew[2,3], Longchuan Li[1], Sharon Usher[4], Xiaoping P. Hu[1], Michael Benatar[4,5]

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Diffusion tensor imaging of the brain and spinal cord in patients with Amyotrophic Lateral Sclerosis and age-matched healthy control subjects revealed a significant decrease in fractional anisotropy, and increase in mean diffusivity and radial diffusivity along the corticospinal tract. The DTI parameters from ALS patients showed significant correlation with their average finger and foot tapping speed, a measure of upper motor neuron dysfunction. These findings suggest that DTI might represent useful imaging biomarkers of ALS disease progression.

2428. Comparison of Limbic Regions FA Using Tractography-Defined ROIs in AD and MCI

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The limbic regions appear to be affected by mild cognitive impairment (MCI) and Alzheimer Disease (AD). We use normalized tractography to objectively isolate the fornix and cingulum in a common template space for a voxel-based analysis of FA changes among normal control, MCI, and AD populations. The results show FA change propagation from normals to MCI to AD with more changes in the right hemisphere, which is consistent with previous reports.

2429. Axial and Radial Diffusivity Measures Detect Brain Tissue Injury in Heart Failure Patients

Rajesh Kumar[1], Mary A. Woo[2], Paul M. Macey[2,3], Gregg C. Fonarow[4], Michele A. Hamilton[4], Ronald M. Harper[1,3]

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Heart failure (HF) patients show injury in multiple brain sites, which may represent axonal or myelin injury, or both; however, the nature of the injury is unclear. We assessed axial and radial diffusivity measures in HF, which show axonal and myelin changes, respectively. Axonal injury with reduced axonal density or caliber appeared in internal capsule and cerebellar regions, and reduced myelin in temporal and frontal areas. Other brain sites, including internal capsule and dorsomedial medulla showed myelin and axonal injury. The processes contributing to tissue injury in different brain regions are unknown, but may include ischemic/hypoxic or inflammatory processes.

2430. Diffusion Two-Tensor Tractography Study on Inter-Hemispheric Connection Between Bilateral Heschl's Gyrus in Schizophrenia

Hsiao Piau Ng[1,2], Marek Kubicki[1,3], James Malcolm[1], Yogesh Rathi[1,3], Paula Pelavin[1], Robert W. McCarley[3], Martha E. Shenton[1,3]

[1]Psychiatry Neuroimaging Lab, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States; [2]Singapore Bioimaging Consortium, Agency for Science, Technology and Research, Singapore, -, Singapore; [3]Clinical Neuroscience Division, VA Boston Healthcare System, Harvard Medical School, Brockton, MA, United States

The connection between bilateral Heschl's gyrus (HG) in normal controls (NC) and schizophrenics (SZ) is investigated using DTI here. Whole-brain tractography was first generated using filtered two-tensor tractography method, instead of conventional streamline tractography. The relevant connection was then extracted using the white matter of bilateral HGs as the ROIs. Measures for quantifying the connection are mean FA, mode, trace, parallel and perpendicular diffusivity. Statistically significant between-group differences in trace, parallel and perpendicular diffusivity were observed. Our findings are consistent with theories which suggest that SZ group has decreased WM pathology, particularly in regions associated with auditory and language processing.

2431. Connection Between Bilateral Superior Temporal Gyrus in Schizophrenia: A Preliminary Diffusion Tensor Imaging Study

Hsiao Piau Ng[1,2], Marek Kubicki[1,3], Doug Terry[1], Paula Pelavin[1], Andrew Rausch[1], Martha E. Shenton[1,3]

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In this study, the connection between the bilateral STGs in normal controls (NC) and schizophrenics (SZ) is investigated using DTI measures, namely FA, mode and trace. The connection was obtained from whole-brain streamline tractography using STGs white matter as ROIs. By dividing the connection into three sub-regions (Left, Corpus Callosum and Right) and comparing the computed DTI measures of NC and SZ, we found statistically significant differences in mean FA and mode in the Right region, with NC having greater values. This study paves the way for further localization of the differences in STGs connection between NC and SZ.

2432. Compromised Frontal Callosal Connectivity in Unmedicated Obsessive-Compulsive Disorder: A Quantitative Diffusion Tractography Study

Jungsu S. Oh[1,2], Joon Hwan Jang[2], Wi Hoon Jung[3], Chi-Hoon Choi[4], Jung-Seok Choi[5], Do-Hyung Kang[5], Jun Soo Kwon[2]

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Delineating frontostriatal network-related white matter tracts into dorsal/ventral pathways is of particular interest in obsessive-compulsive disorder (OCD) studies. Hence we aim to investigate fractional anisotropy (FA) of dorsal/ventral projections of callosal fibers in OCD on the basis of quantitative diffusion tractography analysis using Brodmann ROI approach and tract parameterization. We found significant FA decreases in callosal fibers of OCD in both DLPFC/OFC projections, benefitting from function/region-specific tractography analysis. Thus we validated well-known abnormalities in these networks of OCD. In particular, DLPFC-specific callosal fiber integrity was first revealed by the function/region-sensitivity of the present methods (not found by previous methods).

2433. A DTI-Based Assessment of the Changes in the White Matter in Opioid Addict Patients: A Parcellation Based Approach

Nasim Maleki[1], Jaymin Upadhyay[1], Jennifer Potter[2], Roger Weiss, Lino Becerra[1,3], David Borsook[1]

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White matter abnormalities in a cohort of prescription opioid dependent subjects (vs. demographically matched subjects) are assessed by combining the parcellated structural and DTI data. Our results show that there are significant changes in white matter in the patient group in the form of reduced fractional anisotropy. The approach used in this study to evaluate white matter integrity has the major advantage of taking individual anatomical differences into account for DTI analysis.

2434. A Quantitative Tractography Approach for Exploring Associations Between White Matter Pathways and Cognitive Functions

Eni Halilaj[1], Stephen Correia[2], David H. Laidlaw[1], Stephen Salloway[3]

[1]Computer Science, Brown University, Providence, RI, United States; [2]Department of Psychiatry and Human Behavior, Warren Alpert School of Brown University; [3]Neuroscience, Brown University

In this study we use quantitative tractography to explore potential associations between cognitive functions and cerebral white matter pathways. We support inferences made about relationships between working memory, processing speed, motor function, executive function, visual naming and white matter health not only though observed correlations, but also through the lack thereof, in functions

expected to rely more heavily on the functional integrity of cortical regions. Quantitative tractography metrics are powerful markers of structural integrity in white matter. Using such metrics, rather than diffusivity scalars, helps us identify underlying correlations between localized white matter atrophy and categorical cognitive decline.

2435. Improved Delineation of Brain Tumour Margins Using Whole-Brain Track-Density Mapping

Stephen Rose[1,2], Stuart Crozier, [2,3], Pierrick Bourgeat[4], Nicholas Dowson[4], Olivier Salvado[4], Parnesh Raniga[4], Kerstin Pannek[5], Alan Coulthard[6], Michael Fay[7], Paul Thomas[8], David Macfarlane[8]

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We are investigating the use of HARDI, utilising whole-brain track-density maps to improve definition of brain tumour margins. Our hypothesis is that infiltrating tumour will reduce WM connectivity enabling improved depiction of tumour boundaries. To assist in the determination of tumour extent, the 3D visitation maps are anatomically fused to 18F-FDOPA – PET images. We report that infiltrating tumour delineated on 18F-FDOPA maps that is present outside of the tumour-enhancement boundary defined on CET1 images results in a reduction in WM connectivity or streamline density on corresponding whole-brain track density maps. This has significant implications for surgical and radiation treatment planning.

2436. A Virtual Reality System for Neurosurgery: Integrated Brain Tumor with Peri-Tumoral Neuroanatomy

Chun-Yi Lo[1], Wan-Yuo Guo[2], Kun-Hsien Chou[3], Ching-Po Lin[1]

[1]Institute of Biomedical Imaging and Radiological Sciences, National Yang Ming University, Taipei, Taiwan; [2]Department of Radiology, Taipei Veterans General Hospital, Taipei, Taiwan; [3]Institute of Biomedical Engineering, National Yang Ming University, Taipei, Taiwan

A virtual reality environment for integrating neuroanatomy was developed for clarify the relationship among tumor mass and peri-tumoral microstructures for facilitating neurosurgical trajectory design and optimizing therapeutic outcome. Brain tumor and edema were segmented manually and reconstructed into 3D display. Fiber tracking was carried out via the Fiber Assignment by Continuous Tracking algorithm with fractional anisotropy threshold of 0.2 and angular limitation of 60 degree. The 3D stereo image was projected on the non-depolarizing screen by two projectors with polarizing filter. Therefore, the viewings of the user¡¦s right and left eyes would be slightly different and the stereo image would be produced from the user¡¦s viewpoint with 3D glasses.

2437. Diffusion Tractography of the Motor Pathway in High Grade Brain Tumor Patients: A Comparison of Constrained Spherical Deconvolution (CSD) and DTI Algorithms

Bradford Moffat[1], Christopher Steward[1], Patricia Desmond[1], Simon Salinas[1], Andrew Morokoff[2], Chris Kokkinos[3]

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The aim of this study was to investigate whether a probabilistic tractography algorithm based on CSD (SDPROB) was superior for visualisation of the motor pathway in patients with high grade brain tumors. Track volume intersection (TVI) with independent fMRI identified eloquent cortex from SDPROB tractography was compared to traditional stream tracking algorithms based on CSD (SDST) and DTI eigenvectors (DTST). SDPROB was found to be significantly ($p<0.01$) superior to both SDST and DTST algorithms for mapping the motor pathway to the eloquent motor cortex.

2438. Standard and Probabilistic Models of Diffusion Tensor Imaging and Tractography in Patients with Brain Tumors

Zhixi Li[1], Robert J. Young[2,3], Kyung Peck[4], Nicole Brennan[2], Andrei I. Holodny[2,3]

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The development of diffusion tensor (DT) imaging and tractography affords the ability to account for the white matter fibers and has the potential to be an important tool in neurosurgical navigation. In addition to the usual fiber tracking challenges related to small fibers that may make sharp turns and/or encounter crossing fibers, tractography in patients with brain tumors may be compromised by the tumor and/or the associated edema. In patients with brain tumors near the arcuate fasciculus, we hypothesize that tractography based on a probabilistic model will perform better than a standard deterministic model.

2439. Mapping the Language Network in Grade II Gliomas: A Longitudinal Study with FMRI, MR Tractography and Neuropsychology

Alberto Bizzi[1], Francesca Ferrè[2], GianMarco Castelli[1], Maria Luisa Mandelli[1], Sylvie Piacentini[2], Francesca Ciaraffa[1], Domenico Aquino[1], Carlo Marras[3], Francesco Di Meco[3], Giovanni Broggi[3], Carlo Lazzaro Solero[3]

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Fourteen patients with grade II glioma were evaluated longitudinally with fMRI and DTI-MR Tractography of the language network and Aachener Aphasie Test before surgery, at 3 and 12 months. Functional cortex and streamlines of the dorsal and ventral language pathways were mapped.
Deficits in phonemic and semantic fluencies were prevalent in patients with glioma infiltrating the insula, temporal pole and stem and were associated with ventral pathway interruption. Left hemisphere dominance was preserved in most patients. These imaging data suggest that ipsilateral rather than contralateral mechanisms of functional reorganization of the language network are more common in grade II gliomas.

2440. Role of Diffusion Tensor Imaging in Diagnosis of Medial Temporal Lobe Epilepsy

Heba Ali[1], Mona Mohamed[2], Yosra Abdullah, Ahmed Gaber, Yasser Abbas

[1]AIN SHAMS UNIVERSITY HOSPITALS, CAIRO, Egypt; [2]JOHNS HOPKINS UNIVERSITY SCHOOL OF MEDICINE, BALTIMORE, MD, United States

Modern MR techniques are helpful in assessment of patients presenting with seizures and EEG changes suggestive of temporal lobe epilepsy, yet having normal conventional magnetic resonance imaging (MRI) epilepsy protocol. Here, we performed diffusion tensor imaging (DTI), with quantitative assessment of fractional anisotropy (FA) and apparent diffusion coefficient (ADC) combined with tractography for pertinent white matter tracts. Results revealed that DTI is helpful for more accurate assessment of patients with MTLE.

2441. Impaired Structural Connectivity of Language and Memory Networks in Patients with Chronic Epilepsy

Maarten Vaessen[1,2], Jaap Jansen[3], Paul Hofman, Marielle Vlooswijk, Henriette Majoie, Mark de Krom, Albert Aldenkamp[1,2], Walter Backes

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Patients with chronic epilepsy commonly develop cognitive co-morbidity. Previously, it was observed that their declined cognitive performance was associated with loss of functional connectivity derived from functional MRI of memory and language tasks. In this study we aimed to identify impaired structural connections, obtained with fibre tractography, between brain regions commonly associated with language and memory function. We found that fiber connections between the left and right frontal lobe were significantly reduced in these patients and were correlated with IQ.

2442. Longitudinal Diffusion Tensor Imaging of Fornix Degeneration Following Epilepsy Surgery

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Diffusion tensor imaging (DTI) may be a sensitive method of following the unique phases of Wallerian degeneration of injured white matter fibers in human brain. Longitudinal DTI tractography of the fimbria-fornix was performed at several time points on three patients with temporal lobe epilepsy before and after their anterior temporal resections (several times within the first week and 2-4 months post-surgery). The diffusion parameters of the ipsilateral fornices showed unique dynamic changes, notably a reduction of parallel diffusivity acutely, while perpendicular diffusion curiously showed a smaller reduction within the first week followed by the expected increase at chronic times.

2443. FACT, Probability Maps and Gibbs Tracking for Preoperative Fiber Tracking in Epilepsy Surgery

Irina Mader[1], Constantin Anastasopoulos[1], Valerij G. Kiselev[2], Andreas Schulze-Bonhage[3], Marco Reisert[2]

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Problem: The protection of functional fiber bundles is essential in epilepsy surgery. The aim was to compare FACT, probability maps and Gibbs tracking in their relevance for the neurosurgeon. Methods: Ten patients received pre-operative fiber tracking (5 corticospinal tract, 5 optic radiation). Results: Probability maps and GIBBS tracking were successful for all fiber structures on the healthy and the pathologic side, whereas FACT was only successful in 5 cases on the pathological side and 6 on the healthy side. Conclusion: Probability maps and Gibbs tracking are superior to FACT. A higher specificity of Gibbs cannot be shown at the moment.

2444. Probability Maps Compared to FACT Algorithm in Human Gliomas

Irina Mader[1], Thao Nguyen Thanh[1], Susanne Schnell[2], Thomas Reithmeier[3], Valerij G. Kiselev[2]

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Problem: The importance of FACT algorithm for surgical planning has been substantiated in the past. No clinical experience is available for probability maps. This work aimed to compare FACT and probability maps in human gliomas. Methods: 10 patients with human gliomas (4 WHO°II, 6 WHO°III) received both fiber tracking methods of the motor fibers arising from fMRI derived seed points. Results: Probability maps were successful in all cases.
FACT failed in three cases with moderate to severe motor impairment. Conclusion: Probability maps seem to be superior to FACT, especially in cases with strong fiber deviations and present oedema.

2445. Trimodal Imaging and Brain Plasticity: MR Diffusion Tensor Imaging Supplements Simultaneously Acquired FET-PET and MP-RAGE of Human Brain Tumour Imaging

N. Jon Shah[1,2], Irene Neuner[1,2], Joachim Bernhard Maria Kaffanke[1], Yuliya Kupriyanova[1], Karl-Joseph Langen[1], Hans Herzog[1]

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PET imaging is well established for the diagnosis of brain tumours. Its metabolic specificity delivers valuable information about the malignancy and the extent of tumour tissue. Tumour growth forces the brain to reorganize itself to compensate for the lost areas. It has been shown that DTI is a valuable tool to demonstrate the plasticity of the brain and it therefore offers information about the reorganization caused by tumour growth as well as surgical intervention. The acquisition of trimodal PET, MP-RAGE and DTI data on an MR-PET hybrid scanner, capable of simultaneous MR and PET, to investigate plasticity and reorganisation in human brain tumours is demonstrated.

2446. Comparison of Electrophysiologic Connectivity with Imaging Connectivity from DWI and Resting State FMRI

Stephen Edward Jones[1], Andreas Alexopolous, Erik Beall, Joanna Fong, Jorge Gonzalez-Martinez, Mark Lowe, Blessy Mathew, Dileep Nair, Imad Najm, Michael Phillips, Kenneth Sakaie

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We present a comparison of in-vivo connectivity scores: one derived from electrophysiology (EP) signals in human brains monitored with parenchymal electrodes (for epilepsy workup); and the other from imaging connectivity methods such as HARDI and resting state fMRI. Assuming EP represent a gold standard of connectivity, this provides a validation of various connectivity scores derived from MRI.

2447. Pre-Surgical Mapping Using Magnetoencephalography and Diffusion Tensor Tractography Reveals a Case of Neuroplasticity

Nadia CF Scantlebury[1], William Gaetz[2], Elysa Widjaja, James Rutka[3], Eric Bouffet[4], Conrad Rockel[1], Don Mabbott[1]

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We used combined magnetoencephalography (MEG) and Diffusion Tensor Imaging (DTI) tractography methods to delineate the cortico-spinal tracts (CSTs) of an 11-year old female who presented with an arteriovenous malformation (AVM). Concurrent MEG-DTI techniques revealed a case of cerebral plasticity, whereby motor function of the patient remained intact despite the contra-lateral displacement of her CST by the AVM. These data support the use of the functional activation as a seed for launching neural tracts during pre-surgical evaluation in children. Moreover, these findings demonstrate that using a concurrent MEG-DTI approach to delineate CSTs is invaluable when evaluating plasticity in the developing brain.

2448. Role of FMRI and DTI in Assessing the Efficacy of Visual Neurorehabilitation. Preliminary Data

Matteo Bendini[1], Ingrid Inches[1], Marissa Barabas[2], Massimo Prior[3], Monica Ronzon[1], Stefano Curtolo[1], Davide Canonico[4], Carlo Alberto Marzi[2], Francesco Di Paola[1]

[1]Neuroradiology Department, Ca' Foncello Hospital Treviso, Italy, Treviso, Italy; [2]Department of Neurological and Vision Sciences, University of Verona, Italy; [3]Faculty of Psychology, University of Padua, Italy; [4]Department of Physics, Ca' Foncello Hospital Treviso, Italy

Aim: Establish if f-MRI and DTI are valid (objective) tools to evaluate postchiasmatic damage. Materials and methods: 7 patients with HVFDs underwent to a neuro-psycological evaluation. A f-MRI and DTI sequences were applied to study the visual activation and the optic radiation. Two patients underwent to a visual rehabilitation treatment. Results: In all patients did not show an activation in

the visual cortex ipsilateral to the injury. The contralateral visual area showed a normal pathway of activation. In the two patients treated, higher activation in the contralateral visual areas was observed. Conclusions: F-MRI and DTI are valid tools to study HVFDs.

2449. **Diffusion Tensor Imaging of the Pediatric Optic Nerve: Intrinsic and Extrinsic Pathology Compared to Normal Controls**

Joshua Paul Nickerson[1], Michael B. Salmela[2], Chris John Koski[3], Trevor Andrews[2], Christopher G. Filippi[4]

[1]Radiology, Fletcher Allen Healthcare/The University of Vermont, Burlington, VT, United States; [2]School of Medicine, University of Vermont, Burlington, VT, United States; [3]Political Science, James Madison University, Harrisonburg, VA, United States; [4]Neuroradiology, Fletcher Allen Healthcare/The University of Vermont, Burlington, VT, United States

MRDTI normative data from the optic nerves in 70 normal children was compared to diffusion parameters in children with lesions both intrinsic and extrinsic to the visual pathway. Significant decrease in FA and increase in ADC was present in intrinsic lesions, while extrinsic lesions where only mass effect on the nerves was present did not affect diffusivity or anisotropy. This may improve presurgical planning for visual pathway lesions.

2450. **Spinal Cord White Matter Integrity in Patients with Cervical Spondylosis Is Related to Severity of Spinal Canal Stenosis: A Combined MRI and Diffusion Tensor Imaging Study**

Antoine Feydy[1], Pavel Lindberg[1], Francois Rannou[2], Jean-Luc Drape[1], Marc A. Maier[3]

[1]Radiology B, Hopital Cochin, Paris, France; [2]Rehabilitation, Hopital Cochin, Paris, France; [3]LNRS, Universite Paris Descartes, Paris, France

We used DTI to test if the severity of spinal canal stenosis is related to the degree of spinal white matter integrity in patients with cervical spondylosis. Patients and controls were studied with DTI of cervical spinal cord. The patients had lower FA than controls and increased spinal canal stenosis. The mean degree of spinal canal stenosis correlated with mean FA, i.e., patients with least cervical canal space had lowest FA values of the whole cervical spinal cord. The results show that DTI can quantify spinal cord white matter degeneration related to spinal canal stenosis in patients with cervical spondylosis.

Advanced Imaging of Spine & Spinal Cord

Hall B Monday 14:00-16:00

2451. **Diffusion Tensor Imaging of the Normal and Injured Pediatric Spinal Cord at 1.5 T**

Feroze B. Mohamed[1], Louis N. Hunter[2], Nadia Barakat[1], Chia-Shang Liu[1], Haris Sair[3], Amer Samdani[2], Randal Betz[2], Scott H. Faro[1], John Gaughan[1], Mary J. Mulcahey[2]

[1]Temple University, Philadelphia, PA, United States; [2]Shriners Hospital for Children; [3]Massachusetts General Hospital

To measure and establish normative DTI parameters of healthy spinal cord tissue in children with idiopathic scoliosis as a means for comparison with children with spinal cord injury (SCI). 5 subjects with idiopathic scoliosis and 5 subjects with SCI were imaged twice using DTI. The SCI subjects showed reduced FA values and increased D values compared with control subjects. Test-retest reproducibility showed excellent inter class correlation (ICC) in all the control group DTI index values (>0.9) while the SCI group showed moderate ICC (>0.7). There were statistically significant correlations between the DTI indices and several ISNCSCI clinical impairment scores.

2452. **Reduced Field of View Imaging for Twice-Refocused Diffusion EPI Using a Perpendicular Refocusing Slab**

Rafael Luis O'Halloran[1], Samantha J. Holdsworth[1], Stefan Skare[1], Roland Bammer[1]

[1]Department of Radiology, Stanford University, Stanford, CA, United States

A simple method for reducing the phase field of view in twice-refocused DTI EPI is presented and compared with full of view imaging in DTI of the upper spine. The 180-degree refocusing slice select pulses are played out on the phase encoding axis instead of the slice-encoding axis. This allows the phase field of view to be reduced to the width of the perpendicular refocusing slab without introducing wrap. Results show that the reduced field of view method produces diffusion weighted images of the cervical and thoracic spine that are less distorted than those of standard full field of view EPI for the same scan time.

2453. **Spinal Cord Diffusion Tensor Imaging (DTI) and 1H-MR Spectroscopy (MRS) at 1.5T and 3T.**

Virginie Callot[1], Yann Le Fur[1], Jean-Philippe Ranjeva[1], Guillaume Duhamel[1], Patrick J. Cozzone[1]

[1]Centre de Résonance Magnétique Biologique et Médicale (CRMBM), CNRS, UMR 6612, Faculté de Médecine, Marseille, France

Diffusion Tensor Imaging (DTI) and single-voxel 1H-MR spectroscopy (MRS) of the spinal cord (SC) are challenged by several difficulties, including strong magnetic field inhomogeneities, respiratory and cardiac movements, and small size of the spinal cord. Whereas several studies have shown promising results, there is scant literature comparing 1.5T and 3T MRI and MRS. In this abstract, we investigate the efficiency of the available manufacturer MRS and DTI sequences, in terms of image/spectra quality and metrics, at

both 1.5T and 3T, for different spinal cord locations (thoracic and cervical levels) and for different imaging plane orientations (sagittal and axial).

2454. Diffusion Tensor MR Imaging of the Healthy Human Cervical, Thoracic and Lumbar Spinal Cord

Rachael Lee Bosma[1], Christopher Alan Kidd[1], Patrick W. Stroman[1,2]
[1]Centre for Neuroscience Studies, Queen's University, Kingston, Ontario, Canada; [2]Departments of Diagnostic Radiology and Physics, Queen's University, Kingston, Ontario, Canada

A greater understanding of diffusion indices within the healthy spinal cord is necessary for comparison with clinical populations. Here we measured fractional anisotropy and apparent diffusion coefficient values for cervical (C2-C7), thoracic (T3-T8) and lumbar (T10-L1) regions of the cord. FA vs. ADC values were plotted and three clusters were determined using a k-means partition to characterize each region of the spinal cord. DTI indices in the healthy cord were observed to be relatively consistent across regions, indicating that changes in these indices as a result of trauma at any level can be characterized relative to these observed indices.

2455. Diffusion Tensor MR Characteristics of Cervical Spondylosis

Benjamin M. Ellingson[1,2], Jean-Louis Benae[2], Shekar N. Kurpad[2], Brian D. Schmit[3], Mehmet Kocak[1], Marjorie C. Wang[2]
[1]Dept. of Radiology, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Dept. of Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States; [3]Dept. of Biomedical Engineering, Marquette University, Milwaukee, WI, United States

The objective of the current study was to characterize the diffusion tensor MRI (DTI) properties of the cervical spinal cord in patients diagnosed with cervical spondylosis. Axial DTI was performed throughout the region of highest cord compression in 17 patients with cervical spondylosis using a clinical 1.5T MRI system. Results showed spatially localized regions of high FA and low MD at the site of compression. Longitudinal ADC was significantly lower than historic controls, whereas transverse ADC was significantly higher than historic controls in regions adjacent to the site of compression. Results from this study suggest that FA and MD can be used to localize regions of the spinal cord under the largest degree of compression.

2456. Pitfalls of Spinal DTI in Cervical Spondylotic Myelopathy

Enedino Hernandez Torres[1,2], Alex L. MacKay[2,3], Erin MacMillan[4], Teodoro Cordova Fraga[1], Alonso Ramirez Manzanares[5], Armin Curt[6], David Li[2], Burkhard Mädler[7], M Dvorak[8]
[1]Division de Ciencias e Ingenierias, Universidad de Guanajuato, Leon, Guanajuato, Mexico; [2]Radiology, University of British Columbia, Canada, Vancouver, Brithish Columbia, Canada; [3]Physics & Astronomy, University of British Columbia, Canada, Vancouver, Brithish Columbia, Canada; [4]Clinical Research, University of Bern; [5]Facultad de Matematicas, Universidad de Guanajuato, Guanajuato, Mexico; [6]Spinal Cord Injury Center, University of Zurich; [7]Philips Healthcare, Vancouver, Brithish Columbia; [8]International Collaboration on Repair Discoveries

Diffusion measures have proved to be useful in cervical spondylotic myelopathy (CSM). This study compared two methods of analysis for spinal DTI in CSM subjects and normals. The first approach defined the spine area on the basis of a fractional anisotropy threshold of 0.3; the second employed a threshold based upon eigenvector orientation within 45 degrees of the direction of the spine. The two approaches yielded markedly different diffusion measures in controls, in stenotic regions and in non-stenotic regions. Further examination revealed that the eigenvector orientation approach included signal from CSF and hence gave artifactual results.

2457. Optimization of Reduced Field of View (RFoV) Quantitative Diffusion MRI in Thoracic Spine

David Michael Thomasson[1], Leor Zach[2], Laura Elizabeth Danielian[3], Peter Guion[2], Yuxi Pang[4], Dimitrios Alexopoulos[1], Nicholas John Patronas[1]
[1]Radiology and Imaging Sciences, National Institutes of Health, Bethesda, MD, United States; [2]Radiation Oncology Branch, National Cancer Institute, Bethesda, MD, United States; [3]EMG Section, National Institute of Neurological Disorders and Stroke, Bethesda, MD, United States; [4]BU - MR, Philips Healthcare, Cleveland, OH, United States

Reduced Field of View rFoV diffusion weighted imaging techniques improve quantitative ADC and FA data for sagittal acquired thoracic spine imaging at 3Tesla relative to 1.5T. While lower field has less distortions limiting the necessity of such techniques, the reduced SNR at 1.5T makes them less desirable using clinically acceptable scan times. Here we optimize the rFoV technique in thoracic spine to obtain the best possible data in a clinical population.

2458. Toward Reproducible Tract-Specific in Vivo Diffusion Quantification in Human Cervical Spinal Cord

Junqian Xu[1], Eric C. Klawiter[1], Joshua S. Shimony[2], Abraham Z. Snyder, [12], Robert T. Naismith[1], Agus Priatna[3], Tammie Benzinger[2], Anne Cross[1], Sheng-Kwei Song[2]
[1]Neurology, Washington University in St. Louis, St. Louis, MO, United States; [2]Radiology, Washington University in St. Louis, St. Louis, MO, United States; [3]Siemens Medical Solution, United States

We describe a reproducible in vivo human cervical spinal cord diffusion tensor imaging (DTI) protocol at 3T. The data acquisition and analysis procedures are described with examples from healthy (n = 17) and pathological human spinal (n = 2) cords. The described comprehensive approach (1) accounts for the natural curvature of the human spinal cord by covering C1-6 with separate

tiltable slices/groups, (2) minimizes distortion and signal drop-out by localized shimming, (3) improves the robustness by motion-correction and motion-based outlier rejection, (4) corrects negative eigenvalues by non-negative non-linear DTI calculation, and (5) employs objective geometry based region-of-interest selection for tract identification.

2459. Stimulus Site and Modality Dependence of Functional Activity Within the Human Spinal Cord

Yazhuo Kong[1], Michael Lee[2], Catherine Warnaby[1], Vishwani Wanigasekera[1], Mark Jenkinson[1], Irene Tracey[1], Jonathan Brooks[1]

[1]FMRIB centre, Department of Clinical Neurology, University of Oxford, Oxford, Oxfordshire, United Kingdom; [2]Division of Anaesthesia, University of Cambridge, Cambridge, United Kingdom

Chronic pain is thought to arise due to maladaptive changes occurring at the level of the spinal cord. To investigate such changes in humans, a non-invasive neuroimaging technique is desirable. We have investigated the functional response in the spinal cord of 18 healthy subjects to noxious stimulation using punctate and thermal stimulation of the left and right arms. Group analysis, revealed distinct regions of activity within the spinal cord that were dependent on both the side of stimulation and the type of stimulus used. These results present the first non-invasive evidence for a lateralised and stimulus-specific spinal cord response.

2460. Quantitative Magnetization Transfer Imaging of Human Cervical Spinal Cord at 3T

Richard D. Dortch[1,2], E B. Welch[2,3], John C. Gore[1,2], Seth A. Smith[1,2]

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The goal of this study was to determine the feasibility of performing quantitative magnetization transfer (qMT) at high resolution in the spinal cord on clinical 3T systems. While MT imaging has been used to assess brain tissue microstructure, similar studies in the spinal cord have been limited due to high resolution demands and motion. Presumably, spinal cord qMT studies would benefit from the increased SNR at 3T; however, such studies are limited by SAR constraints. To address these issues, we developed a high resolution qMT imaging protocol of the cervical spinal cord at 3T and acquired data in healthy subjects.

2461. Fast Simultaneous Acquisition of High-Resolution Brain and Cervical Spinal Cord T1w Images to Measure Spinal Cord Atrophy: Methods and Validation

Patrick Anton Bruno Freund[1,2], Catherine Dalton[3], Claudia Angela Michela Wheeler-Kingshott[3], Janice Glensman[1], David Bradbury[1], Alan James Thompson[2], Nikolaus Weiskopf[1]

[1]Wellcome Trust Centre for Neuroimaging, UCL Institue of Neurology, London, United Kingdom; [2]Brain Repair and Rehabilitation, UCL Institue of Neurology, London, United Kingdom; [3]Neuroinflammation, UCL Institue of Neurology, London, United Kingdom

We have developed and validated a method for fast, simultaneous and high-quality imaging of the brain and cervical spinal cord (< 14 mins., 1 mm isotropic resolution) with the potential to detect, besides volumetric changes at cortical level, also changes at cervical level. It is based on a 3D MDEFT scan using an 8-channel receive head coil. Measures of cross sectional cord area, obtained with the MDEFT-based method, are in good agreement with the established standard based on 3D MPRAGE scans with dedicated spine coils, as determined in a group of healthy controls and subjects with traumatic cervical spinal cord injury.

2462. Magnetic Resonance Spectroscopy of the Cervical Spine in ALS and Pre-Symptomatic SOD1 Positive People

John D. Carew[1,2], Govind Nair[3], Sharon Usher[4], Xiaoping P. Hu[3], Michael Benatar[4]

[1]Carolinas HealthCare System, Charlotte, NC, United States; [2]Biostatistics and Bioinformatics, Emory University, Atlanta, GA; [3]Biomedical Engineering, Emory University; [4]Neurology, Emory University

We studied MRS in the cervical spinal cord of amyotrophic lateral sclerosis (ALS) patients, healthy controls, and people with a mutation in the SOD1 gene. Single voxel PRESS/CHESS MRS was used to measure NAA, choline, creatine, and myo-inositol. We found metabolic changes in both ALS and people positive for the SOD1 mutation. Among ALS patients, metabolite ratios correlate with clinical measures of disease severity. The findings in the SOD1 positive sample suggests that metabolic changes occur prior to the onset of clinical symptoms.

2463. In Vivo MR Spectroscopic Changes in the Brain and Spinal Cord After Experimental Spinal Cord Injury in Rats

Johanna Oberg[1], Matthias Erschbamer[2], Rouslan Sitnikov[1], Eric Westman[3], Christian Spenger[1], Lars Olson[2]

[1]CLINTEC, Karolinska Institutet, STOCKHOLM, Sweden; [2]Neuroscience, Karolinska Institutet, Sweden; [3]NEUROTEC, Karolinska Institutet, Sweden

A variety of tests of sensorimotor function are used to characterize outcome after experimental spinal cord injury (SCI). These tests, however, do not provide information about chemical and metabolic processes in the injured CNS. Here, proton magnetic resonance spectroscopy (MRS) was used to monitor chemical changes in CNS (brain and spinal cord) in vivo following SCI. Significant differences were found between control rats and injured rats. Multivariate data analysis was applied. Our findings suggest that MRS is a helpful tool to monitor metabolic changes in vivo in the brain and the spinal cord itself after spinal cord injury.

2464. High-Field in Vivo 1H-MR Spectroscopy of the Injured Mouse Spinal Cord. Feasibility and Potentiality.

Virginie Callot[1], Guillaume Duhamel[1], Mohamed Tachrount[1], Yann Le Fur[1], Patrick J. Cozzone[1]

[1]Centre de Résonance Magnétique Biologique et Médicale (CRMBM), CNRS, UMR 6612, Faculté de Médecine, Marseille, France

Non invasive investigations of the mouse spinal cord pathologies are currently based on anatomic and diffusion MRI. In this work, we investigated whether high-field MR Spectroscopy would be able to provide complementing biochemical information useful to describe the lesion and the repair processes. This preliminary study demonstrates the feasibility of longitudinal follow-ups with localized 1H-MRS in injured mouse spinal cord.

2465. In Vivo MR High Resolution T1rho Mapping of the Spine at 3T Using a Reduced-FOV Approach

Ajit Shankaranarayanan[1], Emine U. Saritas[2], Dwight G. Nishimura[3], Weitian Chen[1], Eric Han[1]

[1]Global Applied Science Lab, GE Healthcare, Menlo Park, CA, United States; [2]Dept of Electrical Engineering, Stanford University, Palo Alto, CA, United States; [3]Dept of Electrical Engineering, Stanford University, Palo Alto, CA, United States

It has been suggested that MR T1ñ relaxation time may potentially be valuable to assess proteoglycan (PG) loss in the early stages of disc degeneration, a known cause for back pain. Previous T1ñ mapping techniques have shown this to be true. However, clinical applicability of these techniques in spine is somewhat limited by either long scan time, lower resolution or insufficient coverage. This work aims to overcome these limitations by applying reduced-FOV technique, previously shown for diffusion imaging to T1ñ imaging. In vivo experiments have been performed on 3T to show the usefulness of such a targeted approach in terms of higher resolution and shorter scan times while providing good coverage in spine.

2466. Ultrashort TE Imaging After Percutaneous Vertebroplasty

Akio Hiwatashi[1], Takashi Yoshiura[1], Koji Yamashita[1], Hironori Kamano[1], Hiroshi Honda[1]

[1]Clinical Radiology, Kyushu University, Fukuoka, Japan

uTE is feasible to evaluate cement distribution after percutaneous vertebroplasty

2467. Bone Marrow Perfusion Magnetic Resonance Imaging in Patients with Osteoporotic Vertebral Compression Fractures: Peak Enhancement Ratio Is an Independent Predictor for Intraosseous Vacuum Phenomena

Wei-Che Lin[1,2], Hsiu-Ling Chen[1], Yu-Fan Cheng[1], Chun-Chung Lui[1]

[1]Department of Diagnostic Radiology, Chang Gung Memorial Hospital - Kaohsiung Medical Center, Chang Gung University College of Medicine, Kaohsiung, Taiwan, Taiwan; [2]Department of Biomedical Imaging and Radiological Sciences, National Yang-Ming University, Taipei, Taiwan, Taiwan

Decrease bone marrow perfusion as reflected by lower peak enhancement ratio (PER) value in dynamic contrast-enhanced MRI (DCE-MRI) can independently predict the presence of intraosseous cleft in patients with osteoporotic vertebral compression fractures.DCE-MRI can help distinguish the more frail patients after VCF suitable for more tailored anti-osteoporotic therapy and can also identify delicate osteoporotic patients for advance treatment before an injury can occur.

2468. Quantitative Assessment of the Cervical Spinal Cord Damage in Neuromyelitis Optica Using Diffusion Tensor Imaging at 3T

Wenshu Qian[1], Henry Mak[1], Queenie Chan[2], Koon Ho Chan[3], Mina Kim[1]

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Neuromyelitis optica (NMO) is an inflammatory and demyelinating disease which consists of optic neuritis and myelitis. Since it usually involves acute and severe attacks, early diagnosis is of vital importance for proper treatment. However, current diagnostic imaging techniques are not sensitive to degenerative changes in early stage of NMO. In this study, we aimed to investigate the normal appearing cervical spinal cord damage in patients with NMO using diffusion tensor imaging (DTI). Our results show DTI-derived metrics can sensitively assess the microstructural abnormalities, suggesting DTI may have great potential as a useful diagnostic tool in detecting early stage of NMO.