Electronics Posters: Neuroimaging

Advanced Imaging of Spine
Hall B Monday 14:00-16:00 Computer 71

14:00 4230 Magnetization Transfer MRI Measurements of Cervical Spinal Cord Abnormalities in Patients with Neuromyelitis Optica
Mina Kim1, Aaron Chan1, Henry Mak1, Queenie Chan2, Koon Ho Chan3
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Diagnosing neuromyelitis optica (NMO) in the early stages is crucial in order to provide the proper treatment as it involves aggressive and severe attacks of blindness and paralysis. However, current diagnostic criteria in routine practice using conventional techniques are not sensitive to early abnormalities in NMO. In the present work, we conducted magnetization transfer (MT) imaging for NMO patients. Our results show that it is feasible to assess NMO cervical cord damage of normal appearing tissues using the quantitative capability of MT imaging, which may lead to a better understanding of the clinical manifestations in NMO.

14:30 4231 Diffusional Kurtosis Imaging of the Cervical Spinal Cord in Multiple Sclerosis Patients
Maxim Bester1,2, Eric Sigmund1, Ali Tabesh1, Hina Jaggi1, Matilde Inglese3,4, Robin Mitnick1
1Radiology, New York University, New York, NY, United States; 2Neuroradiology, Eppendorf-Hamburg University, Hamburg, Germany; 3Radiology, New York University, New York, NY, United States; 4Neurology, New York University, New York, NY, United States

Spinal cord (SC) is a frequent and clinically relevant site of pathology in multiple sclerosis (MS). Diffusion kurtosis imaging (DKI) measures non-Gaussian water diffusion and DKI-derived mean kurtosis (MK) is an index of tissue microstructural complexity. Using a moderately expanded diffusion sampling scheme, MK can be obtained simultaneously with DTI metrics. The aim of this study was to investigate global and regional structural abnormalities in the cervical SC of MS patients using both DKI and DTI. Compared to controls, fractional anisotropy and MK were significantly decreased and mean diffusivity was increased in patients. MK was significantly associated to disability.

15:00 4232 Radial Fractional Anisotropy Mean and Radial Mean Diffusivity Mean: New Metric in the Study of Spinal Cord Tissue
Arturo Cardenas-Blanco1,2, Eve Chung Tsai3,4
1Radiology, Ottawa Hospital Research Institute, Ottawa, Ontario, Canada; 2Cellular and Molecular Medicine, University of Ottawa, Ottawa, Ontario, Canada; 3Neurosurgery, The Ottawa Hospital, Ottawa, Ontario, Canada; 4Cellular and Molecular Medicine, University of Ottawa, Ottawa, Ontario, Canada

Diffusion Tensor Imaging (DTI) and its ability to delineate the motion of water molecules and subsequently white matter tracts has become more important during the last years in the study of spinal cord. Nevertheless, due to the lack of resolution and the poor signal to noise ratio, it is still one of the big challenges in clinical MR research. In this abstract a new approach to quantitatively assess SC tissue is presented. This new approach is based in the combination of quantitative information obtained from DTI; Fractional Anisotropy (FA) and Mean Diffusivity (MD); taking advantage of the singular geometry of the SC.

15:30 4233 T1 and T2 Mapping of the Human Cervical Spinal Cord at 3 Tesla
Maxim Bester1,2, Matilde Inglese1, Lazar Fleisher1
1Radiology and Neurology, New York University, New York, NY, United States; 2Eppendorf-Hamburg University, Hamburg, Germany

The cervical spinal cord (SC) is a frequent site of pathology in several neurological diseases. We measured the T1 and T2 relaxation times of the human SC using a 3-point GRE T1 mapping method with built-in B1-correction and spin-echo sequence with protocol optimization based on 2-point measurements of T2s respectively. The T1 relaxation times measured in our study were lower and the T2 relaxation values were higher than those reported previously. The latter might be explained by the fact that undesired diffusion weighting may be introduced by use of the TSE sequence leading to a decrease in T2 values.
Clinical applications of functional MRI of the spinal cord, in order to assess the effects of spinal cord trauma or disease, must provide sensitive and reliable results, even in the presence of fixation devices to stabilize the spine, and must meet practical time limitations while providing enough information to be diagnostic. Here we demonstrate detailed functional maps in response to stimulation on the right and left sides of the body, at spinal cord segmental levels above and below the level of injury, in spinal cord injured patients. The method is almost fully automated, and takes under 7 minutes.

The application of high-resolution cardiac phase resolved MRI (CINE) to directly visualize arachnoid adhesions for improved intervention planning in syringomyelia was investigated. It could be shown that high-spatial resolution (250µmx500µmx2mm) combined with 30 cardiac phases enabled direct visualization and quantification of the arachnoid adhesions. The position of the adhesions was verified during the intervention and post-interventional MRI was performed for assessment of the structure of the arachnoid adhesion after the microsurgical adhesiolysis procedure.

Adolescent Idiopathic Scoliosis (AIS) is defined as a lateral spinal curvature greater than 10° accompanied by vertebral rotation and has no clear underlying causes. Traditionally AIS was evaluated using standing radiographs of the full spine to assess lateral curvature with the Cobb method, but it is on 2D coronal plane-only evaluating system, ignoring the 3D nature of AIS. MRI and computer-generated 3D images is a noninvasive procedure which could be used to assess the functional morphology in spine. To validate the hypothesis of disproportional growth between neural and skeletal system a MRI study was performed in 149 AIS patients and 41 age-matched controls.

Purpose of this study is to investigate the use of high b-value q-space imaging (QSI) to evaluate spine and spinal cord lesions in vivo, with the use of mean displacement (MD) maps, as feasibility study. In results, various MD values were measured in the lesions. Moreover, MD maps were not apparently well correlated with corresponding apparent diffusion coefficient maps of DWI with b-values of 1000 s/mm². This technique has potential to provide new information in addition to conventional sequences in routine clinical study.
Fully Automated Straightening of the Spinal Cord Using Fiber Tractography

Demian Wassermann1, Julien Cohen-Hadad2,3, Stephane Lehericy4, Habib Benali5, Serge Rossignol6, Rachid Deriche1

1INRIA, Sophia-Antipolis, PACA, France, Metropolitan; 2Athinoula A. Martinos Center for Biomedical Imaging, MGH, Harvard Medical School, Charlestown, MA, United States; 3UMRS 678, Laboratoire d'Imagerie Fonctionnelle, Inserm, UPMC Univ Paris 06, Paris, Ile-de-France, France, Metropolitan; 4Center for NeuroImaging Research, Pitie Salpetriere Hospital, UPMC Univ Paris 06, Paris, Ile-de-France, France; Inserm, UPMC Univ Paris 06, UMRS 678, Laboratoire d'Imagerie Fonctionnelle, Paris, Ile-de-France, France; 6Groupe de recherche sur le Système Nerveux Central, Département de Physiologie, Université de Montréal, Montreal, Quebec, Canada

Spinal Cord MRI (SC-MRI) is a challenging research field with numerous important clinical and basic research applications. Some of the SC-MRI applications strongly need to deal with a well straightened spinal cord either for appropriate methodological developments, for better visualization or diagnostic purposes. In this article, we develop an efficient and automatic method to straighten the spinal cord image and fibres. Diffusion Tensor MRI is first used to recover by tractography the bundles of fibres related to the spinal cord. An efficient Gaussian process framework is then used to automatically recover in a robust way the most representative fibre which is used to interpolate and straighten the spinal cord image and fibres. Our method is successfully tested on real images of one cat with partial spinal cord injury and two healthy volunteers. This capability to reliably reconstruct straightened animal and human spinal cord opens new opportunities for SC-MRI applications.

Susceptibility Weighted Imaging: A New Tool in Detecting Hemorrhage in Spinal Cord Injury

Meiyun Wang1, Yongming Dai2, Qing Lin, Yanhong Han, Man Wang, E Mark Haacke3, Zhen Wu, Dapeng Shi

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We aimed to evaluate the role of SWI in detecting hemorrhage in spinal cord injury (SCI). Eighteen patients with a history of acute cervical spine trauma and 20 volunteers were enrolled in this study. SWI showed hemorrhage in 4 patients, which was not demonstrated on conventional MRI; 4 of 18 had intramedullary hemorrhage, which was proved by SWI and neurosurgery. So we conclude SWI is an invaluable tool for visualizing hemorrhage in SCI compared to conventional MRI methods.

DCE-MRI and DW-MRI in Characterization of Spinal Metastasis

David H. Gultekin1,2, Hebert A. Vargas Alvarez3, Cecilia Wassberg4, Jason A. Koutcher1, Yoshiya Yamada5, Eric Lis6, Sasan Karimi2, Lawrence H. Schwartz7

1Medical Physics, Memorial Sloan-Kettering Cancer Center, New York, United States; 2Radiology, Memorial Sloan-Kettering Cancer Center, New York, United States; 3Radiology, Sloan-Kettering Institute, New York, United States; 4Radiology, Sloan-Kettering Institute, Memorial Sloan-Kettering Cancer C, New York, United States; 5Radiation Oncology, Memorial Sloan-Kettering Cancer Center, New York, United States

The combination of DCE-MRI and DW-MRI in the assessment of metastatic cancer of various primaries (breast, prostate, melanoma, colorectal, papillary thyroid, RCC and NSCLC) in the spine has been evaluated for treatment response monitoring in patients undergoing radiotherapy.

Fast Spin-Echo Triple Echo Dixon: Initial Clinical Experience with a Novel Pulse Sequence for Simultaneous Fat Suppressed and Non Fat Suppressed T2-Weighted Spine Mr Imaging

Russell Norman Low1,2, Matthew J. Austin3, Jingfei Ma4

1Sharp and Children's MRI Center, San Diego, CA, United States; 2San Diego Imaging, San Diego, CA, United States; 3Radiology, University of California at San Diego, San Diego, CA, United States; 4Department of Imaging Physics, The University of Texas MD Anderson Cancer Center, Houston, TX, United States

We evaluate a novel Dixon based FSE sequence (fTED) for spine imaging that efficiently provides T2 weighted imaging with and without fat suppression in a single acquisition. Compared to STIR images the fTED water images showed equal homogeneity of fat suppression with less motion artifact, sharper anatomic detail, and less susceptibility artifact. The T2 fTED images without fat suppression were equivalent to T2 FRFSE images for lesion detection. fTED provides T2 imaging of the spine with and without fat suppression with a 56% savings in scan time compared to STIR and T2 FRFSE imaging.
We present a BOLD signal fractal dimension (FD) mapping approach to assess the tissue microvascular environment in Alzheimer's dementia. The periodicity or temporal complexity can be quantified using this method thus allow insight into the underlying microvascular processes. Alzheimer’s Disease (AD) is associated with regional hypermicrovascularity, especially in the deep grey matter. Furthermore our BOLD FD was inversely correlated to our MRS measures of total creatine.

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behavioral variants of frontotemporal dementia (bvFTD), semantic dementia (SD) and progressive nonfluent aphasia (PNFA) are three major clinical subtypes of frontotemporal lobar degeneration (FTLD). In this study, cross-sectional and a preliminary longitudinal diffusion tensor imaging (DTI) analyses were performed in 12 bvFTD, 6 SD, 6 PNFA, and 19 healthy control (CN) subjects. Cross-sectional analysis revealed bvFTD is associated with a characteristic pattern of fractional anisotropy (FA) reductions in the frontal and temporal regions, SD predominantly affects the uncinate fasciculus, and PNFA affects the left arcuate fasciculus. Preliminary longitudinal analysis suggests that DTI captures disease progression in FTLD.

Automated segmentation of cortical and subcortical gray matter structures for evaluation of Alzheimer's disease and fronto-temporal dementia

Emil Malucelli1, David Neil Manners1, Claudia Testa2, Caterina Tonon2, Giovanni Rizzo1, Roberto Poda1, Federico Oppi1, Michelangelo Stanzani Maserati3, Luisa Sambati1, Bruno Barbirelli2, Roberto Gollas1, Raffaele Lodi2

1Department of Internal Medicine, Aging and Nephrology, University of Bologna, Bologna, Italy; 2Department of Internal Medicine, Aging and Nephrology, University of Bologna, Bologna, Italy; 3Department of Neurological Sciences, University of Bologna, Bologna, Italy

Objectives: To assess the ability of combined MR cortical structure volumetry and DTI to automatically detect regional brain changes in patients with Alzheimer disease (AD) and Frontotemporal dementia (FTD). Methods: 9 AD patients, 7 FTD patients and 7 controls were studied by 3D volumetric and DW MR imaging. An automated registration/segmentation pipeline defined cortical and subcortical regions of interest, yielding structure volumes and mean diffusivity. Results: Diffuse volume reductions and MD increases were found in both patient groups compared to controls. Conclusions: the protocol described has the potential to identify in vivo surrogate markers for brain pathologic changes in neurodegeneration.

Tuesday 13:30-15:30  Computer 72

DTI measurements of neurodegeneration in early Alzheimer's disease: a corpus callosum study

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1Wolfson Brain Imaging Centre, Department of Clinical Neurosciences, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; 2Neurology Unit, Department of Clinical Neurosciences, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom

The splenium and genu of the corpus callosum (CC), which contain millions of inter-hemispheric fibres, were found to be abnormal in early AD. In this study, we analysed the behaviour of several DTI measures in the subregions of the midline CC and assessed their
relationship with global cognitive data. We found that in both splenium and genu, axial and mean diffusion were better predictors of the disease, whereas radial diffusion and particularly, fractional anisotropy exhibited strong correlations with cognitive performance in the splenium only. The results suggest that the neurodegenerative processes affecting the splenium are different than in the genu.

14:00  **4247. Functional Connectivity and Psychometrics as Early Biomarkers for Alzheimer’s Disease**

Partick Rich¹, Huiling Peng², Jewell Thomas³, Joseph Mettenburg³, Tamnie Benzinger³, John Morris⁴, David Balota¹, Beau Ances⁵

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This project investigated early biomarkers of Alzheimer’s disease (AD). In particular, we studied the relationship between psychometrics (the Stroop task) and blood oxygen level dependent resting state functional connectivity magnetic resonance imaging (BOLD-fcMRI). We observed significant differences in BOLD-fcMRI correlations between subjects with high and low COV subjects with both being early markers for individuals at risk for AD.

14:30  **4248. Structural and White Matter Changes in Patients with Dementia: Comparative FDG-PET and MRI Studies**

Elena Gerasimovitch Steffensen¹, Vineet Prakash², Simon Fristed Eskildsen³, Karsten Vestergård⁴, Victor Vishwanath Iyer⁵, Elna-Marie Larsson¹

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Introduction: Volumetry and evaluation of WM damage is used to characterization of dementia. Purpose: To investigate whether cortical/hippocampal volumetry, measurement of mI- and NAA-concentration or FA and ADC is preferable in classification of dementia. Method: 3T protocol: 3D T1-weighted imaging; 1H-spectroscopy and DTI in 34 patients. 18FDG-PET: 9 FTD patients; 9-AD, 2- normal PET. Results: Thinner cortex and higher ratio of ml/NAA was seen in posterior cingulate cortex (PCC) for AD (p<0.05). FA was lower and ADC higher in FTD. Conclusion: WM abnormalities have a potential to facilitate classification of dementia. PCC may be chosen as a region of investigation.

15:00  **4249. Are Behavioural Symptoms of Alzheimer’S Disease Directly Associated to Neurodegeneration?**

Laura Serra¹, Roberta Perri², Mara Cercignani¹, Barbara Spano²,³, Lucia Fadda²,⁴, Camillo Marra², Giovannio Augusto Carlesimo²,⁴, Carlo Caltagirone²,⁴, Marco Bozzali¹

¹Neuroimaging laboratory, Fondazione IRCCS Santa Lucia, Roma, Italy; ²Department of Clinical and Behavioural Neurology, Fondazione IRCCS Santa Lucia, Roma, Italy; ³Department of Neurosciences, University of Rome ‘Tor Vergata’, Roma, Italy; ²Department of Neurology, Università Cattolica, Roma, Italy

Psychiatric symptoms (BPSD) are frequently observed in the clinical course of Alzheimer’s disease (AD). We used voxel-based morphometry to identify, in a large cohort patients with AD at different clinical stages, which BPSD are more significantly associated with regional gray matter degeneration. Correlation analyses showed an association between disinhibition and GM volumes in the cingulate gyrus bilaterally, and in the right middle frontal gyrus, and between delusions and GM volume of the right hippocampus and parahippocampal gyrus, and of the right middle frontal gyrus. These findings indicate that BPSD are likely part of the clinical features of AD.

**Wednesday 13:30-15:30  Computer 72**

13:30  **4250. Retrospective Distortion Correction Using the ADNI Phantom to Salvage Unusable Exams**

Bogdan Dzyubak¹, Jeffrey L. Gunter¹, Edward Brian Welch¹, Ron J. Killiany¹, Clifford R. Jack¹, Matt A. Bernstein¹

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During the Alzheimer’s Disease Neuroimaging Initiative (ADNI) multicenter study, a laser alignment light was mis-calibrated on one scanner, leading to a displacement error in the isocenter location used during image reconstruction. Consequently, the standard gradient distortion correction was inaccurate and the resulting data were unusable for longitudinally tracking brain changes. Off-line processing was used to remove the aberrant distortion correction from ADNI phantom data, then those images were shifted by a variable displacement, and finally the images were re-corrected for gradient distortion. The actual displacement error was determined by this method and the subject data could be re-corrected and salvaged.
14:00 4251. Findings of Nonlinear Behaviors of Log-Signal Intensities on DTI in Patients with Alzheimer’s Disease

Geon-Ho Jahng1, Songfan Xu2, Chang-Woo Ryu3, Dal-Mo Yang1, Dong-Wook Sung3, Dong Ho Lee1, Seungjoon Park4
1Radiology, East West Neo Medical Center, Kyung Hee University, Seoul, Korea, Republic of; 2Biomedical Science, Graduate School of Medicine, Kyung Hee University, Seoul, Korea, Republic of; 3Radiology, KHU Hospital, Kyung Hee University, Seoul, Korea, Republic of; 4Pharmacology and Biomedical Science, School of Medicine, Kyung Hee University, Seoul, Korea, Republic of

Proposing Calculation of Voxel-based B-values on DTI in Patients with Alzheimer’s Disease

14:30 4252. Early and Late Onset Alzheimer’s Disease Patients Have Distinct Patterns of White Matter Damage

Elisa Canu1, Federica Agosta1, Michela Pievani1,2, Giovanni B. Frisoni3, Massimo Filippi1
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SPM5 and the DARTEL method were used to perform a VBM analysis to assess WM differences in 14 early onset AD (EOAD) and 15 late onset AD (LOAD) vs. age- and gender-matched healthy controls (HC). Compared to HC, in EOAD patients, WM loss was mapped mainly to the posterior regions such as the posterior cingulum and the lateral parietal regions, bilaterally. In LOAD patients, WM loss was confined to the medial temporal lobe in the parahippocampal regions. Our findings indicate that EOAD and LOAD patients differ in the topography of WM damage, which reflects the pattern of cortical loss.

15:00 4253. The Diffusivity Pattern of White Matter Degeneration in Semantic Dementia Is Spatially and Qualitatively Different from Alzheimer’s Disease

Julio Acosta-Cabronero1, George Pengas2, Guy B. Williams1, Peter J. Nestor2
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The diffusion profile in semantic dementia (SD) was studied to examine the profile of connection changes. Tract-based spatial statistics in SD patients provided compelling evidence that the network is distinct to that of Alzheimer’s disease (AD), and indicated that the key abnormality exiting the temporal lobe was in the uncinate fasciculus projection to the orbital frontal lobe. The tensor behaviours also indicated that the nature of the neurodegenerative in SD differs qualitatively from that seen in AD.

Thursday 13:30-15:30 Computer 72

13:30 4254. MRI-Derived, ROI-Based Whole-Brain Comparison of FDG- And PIB-PET in Prodromal and Mild Alzheimer's Disease

David S. Karow1, Linda K. McEvoy1, Christine Fennema-Notestine2, Donald J. Hagler, Jr.1, James B. Brewer, 1,3, Carl K. Hoh1, Anders M. Dale, 1,3
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14:00 4255. Lateral Ventricle Segmentation Based on Fusion of Expert Priors in AD

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Measurement of lateral ventricular volume is often used for measuring the progression of neurodegenerative diseases. Existing techniques for ventricle segmentation have been extensively validated for the normal population, but may be suboptimal for the patients with Alzheimer’s Disease (AD), for example. We propose an automated method which uses information from expert manual segmentation combined with a population-specific atlas. Experiments were completed with a group of 271 elderly patients from an ongoing clinical trial, using manual segmentations as a gold standard. We found that proposed algorithm yields accurate results with a median kappa of 0.962.
Assessment of White Matter Tract Damage in Mild Cognitive Impairment and Alzheimer’s Disease

Michela Pievani1,2, Federica Agosta1, Elisabetta Pagani1, Elisa Canu3, Stefania Sala1, Martina Absinta1, Cristina Geroldi1, Rossana Ganzola1, Giovanni B. Frisoni1, Massimo Filippi1
1Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; 2IRCCS Centro San Giovanni di Dio - Fatebenefratelli, Brescia, Italy; 3IRCCS Centro San Giovanni di Dio - Fatebenefratelli IRCCS Centro San Giovanni di Dio - Fatebenefratelli, Brescia, Italy

DT-MRI tractography was used to investigate MD, FA, axial (DA) and radial (DR) diffusivities changes in limbic and cortico-cortical (CCT) WM tracts in 25 patients with Alzheimer’s disease (AD), 19 with amnestic mild cognitive impairment (aMCI), and 15 controls. AD showed increased MD in CCT and cingulum, and reduced FA in fornix. Both patient groups showed increased DA in CCT and DR in the fornix. In AD and aMCI, limbic tracts showed a greater increase in DR vs. DA. Hippocampal volumes correlated with fornix DA. This study suggests different pattern of WM involvement in the limbic and CCT in AD.

2D L-COSY MR Spectroscopy Detects Very Early Changes in the Brain of Alzheimer Mouse

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Proton magnetic resonance spectroscopy (MRS) provides a non-invasive way to investigate in vivo neurochemical abnormalities of many brain disorders. However, its role in finding very early and specific metabolic changes as biomarkers for Alzheimer’s disease (AD) has not yet been established. In the present study we employed, for the first time, localized 2D L-COSY MRS in young wild-type and transgenic APP/PS1 mouse model of AD to probe specific early metabolic changes during AD. Our results provide an important indication of early neurochemical changes that take place before Aβ plaque formation in these transgenic mice.

Echo Planar Spectroscopic Imaging in Patients with Amyotrophic Lateral Sclerosis

Sanjeev Chawla1, Sumei Wang1, Sulaiman Sheriff2, John H. Woo1, Lauren Elman3, Leo F. McCluskey4, Murray Grossman1, Elias R. Melhem1, Andrew Maudsley1, Harish Poptani1
1Radiology, University of Pennsylvania, Philadelphia, PA, United States; 2Radiology, University of Miami, Miami, FL, United States; 3Neurology, University of Pennsylvania, Philadelphia, PA, United States

The purpose of this study was to evaluate the potential of echoplanar spectroscopic imaging (EPSI) in assessing metabolic alterations beyond the motor cortex of ALS patients. NAA/Cr and Cho/Cr were measured from the precentral gyrus (PreCG), postcentral gyrus (postCG) and internal capsule (IC) and compared to Occipital region (OR) as an internal control. Significant reductions in NAA/Cr were observed from the preCG and IC from both the hemispheres. Significantly higher Cho/Cr ratios were also observed from the preCG, postCG and IC regions indicating that metabolic abnormalities in ALS extend beyond the motor cortex that can be observed using EPSI.

Study on Gray and White Matter Changes in ALS with Voxel-Based Morphometry Using DARTEL

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Standard VBM (VBM-STANDARD) has demonstrated gray and white matter loss in ALS. In order to evaluate the efficacy of VBM with DARTEL algorithm (VBM-DARTEL), both VBM-DARTEL and VBM-STANDARD were performed in ALS. High resolution images were acquired from 30 ALS patients and 30 controls. ALS was subclassified into ALS/MCI and ALS/CN, and ALS/Bulbar and ALS/Limb. VBM-DARTEL revealed more gray and white matter deficits than VBM-STANDARD. With VBM-DARTEL, gray matter loss was also detected in ALS/MCI compared with ALS/CN, and gray and white matter deficits in ALS/Limb compared with ALS/Bulbar. VBM-DARTEL was more accurate than VBM-STANDARD in performing volumetric studies.

Whole-Brain Proton MRSI in ALS: Changes in the Distribution of Metabolites by Brain Lobes and Tissue Types

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Whole-brain proton MRSI data acquired at 3T from groups of definite-ALS and control subjects were analyzed by brain hemispheric lobes and parenchymal constituent tissue-types (white matter and gray matter). The metabolite ratios, NAA/Cr and Cho/NAA, in the
white matter showed significant and widespread alterations throughout the brain of ALS patients. In the gray matter of the ALS group, significant differences were found in the left frontal- and left parietal lobes for NAA/Cr, and bilateral frontal lobe for Cho/NAA.

**15:30**  
**4261.** Brain DT MRI Predicts the Long-Term Clinical Evolution in Amyotrophic Lateral Sclerosis: A 3.4 Year Follow Up Study  
*Federica Agosta*, *Elisabetta Pagani*, *Melissa Petrolini*, *Maria Pia Sormani*, *Domenico Caputo*, *Michele Perini*, *Alessandro Prellè*, *Fabrizio Salvi*, *Massimo Filippi*  
1Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; 2Unit of Biostatistics, DISSAL, University of Genoa, Genoa, Italy; 3Department of Neurology, Scientific Institute Fondazione Don Gnocchi, Milan, Italy; 4Department of Neurology, Ospedale di Gallarate, Gallarate, Italy; 5Dino Ferrari Center, Department of Neuroscience, University of Milan, Milan, Italy; 6Department of Neurology, Ospedale di Bellaria, University of Bologna, Bologna, Italy

We investigated whether corticospinal tract (CST) DT-MRI changes contribute to the prediction of long-term clinical evolution in patients with amyotrophic laterals sclerosis (ALS). Conventional and DT-MRI were obtained in 24 ALS patients, who were followed prospectively for 3.4 years. Compared with controls, ALS patients showed increased MD and decreased FA of the CST. Shorter disease duration and lower CST FA were associated with disability worsening. Bulbar-onset and CST FA were independent predictors of time to death in ALS patients. More severe DT-MRI abnormalities in the CST predicted a poorer clinical outcome after a 3.4 year follow up in ALS patients.

**Tuesday 13:30-15:30**  
**Computer 73**

**13:30**  
**4262.** Altered Functional Connectivity of the Motor Network in Multiple System Atrophy  
*Feng Feng*, *Hui You*, *Han Wang*, *Fuling Zheng*, *Chunling Meng*, *Jue Wang*, *Yufeng Zang*  
1Radiology, Peking Union Medical College Hospital, Beijing, China; 2Neurology, Peking Union Medical College Hospital, Beijing, China; 3State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China

MSA is mainly a sporadic neurodegenerative disease. Besides abnormalities of nigrostriatal pathway, the typical pathological findings were also described in primary motor and supplementary motor cortices. We hypothesize that there is associated disturbance of functional connectivity of the motor cortex in MSA patients. To test the hypothesis, resting-state functional MRI was used to measure the coherent spontaneous fluctuations in the blood oxygenation level-dependent signal. Our results showed regional homogeneity changes in left precentral gyrus, right precuneus, supramarginal gyrus and middle frontal gyrus, indicating functional connectivity disturbance of motor-related circuits and left-sided predominance of primary motor cortex involvement.

**14:00**  
**4263.** The Topographical Distribution of White Matter Damage in Parkinson’s Disease and Progressive Supranuclear Palsy  
*Federica Agosta*, *Sebastiano Galantucci*, *T Stojkovic*, *A. Tomic*, *Igor Petrovic*, *Giulia Longoni*, *Vladimir Kostić*, *Massimo Filippi*  
1Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; 2Department of Neurology, School of Medicine, University of Belgrade, Belgrade, Serbia

Using TBSS, we investigated WM changes in 39 Parkinson’s disease (PD) patients, 20 progressive supranuclear palsy (PSP) patients (10 Richardson’s syndrome [PSP-RS] and 10 PSP-Parkinsonism [PSP-P]), and 26 controls. PSP-RS showed the most pronounced pattern of decreased FA, including both infratentorial and supratentorial regions, vs. controls and other patient groups. A similar pattern of FA decrease (except for superior cerebellar peduncle) was found in PSP-P vs. controls and PD (only at a lower significance). Impaired WM integrity was found in PSP but not in PD. The less prominent WM involvement in PSP-P might be associated to its favorable clinical status.

**14:30**  
**4264.** The In-Vivo Topographical Distribution of Brain Tissue Loss Associated with Depression in Parkinson’s Disease: A Voxel-Based Morphometry Study  
*Massimo Filippi*, *Federica Agosta*, *Igor Petrovic*, *Sebastiano Galantucci*, *Vladana Spica*, *Milica Jecmenica*, *Vladimir Kostic*  
1Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; 2Department of Neurology, School of Medicine, University of Belgrade, Belgrade, Serbia

VBM was used to investigate whether specific patterns of gray (GM) and white matter (WM) loss are associated with depression in 40 patients with Parkinson’s disease (PD). Twenty-four PD were diagnosed as non-depressed (PD-NDep), and 16 as having depression (PD-Dep). Compared with PD-NDep, PD-NDep showed WM loss in the right anterior cingulum and inferior orbitofrontal (OF) region. In PD patients, Hamilton rating scale for depression score correlated significantly with right inferior OF WM. The pattern of brain atrophy in PD-Dep overlaps with the key regions involved in major depressive disorders, suggesting an increased vulnerability of this neural circuit in PD.
15:00  **4265. 1H and 31P Spectroscopy: High Energy Metabolism in Idiopathic Parkinson**

**Syndrome**

Elke Hattingen, Ruediger Hilker, Joerg Magekurth, Carola Seifried, Ulrich Pilatus
1Institute of Neuroradiology, University Hospital, Goethe University, Frankfurt, Germany; 2Department of Neurology, University Hospital, Goethe University, Frankfurt, Germany

Combined 31P and 1H spectroscopic imaging was used to study changes in midbrain energy metabolism of patients with Parkinson's disease. Compared to healthy volunteers there is a decrease in high energy phosphates (ATP and phosphocreatine). The effect is more pronounced in the hemisphere contralateral to the clinical more affected side. The results corroborate the hypothesis of a potential role of mitochondrial dysfunction in Parkinson's disease.

**Wednesday 13:30-15:30  Computer 73**

13:30  **4266. Proinflammatory Cytokines Correlate with Diffusion Tensor Imaging Derived Metrics in Patients with Acute and Acute-On-Chronic Liver Failure**

Santosh Kumar Yadav, R Murali, Vivek A. Saraswar, R KS Rathore, A Yadav, K N. Prasad, M A. Thomas, Robert Haley
1Radiodiagnosis, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; 2Gastroenterology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; 3Mathematics and Statistics, Indian Institute of technology Kanpur, Kanpur, Uttar Pradesh, India; 4Microbiology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; 5Radiological Sciences, UCLA School of Medicine, Los Angeles, CA, Los Angeles, CA, United States

Fourteen patients with ALF, 17 with ACLF and 8 age/sex matched controls were included in this study. MRI, 1H-MR spectroscopy and serum proinflammatory cytokines measurements were done in all the patients and controls. Serum proinflammatory molecules were significantly increased in both conditions as compared to controls. A significant positive correlation of CS with IL-6 and TNF-α was observed in ALF while, CS correlated only to IL-6 in ACLF. A significant negative correlation was observed between MD values and IL-6 in both conditions. A significant positive correlation was also observed among Glx/Cr, IL-6 and TNF-α in both conditions. These observations suggest that proinflammatory cytokines may contribute in the development of CE in these patients.

14:00  **4267. Absolute Quantification of Human Brain Metabolites in Gulf War Syndrome Using Proton MR Spectroscopy at 3T**

Hyeon-Man Baek, Sergey Cheshkov, Audrey Chang, Sandeep Ganji, Evelyn Babcock, Richard Briggs, Robert Haley
1Radiology, UT Southwestern Medical Center, Dallas, TX, United States; 2Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States

In the present study, metabolic concentrations of three distinct Gulf War (GW) syndromes (e.g., Syndrome-I is described as “impaired cognition;” syndrome-II, “confusion-ataxia; syndrome-III, “central pain”) were calculated and compared the findings with those for healthy GW veterans. The main observation in this work was the significant reduction of NAA (Syndrome-I, -8%; Syndrome-II, -11%; Syndrome-III, -4%) concentration in left BG and (Syndrome-I, -7%; Syndrome-II, -8%; Syndrome-III, -9%) in right BG of GW syndrome subjects compared to healthy control subjects. The present study demonstrated that quantitative in vivo 1H-MRS can be used to detect the brain abnormalities in GW illness veterans, which may have relevance for the mechanisms of Gulf War syndrome.

14:30  **4268. Brain Diffusion-Weighted Imaging in Friedreich's Ataxia**

Giovanni Rizzo, Caterina Tonon, Maria Lucia Valentino, David Neil Manners, Filippo Fortuna, Cinzia Gelleri, Antonella Pini, Sandro Ghezzo, Agostino Baruzzi, Claudia Testa, emil Malucelli, Bruno Barbiroli, Valerio Carelli, Raffaele Lodi
1MR Spectroscopy Unit, Department of Internal Medicine, Aging and Neurology, University of Bologna, Bologna, BO, Italy; 2Neurological Sciences, University of Bologna, Bologna, BO, Italy; 3U.O. Biochemistry and Genetics, Fondazione IRCCS-Istituto Neurologico Nazionale “Carlo Besta”, Milan, MI, Italy; 4Neuropsychiatric Unit, Ospedale Maggiore, Bologna, BO, Italy

Objectives. To define the extent of the brain damage in FRDA and to identify in vivo markers of neurodegeneration, using DWI. Methods. MD maps from 27 FRDA patients and 21 healthy volunteers were generated. ROI and histogram analysis was performed. Results. MD values of patients were higher than controls in medulla, pons, MCP, SCP, pyramidal tracts, and OR, as well as in whole brainstem, cerebellar hemispheres, cerebellar vermis and sovratentorial compartment, and correlated with genetic and clinical data. Conclusions. Neurodegeneration in FRDA is more extensive than previously reported, and DWI is a suitable technique to provide biomarkers of disease progression.
The major finding of the current study is that brain MRS performed at 3T reveals decreased levels of Glx in the frontal white matter (FWM) of patients with HIV-associated dementia (HAD) compared to those without dementia. FWM Glx decreases were also associated with poorer cognitive function, specifically impaired executive and fine motor functioning in HAD. 3T MRS measurements of Glx may be a useful indicator of neuronal loss or dysfunction in patients with HIV infection.

Thursday 13:30-15:30 Computer 73

13:30 4270 Widespread and Different Distribution of Extrafoveal NAA/(Cr+Cho) Reductions in Mesial Temporal Lobe Epilepsy (TLE) with and Without Mesial Temporal Sclerosis
Susanne G. Mueller1, Andreas Ebel1, Jerome Barakos2, Cathy Scanlon1, Ian Cheong1, Daniel Finary1, Paul Garcia1, Michael W. Weiner2, Kenneth D. Laxer2
1Dept. of Radiology and Biomedical Imaging, UCSF, Center for Imaging of Neurodegenerative Diseases, San Francisco, CA, United States; 2Pacific Epilepsy Program, California Pacific Medical Center; 3Department of Neurology, UCSF

14 TLE with mesial temporal lobe sclerosis (TLE-MTS) and 14 TLE with normal appearing hippocampi (TLE-no) and 18 healthy volunteers were studied with a whole brain 3D EPI at 4T. Widespread NAA/(Cr+Cho) reductions showing a considerable intersubject variability were found in both groups. The distribution of these abnormalities was different in the two TLE groups. These findings indicate that TLE-MTS and TLE-no are metabolically heterogeneous and might even represent different TLE entities.

14:00 4271 Voxel-Based Analysis of Magnetisation Transfer Ratio as a Potential Biomarker in Prion Diseases
Harpreet Hyare1, Enrico De Vita2, Gerard Ridgway1, Rachael Scahill4, Durrenajaf Siddique1, Simon Mead1, Peter Rudge1, Tarek Yousry1, John Collinge1, John Thornton5
1MRC Prion Unit, UCL Institute of Neurology, London, United Kingdom; 2National Hospital for Neurology and Neurosurgery; 3Dementia Research Centre, UCL Institute of Neurology; 4Department of Neurodegenerative Diseases, UCL Institute of Neurology; 5National Hospital for Neurology and Neurosurgery, London, United Kingdom

Voxel based morphometry in inherited prion diseases demonstrates regionally specific atrophy in the basal ganglia, cerebellum and posterior cortical areas but no significant differences in the white matter compared to controls. Voxel-based analysis of magnetisation transfer ratio (MTR) demonstrates decreased MTR in the same grey matter regions but for the same threshold (p<0.001), there is activation of more voxels including white matter voxels. The findings suggesting that MTR may be more sensitive to microstructural changes and offers potential as a neuroimaging biomarker in prion diseases.

14:30 4272 Cerebral White Matter Disruption in Creutzfeldt-Jakob Disease
Hedok Lee1, Chen Hoffmann1, Oren S. Coher1, Peter B. Kingsley5, Isak Prohovnik1,5
1Psychiatry, Mount Sinai School of Medicine, New York, United States; 2Radiology, Sheba Medical Center, Tel Aviv, Israel; 3Neurology, Sheba Medical Center, Tel Aviv, Israel; 4Radiology, North Shore University Hospital, Manhasset, NY, United States; 5Radiology, Mount Sinai School of Medicine, New York, United States

To test the sensitivity of DTI to detect white matter integrity in Creutzfeldt-Jakob disease (CJD), we scanned 21 CJD patients and 19 healthy controls, computed fractional anisotropy (FA), mean diffusivity, radial diffusivity (RD), and axial diffusivity, and quantitatively compared the results in voxel-level analyses of tract-based spatial statistics (TBSS). In CJD patients, significant FA reductions in distinct and functionally relevant white matter (WM) pathways correlated with disease duration and reflected an elevation of RD, suggesting augmented permeability of axonal membranes. Our findings demonstrate involvement of WM pathways connecting structural landmarks that are known to be involved in the disease.

15:00 4273 In Vivo Longitudinal Monitoring of Blood Flow Alterations in TG2576 Mouse Model of Alzheimer’s Disease
F Kara1, N Braaikman1, M. A. van Buchem2, HJM de Groot1, R Schliebs3, A Alia1
1Leiden Institute of Chemistry, Leiden University, Leiden, Netherlands; 2Department of Radiology, Leiden University Medical Center, Leiden, Netherlands; 3Department of Neurochemistry, University of Leipzig, Leiden, Netherlands

In this study we longitudinally monitored, the blood flow alterations in TG2576 mouse model of Alzheimer's disease using MR angiography. Blood flow alterations were clearly increased in transgenic mice over time. Flow defects in middle cerebral artery were seen already at the age of 8 month when there was no cerebral amyloid angiopathy (CAA) was observed. In anterior cerebral artery the flow alterations were visible at the age of 19 months and were correlated with CAA as well as with high plaque deposition in the brain tissues. Our results show that blood flow defects are present long before vascular deposition of Aβ takes place in this mouse model.
14:00  4274.  **Excitatory Neurotransmitter Dysfunction Is Induced in Frontal Brain After Excitatory Drug Abuse**  
Napapon Sailasuta¹, Osama Abuiseoud², Martha Hernandez²,³, Thao T. Tran¹,³, Brian D. Ross¹,³  
¹Clinical MR Spectroscopy, Huntington Medical Research Institutes, Pasadena, CA, United States; ²University of Southern California, Keck School of Medicine, Los Angeles, CA, United States; ³Rudi Schulte Research Institute, Santa Barbara, CA, United States

Does excitatory drug abuse, specifically of methamphetamine, have the expected effect on the major excitatory neurotransmitter, glutamate? Using TE-Average at 3 Tesla, and examining frontal white matter, site of the major neuropsychological deficits in this patient population, we describe a 20% increase in brain glutamate. This is accompanied by the previously described 15% reduction in the neuronal marker NAA. The two neurochemical changes are statistically correlated (P<0.003) inviting the question whether the one is causative of the other. The hypothesis linking excitatory drug use with excitatory neurotransmitter excess is confirmed. Longitudinal studies are in progress to answer that new question.

14:30  4275.  **Anatomical Connectivity Mapping Quantifies Neuroplastic Activity of Anticholinesterase Treatments in Patients with AD**  
Marco Bozzali¹, Tommaso Gilli¹, Laura Serra¹, Bruno Maraviglia¹,³, Carlo Caltagirone¹,³, Karl Embleton⁶, Geoff J. M. Parker⁷, Mara Cercignani¹  
¹Neuroradiology Department, Santa Lucia Foundation, Rome, Italy; ²MarbiLab, Enrico Fermi Centre, Rome, Italy; ³Dept of Physics, University of Rome "La Sapienza", Rome, Italy; ⁴Department of Clinical and Behavioural Neurology, Santa Lucia Foundation, Rome, Italy; ⁵Dept of Neuroscience, University of Rome "Tor Vergata"; ⁶Cognition and Cognitive Neuroscience Group, School of Psychological Sciences, University of Manchester, United Kingdom; ⁷Imaging Science & Biomedical Engineering and the Biomedical Imaging Institute, University of Manchester, United Kingdom

This study assesses WM structural connectivity based on an index derived from diffusion MRI in a group of patients with Alzheimer's disease (AD), in a group of patients with amnestic mild cognitive impairment and in a group of healthy control, in order to investigate whether structural connectivity is altered in AD. The unexpected finding of increased anatomical connectivity in several subcortical areas of patients with AD but not in those with mild cognitive impairment might be explained by the neurotrophic and neurorestorative properties of the cholinesterase inhibitors assumed by these patients, although more investigations are needed.

15:00  4276.  **Differences Between Patients with Parkinson's Disease and Healthy Controls Detected by High Spatial Resolution 3D-MRSI at 3 T**  
Adriane Groeger¹, Grzegorz Chadymski¹, Kathrin Brockmann¹, Karin Srulijes¹, Daniela Berg¹, Uwe Klose²  
¹Department of Neurodegeneration, Hertie Institute for Clinical Brain Research, University of Tuebingen, Tuebingen, Germany; ²Department for Diagnostic and Interventional Neuroradiology, Section for Experimental Magnetic Resonance of Central Nervous System, University of Tuebingen, Tuebingen, Germany

We developed an optimized 3D-MRSI protocol with high spatial resolution at 3T to evaluate a method for assessing the characteristic loss of neurons inside the substantia nigra in patients with Parkinson’s disease. Nine PD patients and eight age-matched healthy controls were examined. A voxel size of 0.252 ml yielded reproducible values for the NAA/Cr ratios in all subjects. Our results show clear differences between the intra-individual NAA/Cr ratios in the SN of PD patients compared to controls and suggest that aspects of the pathophysiological process at the SN can be assessed by 3D-MRSI with high spatial resolution at 3T.

15:30  4277.  **Diffusion Tensor Imaging Detection of Early White Matter Changes in an Accelerated SIV Primate Model of NeuroAIDS**  
Eva-Maria Ratai¹, Vadim Villarroel¹, Julian He¹,², Reza Hakimelah¹,², Robert Fell¹, Chan-Gyu Joo¹,², Jeffrey Bombardier¹, Susan Westmoreland,³,⁴ Kenneth Williams⁵, Ramon Gilberto Gonzalez¹  
¹Department of Radiology, A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; ²Harvard Medical School, Boston, MA, United States; ³Johns Hopkins School of Medicine, Baltimore, MD, United States; ⁴Division of Comparative Pathology, New England Primate Research Center, Southborough, MA, United States; ⁵Biology Department, Boston College, Boston, MA, United States

A significant number of HIV-infected patients develop neurological symptoms which are thought to be a result of injury to neurons in the CNS. Our objective was to use DTI to detect abnormalities in white matter in a SIV-infected, CD8-depleted macaque model of neuroAIDS. MRS and DTI were conducted before and at 2 and 4 weeks post infection. White matter in the corpus callosum showed a trend towards decreased FA at 2 wpi. Correlation analyses demonstrated a significant association between white matter damage in the splenium and increases in choline. FA showed a negative correlation with viral load in the CSF.
Clinical Brain Tumor Imaging

Hall B Monday 14:00-16:00  Computer 74

14:00  4278.  $^1$H-HRMAS of Small-Molecule-Metabolites in Adult Brain Tumours: Assignment, Quantification and Biomarker Determination.

Alan Wright, Greg A. Fellows, John R. Griffiths, Martin Wilson, B Anthony Bell, Franklyn Arron Howe.

1Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; 2ST George’s University of London, United Kingdom; 3CRUK Cambridge Research Institute, United Kingdom; 4University of Birmingham, United Kingdom; 5Birmingham Children’s Hospital NHS Foundation Trust, United Kingdom

MRS has the potential to provide diagnostic and prognostic biomarkers for brain tumours in vivo. We have used the ex vivo technique of $^1$H HRMAS NMR spectroscopy of brain tumour samples to identify the “NMR visible” metabolites in the common adult brain. This has lead to the identification of 29 small molecule metabolites observable in spectra from a set of 65 tumours including grade II astrocytomas, grade III gliomas, GBMs, lymphomas, metastases and meningiomas. We have also identified some novel-potential biomarkers for binary brain-tumour diagnostic comparisons. These include hypotaurine as a marker for GBM when compared to metastases or histidine as a positive marker for gliomas when compared to metastases or meningioma.

14:30  4279. Radiation Toxicity to the Normal Brain Detected by Echoplanar Spectroscopic Imaging in Patients with Brain Metastases Treated with Whole Brain Radiation Therapy.


1Radiology, University of Pennsylvania, Philadelphia, PA, United States; 2Radiology, University of Miami, Miami, FL, United States; 3Radiation Oncology, University of Pennsylvania, Philadelphia, PA, United States

Echoplanar spectroscopic imaging (EPSI) was performed serially in patients with brain metastasis undergoing whole brain radiation therapy to assess metabolic alterations in the normal brain. NAA/Cr and Cho/Cr ratios were measured from dorsolateral-prefrontal-cortex, cingulate-gyrus, thalamus, hippocampus and basal ganglia. In general, a decrease in NAA/Cr was noted from several regions while the Cho/Cr ratio decreased in some regions with a concomitant increase in other regions probably due to neurodegenerative effects of whole brain radiation. These results suggest that EPSI may be used for detecting radiation toxicity to the normal brain in patients with brain metastases treated with radiation therapy.

15:00  4280. Using MR Spectroscopy to Track Metabolic Changes in Glioblastoma After One Dose of Cediranib.

Heisoog Kim, Ciprian Catana, Eva-Maria Ratari, Wei-Ting Zhang, Ovidiu C. Andronescu, Tracy T. Batchelor, Rakesh K. Jain, Alma Gregory Sorensen.

1A.A.Martinos center, Massachusetts General Hospital, Charlestown, MA, United States; 2NSE/HST, Massachusetts Institute of Technology, Cambridge, MA, United States; 3Neurology, Massachusetts General Hospital, Boston, MA, United States; 4Radiology, Massachusetts General Hospital, Boston, MA, United States

This study investigated early changes in predominant metabolites for assessment of tumor response to anti-angiogenic agents in GBM using 1H-MRS. After one dose, NAA/norCre in ET showed a significant increase in good-OS patients (12/19) and no such increase in poor-OS. NAA/Cho increased in good-OS, while decreasing in poor-OS. There were no significant changes in norCre or MRI parameters, including T1, FLAIR, and ADC. The change in NAA/norCre after one dose suggests a revival of neuronal activity as well as a recovery of metabolite concentrations due to reduction of edema. NAA/Cho changes also seem to correlate well with overall survival.

15:30  4281. Combining High Resolution Magic Angle Spinning H1 NMR and Molecular Genomics Predicts Survival in Brain Tumor Patients Better Than Either Methodology Alone.

Loukas G. Astrakas, Konstantinos D. Blekas, Ovidiu C. Andronescu, Michael N. Mindrinos, Peter M. Black, Laurence G. Rahme, Aria Tzika.

1NMR Surgical Laboratory, Department of Surgery, Massachusetts General Hospital and Shriners Burns Institute, Harvard Medical School, Boston, MA, United States; 2Department of Medical Physics, University of Ioannina, Ioannina, Greece; 3Department of Computer Science, University of Ioannina, Ioannina, Greece; 4Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Athinoula A. Martinos Center of Biomedical Imaging, Boston, MA, United States; 5Stanford Genome Technology Center, Department of Biochemistry, Stanford University School of Medicine, Palo Alto, CA, United States; 6Neurosurgery, Brigham and Women’s Hospital, Harvard Medical School, Boston, MA, United States; 7Molecular Surgery Laboratory, Department of Surgery, Massachusetts General Hospital and Shriners Burns Institute, Harvard Medical School, Boston, MA, United States

Our aim was to develop a novel approach that combines high-resolution magic angle spinning (HRMAS) H1 NMR and genomics in the same biopsies to improve prognostication of brain tumors. We employed a linear Support Vector Machine combined with the robust minimum redundancy – maximum relevance feature selection scheme, and applied our algorithm to combined HRMAS 1H MRS and microarray data of the same adult brain tumor biopsies. Our results demonstrate that we are able to produce accurate and meaningful data and introduce a novel classification scheme that predicts a clinically meaningful parameter such as survival better than either method alone.
Correlation Between Diffusion Tensor and Perfusion Imaging in Segmented Enhancing Lesion with High Grade Glioma

Naomi Morita1,2, Masafumi Harada1, Eva Zacharaki2, Priyanka Bhatt1, Sanjeev Chawla2, Elias R. Melhem2, Hiromu Nishitani1

1Radiology, Tokushima University Hospital, Tokushima, Japan; 2Radiology, University of Pennsylvania, Philadelphia, PA, United States

Knowledge about microvasculature, angiogenesis or tumor cellularity is important in determining tumor grade. The purpose of this study was to determine whether there are any correlations between ADC, FA and rTBV value in segmented enhancing lesion within tumor. Thirty three brain tumor patients with contrast enhancement on MRI underwent DTI and PWI. FA, ADC and rTBV values were measured in the segmented enhancing area within tumor. FA and rTBV had a negative correlation (p<0.05). This study indicates that damage of fiber and tumor progression may have any relationships in the course of tumor progression.

Differentiation of Radiation-Injuries and Tumor Recurrence Using Perfusion-Weighted Imaging

Yu Lin Wang1, Lin Ma2

1department of radiology, PLA general hospital, China; 2department of radiology, PLA general hospital, beijing, China

PWI made it possible to obtain measurements of vascularity within brain lesions. The vascularity of malignant tumor differs dramatically from that of radiation necrosis. Thus, tumor recurrence within irradiated lesions may be differentiated from regions of radiation necrosis with PWI. 15 patients were prospectively entered into the study on the basis of the following criteria: previous treatment with radiation therapy after surgical resection for intraxial tumors; new development of enhancing lesions within the radiation field. The final determination of the new development of enhancing lesions was decided either histologically or clinicoradiologically.

Non-Negative Matrix Factorization for Differentiation of Brain Metastasis and Glioblastoma Multiforme, and Visualization of Tumor Infiltration

Jan Luts1, Teresa Laudadio,1,2, M. Carmen Martinez-Bisbal1,4, Sofie Van Cauter1, Enrique Molla1, Jose Piquer1, Johan Suykens1, Uwe Himmelreich1, Bernardo Celda1,3,4, Sabine Van Huffel1

1Katholieke Universiteit Leuven, Leuven, Belgium; 2Istituto Applicazioni Calcolo, CNR, Bari, Italy; 3University of Valencia, Valencia, Spain; 4Networking Research Center on Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN), Valencia, Spain; 1Hospital de La Ribera, Valencia, Spain

This study focuses on the differentiation between solitary brain metastasis and glioblastoma multiforme based on conventional magnetic resonance imaging (MRI) and long TE two-dimensional turbo spectroscopic imaging (2D-TSI) data. Fifteen patients with a brain tumor, nine affected by glioblastoma multiforme and six by metastasis, were considered. Non-negative matrix factorization (NNMF) results in a clear separation of glioblastomas and metastases. The methods allows visualizing the abundances of the normal tissue component, which indicate tumor infiltration. In conclusion, automated processing with NNMF of 2D-TSI enables to visualize metabolic differences between glioblastomas and metastases and enables to visualize tumor infiltration.

The Effect of Bevacizumab on Normal Appearing White Matter Fibers: A Diffusion Tensor Imaging (DTI) Study

Moran Artzi1,2, Deborah T. Blumenthal3,4, Felix Bokstein3,4, Benjamin W. Corn4,5, Palmon Mika1, Orna Aizenstein6, Dafna Ben Bashat1

1The Wohl Institute for Advanced Imaging, Brain Imaging Center, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; 2Sackler Faculty of Medicine, Tel-Aviv University; Tel-Aviv, Israel; 3Neuro-Oncology Service, Oncology Division, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; 4Sackler Faculty of Medicine, Tel-Aviv University, Tel-Aviv, Israel; 5Radiation Oncology Unit, Oncology Division, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; 6Department of Radiology, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel

Combined chemo-radiation therapy (RT) is the standard first-line treatment for glioblastoma (GB). Recently, antiangiogenic-drugs such as bevacizumab have become routine second-line-therapy for patients with recurrent-GB; however the effects of this agent on the normal appearing white-matter (NAWM) are yet unknown. In this work we scanned patients with primary brain tumors before and after RT and during bevacizumab therapy. DTI was used to evaluate NAWM changes compared to healthy controls. Changes in diffusivity values were detected following RT but not during bevacizumab-therapy. Those results support that post-radiation changes occur, without evidence for additional WM toxicity from bevacizumab-therapy.
Support Vector Machines in DSC-Based Glioma Imaging – Suggestions for Optimal Characterization

Frank G. Zöllner¹, Kyrre Eeg Emblem², Lothar R. Schad¹
¹Heidelberg University, Mannheim, Germany; ²Oslo University Hospital, Oslo, Norway

Dynamic susceptibility contrast magnetic resonance perfusion imaging (DSC-MRI) is a method of choice to characterize gliomas. Recently, support vector machines (SVM) have been introduced as means to prospectively characterize new patients based on information from previous patients. Based on features derived from automatically segmented tumor volumes from 101 DSC-MR examinations, four different SVM models were compared. All SVM models achieved high prediction accuracies (>82%) after rebalancing the training data sets to equal amounts of samples per class. Best discrimination were obtained using a SVM model with a radial basis function kernel allowing for a correct prediction of low-grade glioma at 83% and high-grade glioma at 91%.

Differentiation Between Glioblastomas, Brain Metastases and Primary Cerebral Lymphomas Using Diffusion and Perfusion Weighted Imaging

Sumei Wang¹, Sungheon Kim², Sanjeev Chawla³, Ronald L. Wolf¹, David Knipp¹, Arastoo Vossough¹, Donald M. O’Rourke¹, Kevin D. Judy¹, Elias R. Melhem¹, Harish Poptani¹
¹Radiology, University of Pennsylvania, Philadelphia, PA, United States; ²Radiology, New York University School of Medicine, New York, NY, United States; ³Neurosurgery, University of Pennsylvania, Philadelphia, PA, United States

Twenty-six glioblastomas, 25 brain metastases and 16 cerebral lymphomas underwent DTI and DSC studies. FA, ADC, CL, CP, CS and rCBV were measured from the enhancing part of the tumor. Elevated FA, CL, CP and decreased CS were observed in glioblastomas compared with both metastases and lymphomas, whereas ADC and rCBV values from glioblastomas were significantly higher than lymphomas. FA and ADC was the best predictor for differentiation of glioblastomas from non-glioblastomas, whereas ADC, CS and rCBV were the best model for distinguishing lymphomas from metastases. Our study indicates that DTI metrics along with rCBV measurement may be helpful in tumor classification.

Initial RCBV Predicts Response to Bevacizumab in Patients with High-Grade Gliomas

Kathleen M. Schmainda¹,², Devyani Bedekar¹,², Scott D. Rand¹,², Jennifer Connelly, ²³, Mark Malkin, ²³
¹Radiology, Medical College of Wisconsin, Milwaukee, WI, United States; ²Translational Brain Tumor Research Program, Medical College of Wisconsin, Milwaukee, WI, United States; ³Neurology, Medical College of Wisconsin, Milwaukee, WI, United States

The prognosis for patients diagnosed with brain tumors has been dismal. Now there is hope with improved time to progression and survival noted for patients treated with anti-angiogenic drugs such as bevacizumab. Yet, many questions remain regarding the appropriate selection of patients most likely to respond. These questions are important from both a clinical and economic perspective and therefore speak to the need for ways to efficiently and reliably predict response. Here we demonstrate the potential of DSC-measures of rCBV, obtained just prior to treatment with bevacizumab, to predict outcomes in patients with both new and recurrent GBM.

Using Cerebrovascular Response to Hyperoxia  for Assessing Treatment Resonse in Glioblastoma

Heisoog Kim¹,², Ciprian Catana¹, Grace Kim¹, Ovidiu C. Andronesi¹, Dominique L. Jennings¹, Divya S. Bolar³,⁴, Elizabeth R. Gerstner⁴, Tracy T. Batchelor⁴, Rakesh K. Jain⁴, Alma Gregory Sorensen¹
¹A.A.Martinos center, Massachusetts General Hospital, Charlestown, MA, United States; ²NSE/HST, Massachusetts Institute of Technology, Cambridge, MA, United States; ³EECS/HST, Massachusetts Institute of Technology, Cambridge, MA, United States; ⁴Neurology, Massachusetts General Hospital, Boston, MA, United States; ⁵Radiology, Massachusetts General Hospital, Boston, MA, United States

This study quantitatively investigated BOLD responses to pure oxygen in glioblastoma (GBM) throughout the course of the treatment with chemoradiation and an anti-angiogenic drug. BOLD signal changes dropped significantly at the beginning of the treatment in tumor and gradually recovered afterwards. Conversely, in contralateral normal tissue a slight increase was observed at the early time points. Interestingly, no difference was observed between values in both regions after 35 days. Our preliminary findings suggest that assessing the oxygenation status before and after treatment might be useful for both prognostic and diagnostic assessment in GBM patients.
Correlation Between Imaging Findings of Magnetic Susceptibility Weighted Images and MIB-1 Labeling Index. 
Kazuchika Hagiwara¹, Akira Kunimitsu¹, Wataru Gono¹, Harushi Mori¹, Osamu Abe¹, Kuni Ohtomo¹, Hiroyuki Kabasawa²
¹Radiology, Tokyo University Hospital, Bunkyo-ku, Tokyo, Japan; ²GE Healthcare Japan

The purpose of this study was to examine with or without of association between findings in phase sensitive imaging (PSI) that is a susceptibility weighted imaging method and MIB-1 Labeling Index (LI) that is a marker of malignancy of human brain tumors. Forty brain tumors were studied with 3 T MRI and properties of intratumoral dark spots in PSI were graded on scale of 1 to 4 subjectively depending on area proportions of dark spots within tumors. Statistically significant difference of MIB-1 LI was found between low and high grade tumor groups.

Influence of Combined FMRI and MR Tractography on Operative Planning of Brain Tumors: Initial Experience in a Histopathologically Variable Subset of Tumors
Hossam Moussa Sakr¹, Mona Adel Mohamed², Hasan Mohamed Jalalod'din³, Yasser Abd El Azem Abbas¹
¹radiology, Ain Shams University, Cairo, Egypt; ²radiology, Johns Hopkins University School of Medicine, Baltimore, United States; ³neurosurgery, Ain Shams University, Cairo, Egypt

Functional MRI and tractography are two non invasive methods to assess the relation of and possible affection of eloquent cortical brain centers as well as white matter tracts by brain tumors, in this study we show that adding functional and tractography data to the conventional MR data modify the decision of therapy aiming to avoid or minimize post operative deficit.

Breath-Hold Regulated Blood Oxygenation-Level Dependent MRI and Vascular Space Occupancy MRI of Brain Tumors
Yuan-Yu Hsu¹,², Wan-Chun Kwan³, Kun-Eng Lim¹,², Ho-Ling Liu¹,²,³
¹Dept. of Medical Imaging, Buddhist Tzu Chi General Hospital-Taipei Branch, Xindian, Taipei, Taiwan; ²School of Medicine, Tzu Chi University, Hualien, Taiwan; ³Dept. of Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Hsinchu, Taiwan; ³Graduate Institute of Medical Physics and Imaging Science, Chang Gung University, Taoyuan, Taiwan; ³MRI center, Chang Gung Memorial Hospital, Taoyuan, Taiwan

To evaluate the cerebrovascular response of normal tissues and cerebral tumors under breath-holding challenges by using 3-T blood oxygenation-level dependent (BOLD) and vascular space occupancy (VASO) MRI. Six normal adults and 14 patients with brain tumors were studied. There were significant BOLD signal increases and VASO signal decreases in normal appearing gray matter of normal subjects and patients, but not in the tumors. Interestingly, there were BOLD signal decreases or VASO signal increases in two meningiomas. Both 3-T BOLD and VASO MRI can detect breath-hold regulated cerebrovascular changes, with a higher sensitivity for signal detection of BOLD technique.

T1 CUBE Compared to Fast Spin Echo T1 Weighted and BRAVO in Post Contrast Enhanced Brain MRI at 3T
David W. Stanley¹, Amy L. Kotsenas², Timothy J. Kaufmann², Heidi A. Edmonson², Dan W. Rettmann³, Eric T. Han²
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3T MR scanners have become increasingly useful in medical imaging with their increased SNR capabilities and potential of higher resolution images. However, with some existing pulse sequences, mediocre lesion contrast enhancement, image artifacts, excessive vascular enhancement, and increased signal from white matter pose challenges to the assessment of small and subtle enhancing lesions at 3T. The purpose of this study was to compare the quality of imaging and contrast enhancing lesion conspicuity of 3D fast spin echo-based T1 CUBE with a T1 weighted 2D FSE and 3D volumetric T1-weighted IR prepared 3D GRE (BRAVO) in contrast enhanced 3T brain MRI.

Tracer Kinetic Parameters Derived from Quantitative Dynamic Contrast-Enhanced MRI Correlate with VEGF Expression in Head-And-Neck Tumours
Stephanie B. Donaldson¹,², Guy Betts³, Suzie C. Bonington³, Catharine M.L West³, Lucy E. Kershaw³, David L. Buckley³
¹North Western Medical Physics, Christie Hospital NHS Trust, Manchester, United Kingdom; ²Imaging Science and Biomedical Engineering, University of Manchester, Manchester, United Kingdom; ³Academic Department of Radiation Oncology, University of Manchester, Manchester, United Kingdom; ³Department of Radiology,
Dynamic contrast-enhanced (DCE-) MRI using a two-compartment exchange model (2CXM) can provide estimates of perfusion (Fb), microvessel permeability-surface area (PS), interstitial volume (ve), and blood volume (vb). DCE-MRI parameters correlate with VEGF expression, an initiator of angiogenesis and prognostic indicator, in a variety of tumours. Eight patients with head-and-neck cancer underwent high temporal-resolution DCE-MRI before surgery. Whole-tumour concentration-time curves were analysed using the 2CXM to estimate Fb, PS, ve, vb and plasma mean transit time. VEGF mRNA expression was measured at surgery. Fb, ve, and PS correlated significantly with VEGF expression suggesting that DCE-MRI parameters may be indicative of angiogenesis.

14:30 4295. MRI of Head and Neck Patients in the Radiotherapy Treatment Position
Scott Hanvey1, John Foster2
1Radiotherapy Physics, Beatson West of Scotland Cancer Centre, Glasgow, Lanarkshire, United Kingdom; 2MRI Physics, Beatson West of Scotland Cancer Centre, Glasgow, United Kingdom

Accurate localisation of the planning target volume (PTV) is vitally important in radiotherapy. The excellent soft tissue contrast of MRI makes it an ideal imaging modality for radiotherapy of the head and neck. Registration of MRI with CT can be problematic since patients are not positioned in the same way. The following study compared the accuracy of the registration of MRI with CT in 20 head and neck patients receiving an MRI in the typical curved table and within an immobilisation device. It also measured the PTVs of patients in the normal and radiotherapy position in MRI.

15:00 4296. Prognostic Value of Minimum Apparent Diffusion Coefficient for Patients with Hypopharyngeal Cancer
Yu-Chun Lin1,2, Su-Hang Ng1, Yau-Yau Wai1, You-Hsuan Tsai1, Jiun-Jie Wang3
1Department of Diagnostic Radiology, ChangGung Memorial Hospital, KweiShan, Taoyuan, Taiwan; 2Department of Electrical Engineering, ChangGung University, KweiShan, Taoyuan, Taiwan; 3Department of Medical Imaging and Radiological Science, ChangGung University, KweiShan, Taoyuan, Taiwan

The minimum ADC reflects the highest cellularity within the tumor. In this study we proposed to assess the survival rates for patients with hypopharyngeal cancer using minimum ADC, mean ADC and the tumor volume, which is the conventional standard. The Kaplan-Meier survival analysis revealed that the minimum ADC can successfully predict the 16-month overall survival with an optimal threshold of 6.94±10-3 mm2/sec. Thus, the minimum ADC could serve as a biomarker for the prognosis in patients with hypopharyngeal cancer.

15:30 4297. MRI Sialolithography: Direct Visualization of Calculi in the Submandibular Gland
Ali Fatemi1, Colm Boylan2, Judith Coret-Simon2, Michael D. Noseworthy, 23
1Medical Physics and Applied Radiation Sciences, McMaster University, Hamilton, Ontario, Canada; 2Diagnostic Imaging, St. Joseph's Healthcare, Hamilton, Ontario, Canada; 3Electrical and Computer Engineering, School of Biomedical Engineering, McMaster University, Hamilton, Ontario, Canada

A technique is presented that allows for the specific identification and localization of calculi within glandular tissues or ducts using MRI. The technique is based on positive phase filtered SWI, and does not require ionizing radiation or the use of sialogogue.

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13:30 4298. T1 and T2 Relaxation Time Histograms of Mandibular Bone Marrow: A Monomodal Distribution in Sickle Cell Disease
Joseph Liao1, Nekou Nowrouzi1, Elliott Elias1, Hernan Jara1, Osamu Sakai1
1Boston Medical Center, Boston University School of Medicine, Boston, MA, United States

Purpose: To characterize sickle-cell disease-related changes in the mandibular bone marrow using qMRI relaxometry. Materials and Methods: 13 SCD patients (19.8-43 years old) and 17 age-matched controls (23-64 years old) were imaged with the mixed turbo spin-echo pulse sequence. The mandible was manually segmented. T1 and T2 relaxation time histograms were created. Results: 15 of the 17 controls exhibited bimodal peaks in T1; all controls exhibited bimodal peaks in T2. In contrast, all SCD patients exhibited monomodal peaks in both T1 and T2 sequences. Conclusion: qMRI relaxometry reveals a monomodal histogram distribution in the bone marrow in SCD patients.

14:00 4299. Quantitative MRI Analysis of Lacrimal Glands in Patients with Sickle Cell Disease
Elliott Elias1, Joseph Liao1, Memi Watanabe1, Naoko Saito1, Hernan Jara1, Osamu Sakai1
1Boston Medical Center, Boston University School of Medicine, Boston, MA, United States

Purpose: To analyze MR relaxometric and volumetric changes in lacrimal glands in sickle cell disease (SCD) as motivated by a recent case report on lacrimal gland pathology. Materials and Methods: 15 SCD patients (19.8-43.6 yrs) and 23 control subjects (23-64 yrs) were imaged by mixed-TSE sequence at 1.5T. T1, T2, and secular-T2 relaxation time histograms and volumes were analyzed. Results: T2 and secular-T2 relaxation times were significantly shortened in SCD patients, and glandular volumes were increased. No significant differences were observed in T1. Conclusion: Disease specific relaxometric and volumetric were observed in the lacrimal glands of SCD patients.
Quantitative MRI Analysis of Craniofacial Bone Marrow in Patients with Sickle Cell Disease
Elliott Elias1, Joseph Liao1, Memi Watanabe1, Yu Sakai1, Kaan Erbay1, Naoko Saito1, Hernan Jara1, Osamu Sakai1
1Boston Medical Center, Boston University School of Medicine, Boston, MA, United States

Purpose: To analyze MR relaxometric and volumetric changes in craniofacial bone marrow in sickle-cell disease (SCD). Materials and Methods: 15 SCD patients (19.8-43.6 yrs) and 23 controls (23-64 yrs) were imaged by mixed-TSE sequence at 1.5T. Craniofacial bones were manually segmented, and T1, T2, and secular-T2 relaxation time histograms and volumes were analyzed. Results: T2 and secular-T2 peaks revealed significant shortening in SCD patients. Only the first T1 peak showed significant increase. Significant increase in marrow volume was observed in SCD patients. Conclusion: Disease specific relaxometric and volumetric changes were observed in the craniofacial bone marrow in SCD patients.

Susceptibility Weighted Imaging (SWI) for the Assessment of Iron Loading in the Brain of Beta-Thalassemia Major Patients
Deqiang Qiu1, Godfrey CF Chan2, Queenie Chan3, Sau-Yin Ha2, Pek-Lan Khong1
1Diagnostic Radiology, The University of Hong Kong, Hong Kong, China; 2Pediatric and Adolescent Medicine, The University of Hong Kong, Hong Kong, China; 3Philips Healthcare Hong Kong, Hong Kong, China

Brain iron loading was evaluated in a group of thalassemia beta-major patients using susceptibility weighted imaging and compared with normal healthy volunteers. Age and gender effects were found in normal subjects. A wide range of iron concentration was indicated in the patient group with some showing higher phase value and some lower phase value in brain regions than normal. Significantly different phase value was found among patients receiving different iron chelation agents. SWI is sensitive in measuring iron concentration in the brain and provide a valuable tool for iron assessment both for clinical trials and for individual evaluation.

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Imaging Biomarkers in Neurofibromatosis 2-Related Vestibular Schwannomas
Dominique Louise Jennings1, Kim Mouridsen2, Meiyun Wang2, Harry Miao3, Langdon Miller3, Scott R. Plotkin4, A Gregory Sorensen2
1Department of Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, MA, United States; 2Department of Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, MA, United States; 3PTC Therapeutics, Inc., South Plainfield, NJ, United States; 4Department of Neurology and Cancer Center, Massachusetts General Hospital, Boston, MA, United States

This study applied advanced imaging techniques in the evaluation of the tumor heterogeneity in neurofibromatosis type-2 vestibular schwannomas. We aim to develop imaging biomarkers to assess response to anti-angiogenic therapies in this tumor type.

Differential Diagnosis of Intracranial Ectopic Germinomas at Early Stage and Lacunar Infarction by Susceptibility-Weighted Imaging
Xin Lou1, Lin Ma1, Chenglin Tian1, Ailian Zhang1, Yulin Wang1, Zhiye Chen1
1Radiology Department, Beijing, China; 2Neurology Department, Beijing, China

Intracranial germinomas may arise in sites besides pineal and suprasellar regions, which was named intracranial ectopic germinomas (IEGs). Most IEGs at early stage present as lacunar infarct-like or demyelination-like lesions. Because germinomas are highly sensitive to radiotherapy, therefore the early diagnosis is crucial for the treatment. Susceptibility-weighted imaging (SWI) has proved to be more sensitive in detecting early basal ganglia germinoma than conventional MRI. Five patients with early IEGs and six patients with lacunar infarction in basal ganglia were performed SWI and conventional MRI. Our preliminary results revealed SWI is helpful in differentiating early IEGs from lacunar infarction.

Ex Vivo Metabolic Profiles for the Differential Classification Between Oligodendrogial and GBM Tumours
Bernardo Celda1,2, Ruben Ferrer-Luna1, Horacio Martinetto3, Jorge Calvar1, Gustavo Sevlever1, Vicent Esteve2, MCarmen Martinez-Bisbal2
1Physical Chemistry, University of Valencia, Burjassot, Valencia, Spain; 2Physical Chemistry, CIBER-BBN, Burjassot, Valencia, Spain; 3FLENI, Buenos Aires, Argentina

Ex vivo metabolic profiles for 50 brain tumours (20 oligodendrogial (OT) and 30 GBM) obtained by HR-MAS were used for a clear classification between OT and GBM.

r-CBV Changes: Can We Predict Tumor Behavior of Low Grade Gliomas with Rapid Progression from Imaging Features?
Too Jeong Yin1, Soo Chin Kim1, Hyo bin Seo1, Ji Hoon Kim1, Chul-Ho Sohn1, Kee Hyun Chang1
1Radiology, Seoul National University Hospital, Seoul, Korea, Republic of

The purpose of this study was to determine whether r-CBV(relative cerebral blood volume) value in low grade gliomas can be used as an adjunct to pathologic grading. From 2004 to 2009, among 190 pathologically proven low grade gliomas(WHO grade II), fifteen patients(7.8%)(4 astrocytomas, 10 oligodendrogliaomas, 1 oligoastrocytoma) showed malignant transformation. These tumors included
8 anaplastic oligodendroglioma, 3 anaplastic astrocytoma, 3 anaplastic oligoastrocytoma and 1 glioblastoma. At the initial study, mean r-CBV value was 5.07 (range, 2.87-9.32) and 10.4 (range, 3.25-16.15) at malignant transformation. Cut-off value for r-CBV of low grade glioma at the point of high grade transformation is 5.3 (p=0.0005, sensitivity 83.3%, specificity 76.9%). r-CBV values can be used as an accurate adjunct to WHO pathologic grading of low grade gliomas that have a propensity for malignant transformation.

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13:30

4306. Quantitative MRI Analysis of Aging of Human Fat Tissue: Intra-Orbital Versus Extra-Orbital Fat

Memi Watanabe1, Osamu Sakai1, Joseph Liao1, Hernan Jara1,2
1Department of Radiology, Boston Medical Center, Boston University School of Medicine, Boston, MA, United States; 2Department of Biomedical Engineering, Boston University, Boston, MA, United States

Purpose: To study the aging pattern of intra- vs. extra-orbital fat tissue, using multispectral quantitative MR imaging (qMRI).

Methods: Forty-two subjects (M:F=21:21, age: 0.5-87 years, average 31.5) were examined with experimental mixed turbo spin echo (mixed-TSE) sequence. Region-of-interest (ROI) measurements of retrobulbar fat, buccal fat and subcutaneous fat tissues were obtained for multispectral qMRI analysis. Results: PD and T1 values of all fat tissues showed similar tissue characteristics and aging patterns, while a decrease in T1 and secular-T2 values was seen in extra-orbital fat with aging. Conclusion: Multispectral qMRI data of aging in intra- and extra-orbital fat tissues were obtained.

14:00

4307. High-Resolution Diffusion-Weighted Imaging of the Orbits Using Readout-Segmented EPI

Roland Bammer1, Kristen W. Yeom1, Samantha J. Holdsworth1, Stefan T. Skare1
1Radiology, Stanford University, Stanford, CA, United States

Diffusion-weighted MRI (DWI) of the Orbits bears great diagnostic potential. Its use, however, has been limited due to profound geometric distortions and signal loss related to single-shot EPI. We demonstrate that diffusion-weighted readout-segmented (RS)-EPI with its significant distortion reduction capacity can provide high-resolution DWI and DTI scans that allows one to delineate intra-orbital structures within clinically reasonable scan times. A consecutive series of 35 pediatric patients was enrolled in a comparative evaluation and a 100% superiority of RS-EPI (both in resolution and distortion reduction) over ASSET-enhanced EPI could be demonstrated.

14:30

4308. The Effects of Age, Gender and BMI on Parotid Fat and Parotid ADC Measurements in EPI Based and FSE-PROPELLER Based Diffusion Weighted Imaging

Hui-Chu Chiu1,2, Chun-Jung Juan1, Hsing-Chiuh Chang1,5, Hsiao-Wen Chung1,5, Cheng-Chieh Cheng1,5, Su-Chin Chiu1, Cheng-Yu Chen4, Guo-Shu Huang3
1Department of Nuclear Medicine, Tri-Service General Hospital, Taipei, Taiwan; 2EMBA in Global Chinese Management, Department of Business Administration, College of Management, Tumkang University, Taipei, Taiwan; 3Department of Radiology, Tri-Service General Hospital, Taipei, Taiwan; 4Applied Science Laboratory, GE Healthcare Taiwan, Taipei, Taiwan; 5Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan

The effects of age, gender and body mass index (BMI) on parotid fat content and parotid ADC measurements have never been investigated yet. In this study, we measured parotid ADC values using non-fat-saturated and fat-saturated DWI pulse sequences including fast spin-echo PROPELLER and echoplanar acquisitions. Our results highlight the parotid fat content is influenced by gender and is significantly positively associated with age and BMI. The parotid fat content has a significantly negative effect on parotid ADC values that is most apparent in non-fat-saturated DWI pulse sequence and the effect could not be remedied by any fat-saturated DWI pulse sequence.

15:00

4309. Cortical Activation During Swallowing Rehabilitation Maneuvers: A Functional MRI Study of Healthy Controls

Kyung K. Peck1, Ryan Branski, Cathy Lazarus2, Victoria Cody, Devon Kraus, Samantha Haupage, Cindy Ganz, Andrei Holodny, Dennis Kraus
1Medical Physics and Radiology, Memorial Sloan-Kettering Cancer Center, New York, United States; 2New York University

Both the Effortful and Mendelsohn maneuver are currently used in the clinical setting as a component of a comprehensive rehabilitation of swallowing. However, the brain responses to these tasks and how activation differs from dry swallowing has not been investigated. In this study, we seek to provide preliminary data regarding the neural networks associated with commonly-employed rehabilitation strategies. We hypothesize that with increased understanding of the neural bases behind these maneuvers, factors of peripheral injury as well as the central adaptor response can be considered in order to develop enhanced rehabilitation strategies for this challenging patient population.
Magnetization transfer (MT) is an important MRI measure in MS and the MT effect can be assessed qualitatively using magnetization transfer ratio (MTR) maps. A distinctive peak is observed in the z-spectrum of the human brain, at -1.05k Hz offset from the water frequency at 7T. This is caused by endogenous chemical exchange saturation transfer (CEST) between amide (chemical group attached to the peptide bond) and water protons. Here we obtain MTR images for negative (MTR- sensitive to MT + CEST effects) and positive (MTR+ sensitive to just MT effects) frequency offsets of the saturation and compare the distributions of these parameters in NAWM of healthy controls and patients with Clinically Isolated Syndrome (CIS: a condition that is likely to lead to MS).

Increased contrast from chemical exchange saturation transfer (CEST) effects in human brain at 7T has been used to study amide proton transfer (APT) and applied in multiple sclerosis (MS). APT imaging is sensitive to the mobile protons associated with proteins and peptides. The increased signal, T1, and spectral dispersion at 7T ameliorate this molecular MRI method. APT asymmetry analysis at 7T was used to examine unique white matter, gray matter contrast in healthy controls as well as an MS patient. Herein, we utilize the Water Spectrum Shift Reference (WASSR) method to correct for B0 inhomogeneities and center the CEST spectra.

Multiple Sclerosis (MS) is known to reduce magnetization transfer ratio (MTR) and increase the longitudinal relaxation time (T1) in the white matter (WM). Here, we measure the distribution of MTR and T1 values in normal appearing white matter (NAWM) at 7T and high spatial resolution, comparing CIS patients with healthy controls.

Signal abnormalities in multiple sclerosis such as neocortical and juxtacortical lesions can be visualized best using a double inversion recovery (DIR) sequence. DIR sequences are based on T1 filtering and aim on suppressing signal from white matter and cerebrospinal fluid. We here investigated, whether the application of additional MT saturation pulses can further improve the contrast between cortex, white matter and embedded lesions. The new sequence was evaluated in the brain of healthy volunteers and multiple sclerosis patients.
even stronger T1 contrast than FLAIR. Here, we describe an optimization with DIR to produce an image with pure T2 weighting while simultaneously suppressing CSF and demonstrate results in normal volunteers with a single slab 3D acquisition.

**14:00 4315. Diffusional Kurtosis Imaging of Gray Matter in Patients with Multiple Sclerosis**

Maxim Bester¹,², Jens H. Jensen¹, Ali Tabesh¹, Hina Jaggi¹, Cathy Hu¹, Joseph Herbert¹, Robert I. Grossman¹, Matilde Inglese³,⁴
¹Radiology, New York University, New York, NY, United States; ²Neuroradiology, Eppendorf-Hamburg University, Hamburg, Germany; ³Neurology, New York University, New York, NY, United States; ⁴Radiology, New York University, New York, NY, United States

Diffusion tensor imaging (DTI) is useful to assess subtle pathology in normal-appearing white matter of multiple sclerosis (MS) patients. Diffusional kurtosis imaging (DKI) measures the non-Gaussian water diffusion and mean kurtosis (MK) is sensitive to structural changes in isotropic tissue such as gray matter (GM). The aims of this study were to assess GM in MS patients using DKI and DTI and to investigate the relationship between GM MK and white matter injury. Differences from controls were observed in both GM MK and DTI metrics suggesting that DKI can provide additional complementary information about brain tissue microstructure.

**14:30 4316. Magnetization Transfer DTI in Multiple Sclerosis**

Alexandru Vlad Avram¹, Arnaud Guidon¹, Jeffrey Petrella, Joel Morgenlander², Allen W. Song
¹Brain Imaging and Analysis Center, Duke University, Durham, NC, United States; ²Department of Neurology, Duke University

We present a stimulated echo DTI sequence with magnetization transfer capable of imaging the diffusion anisotropy of myelin water and evaluate its potential for early detection of white matter abnormalities in multiple sclerosis. The observed myelin-specific FA changes clearly indicated the underlying demyelination in MS patients, and the degrees of the FA changes may further characterize the stage of disease progression, which may lead to an early detection of areas undergoing initial myelin microstructural changes before any significant myelin content reduction.

**15:00 4317. A Multi Center Longitudinal Study of Diffusion Tensor MRI Changes in Healthy Volunteers and People with MS**

Elisabetta Pagani¹, Jochen G. Hirsch², Petra J.W. Pouwels³, Mark A. Horsfield⁴, Elisabetta Perego¹, Achim Gass³, Stefan D. Roosendaal³, Frederik Barkhof⁴, Federica Agosta¹, Roberto Vuotto¹, Marco Rovaris¹, Domenico Caputo¹, Antonio Giorgio⁶, Jacqueline Palace⁵, Stefan Ropele⁷, Massimo Filippi⁸
¹Scientific Institute and University Hospital San Raffaele, Italy; ²University Hospital Basel, Switzerland; ³VU University Medical Centre, Netherlands; ⁴University of Leicester; ⁵Scientific Institute Fondazione Don Gnocchi, Italy; ⁶University of Oxford, United Kingdom; ⁷Medical University of Graz, Austria; ⁸Scientific Institute and University Hospital San Raffaele, Milan, Italy

We studied diffusion tensor (DT)-derived metrics acquired at baseline and after 6 months with the aims of assessing: a) longitudinal stability in healthy subjects, and b) sensitivity to tissue damage in multiple sclerosis (MS) patients. Thirty-one healthy subjects and 22 MS patients were studied in 7 MRI centers using a standardized DT-MRI sequence. Mean diffusivity and fractional anisotropy longitudinal changes in healthy subjects ranged from 1% to 3.7%. Neither of these two DT-MRI measures disclosed progressive tissue changes in MS patients, possibly because of the relatively short follow-up period.

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**13:30 4318. Knowledge-Driven Automated Segmentation of Cortical Lesions on MR Brain Images in MS**

Sushmita Datta¹, Jerry S. Wolinsky², Ponnada A. Narayana¹
¹Diagnostic and Interventional Imaging, The University of Texas Medical School at Houston, Houston, TX, United States; ²Neurology, The University of Texas Medical School at Houston, Houston, TX, United States

A knowledge-based technique for segmenting cortical lesions in multiple sclerosis (MS) with minimal human intervention is presented. This method relies on double inversion recovery and phase sensitive inversion recovery images combined with morphological operations. To the best of our knowledge, this is the first study that addresses the segmentation of cortical lesions in MS.

**14:00 4319. Detecting Multiple Sclerosis Cortical Lesions Post-Mortem Using 7 Tesla Magnetic Resonance Imaging**

Bing Yao¹, Simon Hametner², Peter van Gelderen¹, Hellmut Merkle¹, Fredric Cantor³, Henry McFarland², Hans Lassmann², Jeff H. Duyn¹, Francesca Bagnato³
¹AMRI, NINDS, National Institutes of Health, Bethesda, MD, United States; ²Centre for Brain Research, Medical University, Vienna, Austria; ³NIB, NINDS, National Institutes of Health, Bethesda, MD, United States

Focal cortical grey matter lesions (CLs) are an important component of multiple sclerosis (MS) pathology. However, detecting cortical lesions in MS using MRI poses challenges. MRI at ultra-high field strengths such as 7 Tesla has the potential to superbly enhance MS-induced CLs visibility. In this study, we applied ultra-high resolution R2* maps to detect and evaluate cortical lesions and their subtypes and the MRI results were compared with the pathology analysis.
Profile-Based Cortical Parcellation to Detection of Cortical Multiple Sclerosis

Cortical grey matter (GM) multiple sclerosis lesions are difficult to segment in MR images due to poor contrast with normal appearing GM and spatial variation in healthy GM. We propose using an observer-independent profile-based method for cortical parcellation to detect cortical lesions. Following tissue classification and surface extraction, profiles are extended from the white matter surface to the cortical surface. The cortex is parcellated according to profile intensity and shape using a kmeans classifier with squared Euclidean distance. The method is tested on high-resolution MR data from a fixed postmortem MS brain, and validated using myelin basic protein immunohistochemistry.

Evidence of Distributed Subpial T2* Signal Changes at 7T in Multiple Sclerosis: An Histogram Based Approach.

We investigated whether a histogram-based analysis of 7T T2* signal intensity in the cortex can show distributed subpial cortical changes in 14 patients with multiple sclerosis (MS), as described histopathologically. We hypothesized that this show significantly increased T2* signal intensity in patients vs controls. FLASH-T2* spoiled gradient-echo weighted images acquired at 7T. Pial and white matter surfaces generated by FreeSurfer on a 3T MEMPR were overlaid on the 7T FLASH-T2* images. T2* intensities were normalized to mean CSF intensity (T2*/CSF) and then sampled 1mm inside the pial surface. The histogram-based analysis showed significant, diffuse T2*/CSF signal increases in MS vs matched controls, particularly evident in frontal areas.

Optimisation of 3 T and 7 T T2*-Weighted MRI for the Detection of Small Parenchymal Veins in MS Lesions

Post-mortem studies of MS lesions show a close spatial relationship to parenchymal veins. In vivo study of this has previously been limited by the difficulties in demonstrating both lesions and veins on a single MR image. Recently, we have shown that T2*-weighted MRI at 7T enables simultaneous visualisation of both structures, and found that 82% of white-matter MS lesions contained a detectable vein. Here, we predict optimal scanning parameters for increasing the sensitivity of vessel detection and reducing the inherent bias towards detection of veins with particular orientations.

High Resolution Magnetic Susceptibility Mapping in Patients with Clinically Isolated Syndrome

Neurodegeneration in MS might be expected to cause an accumulation of iron in deep grey matter (dGM) structures. The aim of this study is to measure the susceptibility of dGM structures in patients with Clinically Isolated Syndrome (CIS), an early manifestation of MS.

Iron-Sensitive Quantitative Methods for Multiple Sclerosis: Lesion Evolution and Deep Grey Matter Iron Deposition

Three iron-sensitive methods are applied at 4.7T for tracking iron-based changes in the brain of patients with relapsing-remitting multiple sclerosis (MS). The methods are phase susceptibility, R2 and R2* mapping. Each method is applied with special high field adaptations. They are used to track lesion progression as well as deep grey matter changes. Each measure provides unique contrast and its own sensitivity and specificity to iron. Together these methods can provide new insight into MS progression.
Abnormal Iron Content in Deep Grey Matter Structures of MS Patients as a Function of Age
Charbel Abdo Habib1, James Garbern, 1,2, Manju Liu1, Ewart Mark Haacke1
1Radiology, Wayne State University, Detroit, MI, United States; 2Neurology, Wayne State University, Detroit, MI, United States

Multiple sclerosis (MS) is a disease whose etiology until recently has remained a mystery. A possible explanation for MS has been put forward by Zamboni et al that it is caused by a chronic cerebrospinal venous insufficiency (CCSVI). In this abstract, we show that the iron deposition seen by susceptibility weighted imaging (SWI) in MS patients is abnormal compared to normal controls and appears in areas drained by the medial venous drainage system. This finding is consistent with the CCSVI hypothesis.

Multiple Sclerosis II
Hall B Monday 14:00-16:00 Computer 77

Deep Gray Matter Atrophy in a Large Sample of Clinically Isolated Syndrome and Early Relapsing-Remitting Multiple Sclerosis Patients
Niels Bergsland1, Michael G. Dwyer1, Dana Horakova2, Ondrej Dolezal1, Zdenek Seidl1, Manuela Vanneckova1, Eva Havrdova1, Robert Zivadinov1
1University at Buffalo, Buffalo Neuroimaging Analysis Center, Buffalo, NY, United States; 2Charles University, Department of Neurology, Prague, Czech Republic; 3Charles University, Department of Radiology, Prague, Czech Republic; 4Neurology, Buffalo Neuroimaging Analysis Center, Buffalo, NY, United States

To quantify deep gray matter (DGM) atrophy in a large sample of clinically isolated syndrome (CIS) patients, early relapsing-remitting (RR) multiple sclerosis (MS) patients, and healthy controls (HC). To investigate the relationship between DGM atrophy and disability in CIS patients.

Exploring the Relations Between Emotional Disability and Subcortical Atrophy in Patients with Multiple Sclerosis
Francesca Bagnato1, Clelia Pellicano1, Fredric Cantor1, Antonio Gallo1, Sungyoung Auh1, Mary Ehrmantraut1, Jordanis Evangelou1, Vasiliki Ikonomidou1, Robert Kane1, Joan Ohayon1, Susan Stern1, Mary Ehrmantraut1, Iordanis Evangelou1, Vasiliki Ikonomidou1, Robert Kane1, Joan Ohayon1, Susan Stern1, Mary Ehrmantraut1
1NIB-NINDS-NIH, Bethesda, MD, United States; 2Clinical Director Office-NINDS-NIH, Bethesda, MD, United States; 3VA, Baltimore

Pathophysiological mechanisms underlying the development of depression in patients with multiple sclerosis (MS) remain unknown. We here demonstrate that atrophy of deep grey matter (GM) structures of the limbic circuit, such as thalamus and hippocampus, may explain up to 30% of the variance of depression in MS. The relation between depression and GM atrophy holds significant when the effect of patients’ physical disability is taken into account. The results highlight the role of neurodegeneration in specific brain sites as an important factor associated with depression in MS patients.

A Five-Year Serial Longitudinal Study of Deep Gray Matter Atrophy in Patients with Multiple Sclerosis
Robert Zivadinov1, Dana Horakova1, Michael G. Dwyer1, Deepa Ramasamy1, Eva Havrdova1, Zdenek Seidl1, Ondrej Dolezal1, Sara Hussein1, Ellen Carl1, Manuela Vanneckova1, Niels Bergsland1
1Neurology, Buffalo Neuroimaging Analysis Center, Buffalo, NY, United States; 2Charles University, Department of Neurology, Prague, Czech Republic; 3University at Buffalo, Buffalo Neuroimaging Analysis Center, Buffalo, NY, United States; 4Charles University, Department of Radiology, Prague, Czech Republic

To compare the evolution of deep gray matter (DGM) atrophy in early relapsing-remitting (RR) multiple sclerosis (MS) patients and in normal controls (NC) over 2 years. To investigate the extent of DGM atrophy progression in MS patients over 5 years.

Relation Between Thalamic Atrophy and Long-Term Disability Progression in Multiple Sclerosis: A 8-Year Follow Up Study
Maria A. Rocca1, Sarliota Mesaros1, Elisabetta Pagni1, Maria Pia Sormani1,2, Vittorio Martinelli1, Giancarlo Comi2, Massimo Filippi1
1Neuromaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; 2Unit of Biostatistics, DISSAL, University of Genoa, Genoa, Italy; 3Department of Neurology, Scientific Institute and University Hospital San Raffaele, Milan, Italy

We assessed the value of thalamic damage (in terms of atrophy and magnetization transfer ratio-MTR), taken in isolation, and its short-term changes in predicting accumulation of disability over an 8-year period in 73 patients with relapse-onset multiple sclerosis (MS). At the end of follow up, 44 patients (60%) showed a significant disability worsening. A multivariable model included baseline thalamic fraction \( p=0.01 \), odds ratio (OR)=0.62, and average lesion MTR percentage change after 12 months \( p=0.04 \), OR=0.90 as
independent predictors of disability worsening at 8 years (r²=0.29) suggesting that thalamic damage predicts the long-term accumulation of disability in MS.

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13:30  4330.  Cortical N-Acetyl Aspartate Predicts Long-Term Clinical Disability in Multiple Sclerosis – a Longitudinal MR Spectroscopic Imaging Study
   Xingchen Wu1, Lars G. Hanson1,2, Morten Blinkenberg1, Arnold Skimminge1, Per Soelberg Sorensen1, Olaf Paulson1,4, Henrik Mathiesen1,3
   1Danish Research Center for Magnetic Resonance, MR Dept., Copenhagen University Hospital Hvidovre, Hvidovre, Denmark; 2Department of Electrical Engineering, Technical University of Denmark, Denmark; 3Danish MS Research Center, Neurology Dept., Copenhagen University Hospital Rigshospitalet, Denmark; 4Dept. Neurology and Neurobiology Research Unit, Copenhagen University Hospital Rigshospitalet, Denmark

MR spectroscopic imaging (MRSI) provides in vivo information about neuronal loss or dysfunction by measuring N-acetyl aspartate (NAA). This aim of this multi-slice echo-planar spectroscopic imaging study was to test the hypothesis that cortical NAA/Creatine (Cr) is a potential predictor of neurological disability in relapsing-remitting multiple sclerosis (RRMS) by serial MRSI once every 6 months for 24 months. Clinical examinations including the Expanded Disability Status Scale (EDSS) were performed at baseline, month 24, and year 7. We found that baseline cortical NAA/Cr ratio was negatively correlated with EDSS at month 24 and year 7. In conclusion, cortical NAA/Cr in early RRMS predicts clinical disability in 7 years.

14:00  4331.  The Correlation Between Whole-Brain N-Acetylaspartate Quantification and Multiple Sclerosis Severity Score
   Daniel Rigotti1, Nissa Perry1, Joseph Herbert2, Oded Gonen1
   1Radiology, NYU School of Medicine, New York, NY, United States; 2Neurology, NYU School of Medicine, New York, NY, United States

Due to its homogeneity, there remains no accurate way to quickly assess current disease status of relapsing-remitting multiple sclerosis (RR-MS). We combine data from the Multiple Sclerosis Severity Scale (MSSS), an EDSS-based marker sensitive to small lesions in eloquent areas, with whol-brain N-acetylaspartate (WBNAA), a marker specific for diffuse neurodegeneration in a large cohort of MS patients (including ~50 clinically-confirmed benign). We show a near unanimous concurrence of the two methods in the benign patients. Additionally, using the confirmed benigns as an internal standard, ~20% of non-benigns meet the both definitions of benign, which is similar to the accepted prevalence.

14:30  4332.  Serial Whole-Brain N-Acetylaspartate Concentration in Multiple Sclerosis Patients
   Daniel Rigotti1, Matilde Inglese1, Nissa Perry1, James Babb1, Joseph Herbert2, Oded Gonen1
   1Radiology, NYU School of Medicine, New York, NY, United States; 2Neurology, NYU School of Medicine, New York, NY, United States

The irreversible effects of multiple sclerosis are chiefly caused by neuronal loss. The global concentration of the neuron-specific amino-acid derivative N-acetylaspartate (WBNAA1) has been shown to be a sensitive marker for diffuse neurodegeneration in cross-sectional studies. Here we show data from a year-long longitudinal study of nineteen newly-diagnosed MS patients where we detect a significant and biologically relevant serial decline in WBNAA. This is the first time, to our knowledge, that quantifiable changes reflecting ongoing pathogenesis have been measured in MS using WBNAA.

15:00  4333.  Classification of Multiple Sclerosis Clinical Forms by 1H Magnetic Resonanace Spectroscopy of Cerebrospinal Fluid
   Francesc Xavier Aymerich1,2, Julio Alonso1, Manuel Comabella3, Miquel E. Cabañas4, Mar Tintore2, Xavier Montalban1, Alex Rovira1
   1Unitat RM Vall Hebron (IDi), Hospital Vall Hebron, Barcelona, Spain; 2Enginyeria de Sistemes, Automàtica i Informàtica Industrial, Universitat Politècnica de Catalunya, Barcelona, Spain; 3Unitat Neuroimmunología Clínica, CEM Cat, Hospital Vall Hebron, Barcelona, Spain; 4Servei Ressonància Magnètica Nuclear, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Barcelona, Spain

The purpose was the design of a fuzzy classifier to differentiate among primary progressive multiple sclerosis (MS), relapsing remitting MS and non-MS conditions by 1H-NMR spectroscopy of cerebrospinal fluid. The design considered the fusion of classifiers based on fuzzy decision trees. We considered three different datasets (aliphatic region, aromatic region and the aggregation of both regions). We evaluated for each dataset the classifier performance by means of two classification quality indexes (correctness and robustness). Results showed mean classification correctness and robustness in the intervals [0.92,1] and [0.34,0.50] respectively. The aggregation of aliphatic and aromatic regions provided the best results.
13:30

**4334. Transversal and Longitudinal Voxelwise Whole Brain Evaluation in the Earliest Stages of Multiple Sclerosis**

Eytan Raz\(^1\), Mara Cercignani\(^2\), Emilia Shardella\(^1\), Porzia Totaro\(^1\), Carlo Pozzilli\(^1\), Marco Bozzali\(^2\), Patrizia Pantano\(^1\)

\(^1\)Department of Neurological Sciences, Sapienza University of Rome, Rome, Italy; \(^2\)Neuroimaging Laboratory, Santa Lucia Foundation, Rome, Italy

In patients with multiple sclerosis, the relationship between white matter and gray matter damage evolution is not fully understood; we aimed at longitudinally (one-year interval) evaluating the white matter and gray matter damage in the same cohort of clinically isolated syndrome patients recruited at onset. While white matter damage is detectable early and widely involves most tracts, no white matter changes over one year follow-up period are noted; conversely, a significant decrease in cortical and deep gray matter volume is observed at 1 year follow-up evaluation.

14:00

**4335. Relationship Between Structural Brain Damage and Functional Cortical Reorganisation in Patients with Benign Multiple Sclerosis**

Antonio Giorgio\(^1\), Emilio Portaccio\(^2\), Maria Laura Stromillo\(^3\), Silvia Marino\(^1\), Valentina Zipoli\(^2\), Gianfranco Siracusa\(^2\), Marco Battaglini\(^3\), Maria Letizia Bartolozzi\(^4\), Anita Blandino\(^4\), Leonello Guidi\(^5\), Sandro Sorbi\(^2\), Antonio Federico\(^5\), Maria Pia Amato\(^2\), Nicola De Stefano\(^5\)

\(^1\)Neurology and Neurometabolic Unit, Dept. of Neurological and Behavioral Sciences, Siena University, Siena, Italy; \(^2\)Dept. of Neurology, University of Florence, Italy; \(^3\)Neurology and Neurometabolic Unit, Dept. of Neurological and Behavioral Sciences, Siena University, Siena, Italy; \(^4\)Neurology Unit, Hospital of Empoli, Italy

It is not currently known whether the favorable clinical status present several years after disease onset in Benign Multiple Sclerosis (B-MS) might be due to the presence of a more efficient functional cortical reorganisation. In 25 right-handed patients with B-MS, different bilateral brain areas, not only those devoted to motor tasks, were recruited during a simple motor task. This widespread functional cortical reorganisation appeared directly related to the integrity of normal appearing brain tissues and inversely associated with focal WM pathology and progressive brain volume loss.

14:30

**4336. Patterns of Regional Gray Matter Atrophy and Cognitive Impairment in Multiple Sclerosis Patients with Different Disease Phenotypes**

Gianna Riccitelli\(^1\), Maria A. Rocca\(^1\), Cristina Forn\(^1\), Andrea Falini\(^2\), Elisabetta Pagani\(^1\), Mariaemma Rodegher\(^3\), Monica Falautano\(^1\), Paolo Rossi\(^1\), Giancarlo Comi\(^1\), Massimo Filippi\(^1\)

\(^1\)Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; \(^2\)Department of Neuroradiology, Scientific Institute and University Hospital San Raffaele, Milan, Italy; \(^3\)Department of Neurology, Scientific Institute and University Hospital San Raffaele, Milan, Italy

Using voxel-based morphometry, we found distinct patterns of regional distribution of GM damage associated with cognitive impairment (CI) in MS patients with different clinical phenotypes. CI relapsing-remitting MS patients had GM volume loss in the deep GM nuclei and in several regions in the frontal, parietal and temporal lobes. CI secondary progressive MS patients had GM volume loss in regions of the fronto-temporal lobes, and the hippocampus. CI primary progressive MS patients showed GM volume loss in the cingulum, superior temporal gyrus, inferior frontal gyrus and cerebellum. GM loss in CI MS patients was only partially correlated with T2-visible lesions.

15:00

**4337. Variation in Signal Surrounding White Matter Lesions in Primary Progressive Multiple Sclerosis**

Daniel J. Tozer\(^1\), Abdulgabbar Hamid\(^2\), Declan T. Chard\(^1\), David H. Miller\(^1\), Alan J. Thompson\(^2\)

\(^1\)NMR Unit, Department of Neuroinflammation, UCL Institute of Neurology, London, United Kingdom; \(^2\)Brain Repair and Rehabilitation, UCL Institute of Neurology, London, United Kingdom

It is known that the normal appearing tissue of subjects with multiple sclerosis is abnormal, but not whether this is linked to focal white matter (WM) lesions or more widespread. This work investigates the tissue surrounding lesions for a variety of MRI parameters and compares them to the lesion and distant WM. Up to 9 pixel thick layers were extracted for MTR, T1 and T2 maps. It was found that much of this tissue is different to WM and the lesion. Hypointense and isointense lesions (on T1 weighted images) also behaved differently suggesting different pathological processes occurring at different times.
Conventional MRI based on spin-echo sequences aids in the diagnosis of multiple sclerosis. However, MRI markers derived from these SE sequences provide limited information about tissue damage and correlate poorly with patient disability assessed with clinical tests. In this study, we introduce for the first time a new scoring method for MS evaluation using R2* histograms acquired by means of Gradient Echo Plural Contrast Imaging technique. This method is sensitive not only to lesion load, but also to the degree of tissue damage within the MS lesions thus holding promise for improving the evaluation of MS pathology.

We investigated the permeability of Blood-Brain Barrier by employing contrast-enhanced MRI, a reduced dose of Gd-DTPA and a fast T1 mapping technique. A series of T1 images before and after the injection of contrast agent were acquired. By using Patlak modeling technique and a reference for concentration of Gd-DTPA in plasma we were able to build a permeability map corresponding to the permeability of BBB underlying each pixel. We have recruited ten MS patients under the conventional treatment along with 17 controls and compared results. We were able to distinguish between high and low grade activities of BBB in MS.

Chronic cerebrospinal venous insufficiency (CCSVI) is a vascular condition characterized by anomalies of the primary veins outside the skull that restrict the normal outflow of blood from the brain in patients with multiple sclerosis (MS). Extracranial venous flow morphology in 57 MS patients and in 21 age- and sex-matched normal controls (NC), was investigated by using magnetic resonance venography (MRV) on a GE 3T scanner. 4D Time Resolved Imaging of Contrast Kinetics (TRICKS) and enhanced and unenhanced 3D Time of Flight (TOF) MRI sequences were performed. No extracranial venous flow morphology MRV differences were detected between MS patients and NC.

Chronic cerebrospinal venous insufficiency (CCSVI) is a vascular condition described in multiple sclerosis (MS) patients, characterized by stenoses of the main extracranial veins with hampered cerebral venous outflow. We hypothesized that the impaired venous outflow contributes to hypoperfusion of brain parenchyma, as measured by perfusion-weighted imaging. CCSVI was established based on the venous hemodynamic (VH) Doppler criteria. There was a significant strong association between VH criteria and PWI indices in all examined regions of the brain parenchyma in MS patients. This study demonstrates that severity of CCSVI is directly associated with hypoperfusion of the brain parenchyma in MS.
Whole-Brain Histograms of the Bound Pool Fraction Reveal Delayed White and Gray Matter Damage After Blast-Induced Mild Traumatic Brain Injury (MTBI)

Vasily L. Yarnykh¹, Hunter R. Underhill¹, Donna J. Cross¹, Kevin McCraw¹, J Biberston², D J. Hoff³, Kevin Hart⁴, Satoshi Minoshima¹, Eric C. Petrie³,⁴, Murray A. Raskind², Elaine R. Peskind³,⁴

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Cross-relaxation imaging (CRI) is a new method for quantitative mapping of parameters describing magnetization transfer between mobile water protons (free pool) and macromolecular protons (bound pool) in tissues. The purpose of this study was to test the capability of CRI to identify post-traumatic changes in brain tissues caused by blast-induced mTBI. CRI was performed in groups of military veterans recently exposed to blast trauma and healthy controls. Bound pool fraction (f) maps were reconstructed using a novel modification of the CRI processing algorithm. Histogram analysis revealed a significant decrease of f in both white and gray matter of mTBI patients.

DTI Parameters Predict Outcome in Severe Traumatic Brain Injury Patients

Joshua F. Betz¹, Jiachen Zhuo¹, Anindya Roy², Kathirkamanthan Shanmuganathan¹, Rao P. Gullapalli¹

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Patients presenting with Diffuse Axonal Injury (DAI) follow a highly variable clinical course, with initial neurological status frequently discrepant from long-term outcomes.

In this study, we compared Diffusion Tensor Imaging (DTI) parameters in 38 TBI patients with their Glasgow Coma Scale (GCS) at discharge. The DTI parameters ADC and Axial Diffusion are shown to be correlated with the GCS at the time of MRI, and can be used to predict survival better than GCS alone. In addition DTI parameters are able to predict neurological recovery at discharge.

Diffuse Metabolic Abnormalities in Acute Mild Traumatic Brain Injury: A Quantitative Proton MR Spectroscopy Study

Ivan Kirov¹, James Babb¹, Joseph Reaume¹, Robert Grossman¹, Oded Gonen¹

¹Radiology, New York University, New York, NY, United States

Since injury in mild traumatic brain injury is likely both minimal and diffuse, we used a proton MR spectroscopy (1H-MRS) strategy of both high coverage and sensitivity. To achieve the former, a 3D 1H-MRS volume-of-interest (VOI) covered 360cc of mostly white matter, and whole-brain 1H-MRS accounted for all the brain. For high sensitivity, all 480 spectra of the 3D VOI were summed, yielding one spectrum per subject. Since B0 homogeneity is better across small voxels, spectra alignment before summation resulted in excellent spectral resolution. Results revealed no neuronal dysfunction or atrophy, but diffuse elevation of choline and myo-inositol in the 3D VOI.

Parcellating Disconnectivity: Understanding the Microstructural Abnormalities Associated with Neurocognitive Deficits in Traumatic Brain Injury

Virginia F. Newcombe²,³, Jo G. Outtrim¹, Dot A. Chatfield¹, Anne Manktelow¹, Peter J. Hutchinson¹, Jon P. Coles¹,², Guy B. Williams¹, Barbara Sahakian³, David K. Menon¹,²

¹Division of Anaesthesia, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; ²Wolfson Brain Imaging Centre, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; ³Academic Department of Neurosurgery, University of Cambridge, Cambridge, United Kingdom; ⁴Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom

Impairment in decision making is commonly impaired post TBI contributing to the burden on healthcare systems worldwide. Diffusion tensor imaging (DTI) in selected ROIs was correlated with neurocognitive performance in a decision making task, the Cambridge Gambling Task; CGT. Cognitive performance on neuropsychological testing correlated significantly with diffusivity parameters in cognate brain regions. Our data add to the evidence that loss of microstructural integrity, as detected by DTI, is an important determinant of function following TBI, and confirm the involvement of key neurochemical networks in these complex neurocognitive tasks. DTI may be a useful research and clinical tool in this setting.
We report longitudinal differences of white matter degradation in 16 amyotrophic lateral sclerosis (ALS) patients who were scanned at 7-month intervals, by using a preliminary longitudinal assessment of diffusion tensor MRI (DTI). Both tractography-guided ROI analysis and voxel-wise whole brain analysis showed a significant decline of fractional anisotropy (FA) over time in the right corticospinal tract (CST). Furthermore, the FA decline was significant in the localized (mild) subgroup of ALS but not the generalized (severe) subgroup. These preliminary results suggest that longitudinal DTI measurements capture clinical progression of ALS.

### 14:00 4347 Correlation of Quantitative Diffusion Tensor Tractography with Clinical Grades of Subacute Sclerosing Panencephalitis

**Rica Trivedi**, H Anuradha, Atul Agarwal, Ram KS Rathore, Kashi N. Prasad, Rajendra P. Tripathi, Rakesh Kumar Gupta

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Diffusion tensor tractography using FACT algorithm was performed on 20 children with different grades of subacute sclerosing panencephalitis (SSPE) to look for probable correlation between tract-specific DTI metrics in major white matter pathways and Jabbour classification based clinical grades. A significant inverse correlation was observed between fractional anisotropy (FA) in major white matter tracts and clinical grades. We conclude that FA is a better measure than conventional MRI for the assessment of clinical grade in these patients.

### 14:30 4348 Diffusion Tensor Imaging of Optic Neuritis and Its Recovery

Nourhan Zayed, Fiona Costello, Michael Smith, Bradley Goodyear

1Electrical and Computer Engineering, University of Calgary, Calgary, Alberta, Canada; 2Clinical Neurosciences, University of Calgary, Calgary, Alberta, Canada; 3Electrical and Computer Engineering, University of Calgary, Calgary, Alberta, Canada; 4Radiology, University of Calgary, Calgary, Alberta, Canada

Appropriate DTI measures to characterize the presence and severity of optic neuritis (ON) as well as its recovery are not established. We hypothesized that the optic nerve experiencing ON may not actually exhibit significantly different FA or ADC from that of the unaffected eye or over the course of recovery. Instead, we predicted that ON is characterized by a greater distribution of FA and ADC, rather than means, may be a more sensitive indicator of ON and its recovery. Variability of DTI measures, rather than differences in voxel-wise whole brain analysis showed a significant decline of fractional anisotropy (FA) over time in the right corticospinal tract (CST). Furthermore, the FA decline was significant in the localized (mild) subgroup of ALS but not the generalized (severe) subgroup. These preliminary results suggest that longitudinal DTI measurements capture clinical progression of ALS.

### 15:00 4349 Effect of Central Nervous System Involvement in Systemic Lupus Erythematosus

Shiou-Ping Lee, Jie-Zhi Cheng, Wen-Yang Chiang, Chung-Ming Chen, Kao-Lun Wang

1Department of Medical Imaging and Technology, Far Eastern Memorial Hospital, Taipei, Taiwan; 2Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan; 3Center for Optoelectronic Biomedicine, National Taiwan University Medical College, Taipei, Taiwan

None of systemic lupus erythematosus (SLE) studies examined diffusion tensor imaging (DTI) and volumetric measurement in the same groups. This paper aimed to investigate the effect of central nervous system (CNS) involvement in SLE patients on two diffusion parameters, i.e., fractional anisotropy (FA) and mean diffusivity (MD), and one volumetric measurement, i.e., volume. To accurately define the corpus callosum boundaries, an automatic segmentation algorithm, cell-competition method, was adopted to delineate the boundaries of the corpus callosum on mid-sagittal FA maps to calculate FA, MD and volume of corpus callosum.
changes in leukoaraiosis include both an ischemic and a toxicity component, suggesting a central role of vascular endothelium in the formation of leukoaraiosis.

14:00  4351  Relation Between Cerebral Small Vessel Disease and Vascular Reactivity - A 7 Tesla Study
Mandy Conijn, Hans Hoogduin, Jeroen Hendriks, Mirjam Geerlings, Peter Luijten
Radiology, University Medical Center Utrecht, Utrecht, Netherlands

Lacunar infarcts and white matter lesions are thought to be caused by changes in the small vessels of the brain. It is possible that these changes influence the vascular reactivity in the brain. This study assessed if the presence of lacunar infarcts or white matter lesions is associated with a reduction of vascular reactivity, measured through the BOLD response at 7T. Both the whole brain signal change and the percentage of activated voxels were significantly decreased in patients with lacunar infarcts, but both measures were not related to white matter lesions.

14:30  4352  Characteristics of White Matter Hyperintensities in MR Images of Cerebral Amyloid Angiopathy
Junya Konishi, Julien Milles, Jeroen van der Grond, Mark A. van Buchem
1Department of Radiology, Kobe University Graduate School of Medicine, Kobe, Japan; 2Department of Radiology, Leiden University Medical Center, Leiden, Netherlands

MRI manifestations of cerebral amyloid angiopathy (CAA) are white matter hyperintensities (WMH) and cerebral micoleeds (CMB), and the characteristics of CAA-related WMH have not been studied before. The purpose of this study was to study the volume and distribution of CAA-related WMH using an automated method for probability maps and voxelwise statistical maps of WMH on MRI. Our study demonstrated that CMB are associated with WMH, and increased numbers are associated with increased volumes of WMH. Also we found evidence for differences in distribution of WMH associated with CAA-type CMB as compared to other types of CMB.

15:00  4353  Asymmetric Dilatation of Virchow-Robin Space in Unilateral Internal Carotid Artery Stenosis
Tae-Sub Chung, Ah Young Park, Sang Hwan Suh
1Diagnostic Radiology, Gangnam Severance Hospital, Yonsei University College of Medicine, Seoul, Korea, Republic of

Problem: To test the hypothesis that chronic ischemia followed by white matter atrophy is associated with Virchow-Robin spaces (VRSs) dilatation by determining the relationship between unilateral internal carotid artery (ICA) stenosis and asymmetric dilatation of VRSs on the same side. Methods: We retrospectively reviewed axial T2-weighted and diffusion weighted MR images (GE Signa Excita 3-T) of 46 patients with severe unilateral ICA stenosis (>70%), diagnosed by carotid contrast MRA and carotid digital subtraction angiography (DSA) between Feb. 2007 and Sep. 2009. Hyperintense lesions in the pre- and post-central gyri and corona radiata along CST pathway in the high convexity white matter on T2WI were included as VRSs. All lesions were graded into score 0 (None), score 1 (linear hyperintensity not extending to the corona radiata), score 2 (linear hyperintensity extending to the corona radiata) and score 3 (round or oval hyperintensity larger than 2mm). We statistically analyzed the difference of VRSs score between bilateral hemispheres, the correlation between VRSs score and severity of ICA stenosis, the correlation between VRSs score and age, and the difference of ipsilateral VRSs scores according to existence of infarction. Results: The VRSs on the ipsilateral and contralateral sides showed statistical difference (p<0.01). The relationship between the patient’s age and VRSs score showed positive correlation(p=0.01) There was no significant correlation between VRSs score and ICA stenosis severity. The ipsilateral VRS scores were significantly higher in the cases with infarction than without infarction(p<0.05).Conclusion: Our results suggest that chronic ischemic process and subsequent white matter degeneration and atrophy is a factor of VRSs dilatation. Therefore, if we detect the unusual VRSs dilatation on brain MR, it is worth considering the possibility of ischemic condition and necessity of furtherworkup.
In Vivo Quantitative Imaging and Postmortem Protein Analysis Reveal CNS Hypomyelination in the Restless Legs Syndrome

Byeong-Yeul Lee1, Padmavathi Ponnuru2, James R. Connor2, Qing X. Yang1,3
1Bioengineering, Penn State Hershey Medical Center, Hershey, PA, United States; 2Neurosurgery, Penn State Hershey Medical Center, Hershey, PA, United States; 3Radiology, Penn State Hershey Medical Center, Hershey, PA, United States

Iron deficiency has been known as a contributing factor for restless legs syndrome (RLS), resulting in the disruption of iron availability in the brain. In this study, we investigated the ex vivo myelin analysis in RLS autopsy brain tissue and imaging-based analysis using voxel-based morphometry (VBM). Our data showed that a decrease in expression of myelin-specific protein and decrease in the white matter volume in RLS brain. These results support our hypothesis that global iron deficiency may cause reduction of myelin (hypomyelination), which in turn leads to structural change of white matter in RLS.

Multimodality Study for Restless Legs Syndrome Revealed Local Morphological Changes Associated with T2: Hypomyelination or Iron Deficiency?

Byeong-Yeul Lee1, James R. Connor2, Qing X. Yang1,3
1Bioengineering, Penn State Hershey Medical Center, Hershey, PA, United States; 2Neurosurgery, Penn State Hershey Medical Center, Hershey, PA, United States; 3Radiology, Penn State Hershey Medical Center, Hershey, PA, United States

Restless leg syndrome (RLS) is a sensory-motor disorder characterized by uncontrollable urges to move the legs, causing chronic sleep disturbances. Brain iron deficiency has been considered as an important contributing factor to RLS. In this study, we applied voxel-based relaxometry (VBR) for in vivo iron measurement and voxel-based morphometry (VBM) for morphological study, respectively to a same study cohort, aiming to determine the impact of iron deficiency on brain morphology. Our results revealed a striking association of local T2 change with brain atrophy.

7T MRI Demonstrates Diffuse Iron Deposition in the Putamen and Caudate Nucleus in CADASIL

Michael K. Liem1, Saskia A.J. Lesnik Oberstein2, Maarten J. Versluis1, Marion L.C. Maat-Schieman1, Joost Haan1, Andrew G. Webb1, Michel D. Ferrari3, Mark A. van Buchem1, Jeroen van der Grond1
1Radiology, Leiden University Medical Center, Leiden, Netherlands; 2Clinical Genetics, Leiden University Medical Center, Leiden, Netherlands; 3Neurology, Leiden University Medical Center, Leiden, Netherlands

In this study we quantified focal and diffuse iron deposition in cerebral autosomal dominant arteriopathy with subcortical infarcts and leukencephalopathy (CADASIL), using in-vivo and ex-vivo 7 Tesla MRI. Twenty-five CADASIL patients and 15 healthy controls were examined using high resolution susceptibility-weighted imaging on 7 Tesla MRI. Three ex-vivo CADASIL brain specimens were scanned with extra high resolution. Focal areas of signal loss were found in 36% of CADASIL patients, in a pattern consistent with microbleeds. Diffuse areas of signal loss were found in the putamen and caudate nucleus of CADASIL patients, in a pattern consistent with increased iron accumulation.

Advanced MRI in the Ageing Brain & Related Psychiatric Diseases

Hall B Monday 14:00-16:00 Computer 79

Evidence for Brain White Matter Damage and Atrophy with Aging: A Diffusion Tensor MRI Tractography Study

Federica Agosta1, Stefania Sala1, Elisabetta Pagani1, Domenico Caputo2, Massimo Filippi1
1Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; 2Department of Neurology, Scientific Institute Fondazione Don Gnocchi, Milan, Italy

Linear and quadratic age-related WM tract microstructural and volumetric changes were evaluated in 84 healthy volunteers. Age-related MD increase and FA decrease were associated with region-specific patterns of radial diffusivity increase and both decrease and increase in axial diffusivity. The quadratic model better fitted DT-MRI changes in several WM tracts. A negative correlation was found between age and left cingulum and fornix volumes. The quadratic model better fitted volume decline in corpus callosum and right inferior-fronto-occipital fasciculus. WM integrity loss and atrophy varies with age by WM tract and may reflect different degrees of severity of changes in WM properties.
Large-Scale ADC Histogram Analysis of the Brain Aging: Normal Versus Abnormal (667 Subjects, 2 Days-93.8 Years)
Memi Watanabe, Noreen Ward, Al Ozonoff, Steven Kussman, Koji Tanabe, Kaan Erbay, Naoko Saito, Hernan Jara, Osamu Sakai
1Department of Radiology, Boston Medical Center, Boston University School of Medicine, Boston, MA, United States; 2Department of Biostatistics, Boston University School of Public Health, Boston, MA, United States; 3Department of Biomedical Engineering, Boston University, Boston, MA, United States

Purpose: To study age dependencies of ADC histogram and impact of brain abnormalities on ADC in a large and wide age ranged population. Methods: Brain data of 667 subjects (2 days-93.8 years) were obtained by DW-SE-ssEPI and ADC histograms of the whole brain were generated. The subjects were divided into normal and abnormal groups by MR findings and clinical histories. Results: The abnormal group showed higher ADC peak values compared with the normal. Conclusion: The aging patterns of ADC peak values of normal and abnormal brain groups have been demonstrated in a large and wide age ranged population.

Cortical Thickness Is Linked to Executive Functioning in Adulthood and Aging.
Agnieszka Z. Burzynska, Irene E. Nagel, Claudia Preuschhof, Sebastian Gluth, Lars Bäckmann, Shu-Chen Li, Ulman Lindenberger, Hauke R. Heekeren
1Max Planck Institute for Human Development, Berlin, Germany; 2Aging Research Center, Karolinska Institutet, Stockholm, Sweden; 3Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

We investigated the cortical structural underpinnings of executive functioning in 129 healthy adults (73 younger, 20-32 years; 56 older, 60-71 years). We measured executive functions by Wisconsin Card Sorting Test (WCST) and cortical thickness by applying surface-based segmentation (Freesurfer). The structural underpinnings of WCST largely overlapped with previously defined WCST functional patterns and the structure-performance relationship was stronger in later than in earlier adulthood. Our data suggest that the extent of structural preservation in old age differentiates between high and low performers, underscoring the need of taking performance level into account when studying changes in brain structure across adulthood.

Assessing the Corticospinal Tract with Multimodal Quantitative MRI
Pierre-Yves Herve, Eleanor F. Cox, Ashley Loftipour, Olivier Mougin, Sam Wharton, Richard W. Bowtell, Tomas Paus, Penny A. Gowland
1Brain & Body Centre, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; 2SPMMRC, Physics & Astronomy, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

The study of human white matter fibre pathways was first performed on post-mortem material, notably via dissection or with the Weigert staining method for myelinated fibres (Dejerine, 1895). More recently, diffusion weighted imaging emerged as a non-invasive alternative for both the tracing and the measurement of quantitative parameters of fibre pathways. Here we use multimodal quantitative imaging to assess differences between white matter structures.

Tuesday 13:30-15:30 Computer 79

Mineralization of the Globus Pallidus as a Function of Age: Are There Major Differences Between Caucasians and Chinese?
jiangtiao liu, E Mark Hacke, Kuncheng li, Manju liu, Ana M. Daugherty, Ambreen Sattar, bo wu
1Radiology, Xuanwu hospital, Beijing, China; 2MRI Institute for Biomedical research, Wayne State University, Detroit, MI, United States; 3Behavioral and Cognitive Neuroscience, Wayne State University, Detroit, MI, United States; 4Diagnostic Radiology, Wayne State University, Detroit, MI, United States

SWI images for 37 age and gender matched healthy paired subjects (Chinese versus Caucasians) were retrospectively reviewed. The GP was measured in two adjacent slices. Two cutoffs were used and the percentage cutoff pixels between two groups was compared. Mineralization increases with age in the GP whether measured with phase or magnitude. For the right globus pallidus, healthy Chinese subjects have a higher percentage of mineralization at any age group while for the left side it tends to grow after age 40. SWI offers the potential to examine differences in disease that might correlate with mineralization.

Measuring T2 at Ultra High Field: Effects of Age and Sex
Eleanor F. Cox, Susan E. Pritchard, Peter J. Wright, Tomas Paus, Penny A. Gowland
1SPMMRC, Physics & Astronomy, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; 2Brain & Body Centre, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

This study has examined the effects of age (40-75 years) and sex on the T2 of the human brain at 7.0 T. The results show that there is considerable variation in T2s across grey and white matter regions, and a trend for women to have longer WM T2s than men. The white matter T2s of men changed with age but the T2s of women did not.
questioned. Here we report on a study of myelin content in schizotypy, revealing a linear association between schizotypy score and proneness, remains unknown. Increasingly, the role of white matter connectivity, mediated by myelin, to these disorders is being schizophrenia spectrum disorders. However, the underlying etiology of these disorders, believed to represent a spectrum of psychosis white matter efficiency and processing ability in high schizotypes.

regions, and significant correlation between intensity over one difference cluster and known exposure-related measures. Results imply compared to Talairach transformation, functional image registration by DARTEL had more group difference clusters in expected (diffeomorphic anatomical registration through exponentiated lie algebra) to functional image registration in the PAE population. As been a roadblock in the detailed analysis of images from this population. The present study examines the applicability of DARTEL (diffeomorphic anatomical registration through exponentiated lie algebra) to functional image registration in the PAE population. As compared to Talairach transformation, functional image registration by DARTEL had more group difference clusters in expected regions, and significant correlation between intensity over one difference cluster and known exposure-related measures. Results imply DARTEL may be a more accurate method for functional image registration for the PAE population.

Wednesday 13:30-15:30 Computer 79

13:30 4366. Do Differences in Myelin Underlie the Schizotypal Personality Spectrum? 
Katrina McMullen1, Shannon Kolind1,2, Emma Barkus1, Sean CL Deoni1
1Centre for Neuroimaging Sciences, Institute of Psychiatry, London, England, United Kingdom; 2Centre for Functional Magnetic Resonance Imaging of the Brain, Oxford University, Oxford, England, United Kingdom; 3Department of Psychiatry, University of Wollongong, NSW, New South Wales, Australia

ALTERATIONS IN REGION GREY MATTER VOLUME, WHITE MATTER STRUCTURE AND BRAIN FUNCTION ARE KNOWN ASSOCIATES SCHIZOPHRENIA AND SCHIZOPHRENIA SPECTRUM DISORDERS. HOWEVER, THE UNDERLYING ETIOLOGY OF THESE DISORDERS, BELIEVED TO REPRESENT A SPECTRUM OF PSYCHOSIS PROVENESS, REMAINS UNKNOWN. INCREASINGLY, THE ROLE OF WHITE MATTER CONNECTIVITY, MEDIATED BY MYELIN, TO THESE DISORDERS IS BEING QUESTIONED. HERE WE REPORT ON A STUDY OF MYELIN CONTENT IN SCHIZOTYPY, REVEALING A LINEAR ASSOCIATION BETWEEN SCHIZOTYPY SCORE AND MYELIN WATER FRACTION, LOCALIZED TO THE LEFT HEMISPHERE. THESE RESULTS, CONSISTENT WITH PRIOR fMRI RESULTS, ARE SUGGESTIVE OF ALTERED WHITE MATTER EFFICIENCY AND PROCESSING ABILITY IN HIGH SCHIZOTYPES.

14:00 4367. Clinical 1H MRS Studies of Glutamatergic Neurotransmission in Bipolar Disorder 
Wen-Jang Chui1,2, Mathew Norris1, Renu Kotwal, Caleb M. Adler, Mi-Jung Kim, Rachel Whitsel, Jing-Huei Lee,1,2, Melissa P. DelBello, Stephen M. Strakowski,2
1Psychiatry, Univ. of Cincinnati, Cincinnati, OH, United States; 2Center for Imaging Research, Univ. of Cincinnati, Cincinnati, OH, United States; 3Department of Psychiatry, University of Wollongong, NSW, New South Wales, Australia

GLUTAMATE (Glu) HAS BEEN FOUND TO PLAY AN IMPORTANT ROLE IN Bipolar Disorder (BD). THE ACCURATE MEASUREMENT OF Glu HAS BEEN HURDLED BY THE LARGE SIGNALS OVERLAPPING AND BROADENING BASELINE. INSTEAD OF REPORTING Glu LEVELS, THE Glx SUM OF Glutamate, Glutamine and GABA) HAS BEEN WIDELY USED IN GLUTAMATERGIC NEUROTRANSMISSION RESEARCH. IN THIS WORK, WE STUDIED Glu LEVELS USING SHORT ECHO PRESS SPECTROSCOPY, AND TE-AVERAGED SPECTROSCOPY IN MEDICATION-FREE, Lithium-TREATED BD PATIENTS AND HEALTHY VOLUNTEERS. THE RESULTS HAVE ALLOWED US TO EVALUATE THE Glu LEVEL DIFFERENCES BETWEEN THE TWO GROUPS, AND THE EFFECT OF LITHIUM TREATMENT ON Glu LEVELS.

14:30 4368. Impaired Brain Circuitry and High-Energy Phosphates in Bipolar Disorder 
Wen-Jang Chui1,2, Amanda Stover,1 Jonathan Dudley,1 David Caldwell,1 Amanda Marie Opaskar2, Mathew Norris1, Martine Lamy1,2, Jane Allendorfer1, Stephen M. Strakowski1,2, Jing-Huei Lee1,2, James C. Eilissen1,2
1Psychiatry, Univ. of Cincinnati, Cincinnati, OH, United States; 2Center for Imaging Research, Univ. of Cincinnati, Cincinnati, OH, United States; 3Graduate Program in Neuroscience, Univ. of Cincinnati; 4Biomedical Engineering, Univ. of Cincinnati

THE COMBINED APPROACH OF fMRI AND 31P spectroscopy is used to investigate 1) abnormal brain activation, and 2) the correlation between high-energy phosphates and abnormal activation in the brains of patients with bipolar disorder. A behavioral task, the Balloon Analogue Risk Task, was used during fMRI to identify brain regions that differed between bipolar and healthy subjects. Several regions within anterior limbic network such as amygdala, ventrolateral prefrontal cortex and orbitofrontal cortex were identified by fMRI activation differences. 31P MRSI data showed significant alterations of Pi, PDE and PCR in some of these regions.
15:00

**4369. Brain Morphometry Correlates of Pharmacoresistant in Schizophrenia**

Mario Quarantelli, Olga Palladino, Anna Prinster, Vittorio Schiavone, Barbara Carotenuto, Arturo Brunetti, Gianluca Ventrella, Angela Marsili, Andrea De Bartolomeis, Marco Salvatore

1Biostructure and Bioimaging Institute, National Research Council, Naples, Italy; 2Institute of Psychiatry, University “Federico II”, Naples, Italy; 3“S.D.N.” Foundation, Naples, Italy; 4Department of Biomorphological and Functional Sciences, University “Federico II”, Naples, Italy

We assessed structural cerebral differences between 16 normal volunteers (NV), 16 Responder (R-SC), and 19 Non-Responder (NR-SC) schizophrenia patients. Segmented T1-weighted volumes were analyzed voxel-wise to assess local differences in gray matter volume between the three groups, using permutation tests implemented in the CamBA software. Main clusters of significant GM differences among the three groups emerged in bilateral frontal cortices, right insula and right medial temporal lobe, differences being mainly due to reduced GM volumes in NR-SC, as compared to both NV and R-SC, suggesting that differences between NV and SC may be mainly driven by NR-SC patients.

**Thursday 13:30-15:30**

**Computer 79**

13:30

**4370. Increased Anterior Cingulate GABA Level Following Electroconvulsive Therapy in Patients with Major Depressive Episodes**

Pallab Bhattacharyya, Erik Beall, Mark Lowe, Michele Phillips, David Muzina

1Cleveland Clinic, Cleveland, OH, United States

Gamma amino butyric acid (GABA) level in anterior cingulate is known to be reduced in depression patients. Electroconvulsive therapy (ECT) is a commonly used treatment for major depressive episodes (MDE). Using 1H spectroscopy we have measured anterior cingulate GABA level 2 weeks before and 1-2 weeks after ECT treatment in MDE patients. Our preliminary data show an increase in anterior cingulate GABA level following ECT in MDE patients.

14:00

**4371. Cingulate Cortex Functional Connectivity Increase Predicts Relapse of Major Depression.**

Naranjargal Dashdorj, Neil L. Nixon, G Worwood, M Liotti, E Georgiadi, D P. Auer, P F. Liddle

1Academic Radiology, University of Nottingham, Nottingham, United Kingdom; 2Division of Psychiatry, University of Nottingham, United Kingdom

Functional imaging studies suggest alterations in cortico-limbic circuit connectivity in depression. Moreover, these functional connectivity (fc) changes were found to correlate with symptom severity and normalised upon antidepressant treatment. The direction of these fc changes is however debated with one group showing increased default network connectivity and another showing decreased cortico-limbic connectivity. Nonetheless, more studies implicate cingulate gyrus as a focus of dysfunction. In this study, we compared fc of the rostral anterior cingulate between patients with history of remitted recurrent depression and healthy controls.

14:30

**4372. Regional Gray Matter Changes in Major Depressive Disorder: An Optimized Voxel-Based Morphometry Study**

Zhiyun Jia, Tijiang Zhang, Qizhu Wu, Junran Zhang, Su Lu, Xiaoqi Huang, Weihong Kuang, Qiyong Gong

1Huaxi MR Research Center (HMRRC), Department of Radiology, West China Hospital of Sichuan University, Chengdu, Sichuan province, China; 2Department of Psychiatry, West China Hospital of Sichuan University

High resolution 3-dimensional T1-weighted (T1W) images were acquired using a 3.0T MR scanner in fifty two patients experiencing major depression (MDD) and fifty two normal controls. Using voxel based morphometry (VBM), we demonstrated that MDD patients have higher volume and density of grey matter in multiple brain areas than controls, especially in bilateral thalamus. This is consistent with a previous postmortem study which demonstrated increased neuronal number in the thalamus of patients with depression relative to the nonpsychiatric comparison subjects. Further study should reveal this change in thalamus using multiple methods.

15:00

**4373. Thickness Profile Generation for the Corpus Callosum Using Laplace's Equation**

Christopher Leslie Adamson, Amanda Wood, Jian Chen, Sarah Barton, David Reutens, Mark Waltefang

1Developmental and Functional Brain Imaging, Murdoch Childrens Research Institute, Melbourne, VIC, Australia; 2Department of Medicine, Southern Clinical School, Monash University, Melbourne, VIC, Australia; 3Centre for Advanced Imaging, University of Queensland, Brisbane, QLD, Australia; 4Neuropsychiatry Unit, Royal Melbourne Hospital, Melbourne, VIC, Australia; 5Melbourne Neuropsychiatry Centre, University of Melbourne, Melbourne, VIC, Australia

We present a method to generate thickness profiles of the corpus callosum from midsagittal slices of MR images. The method is mostly automated, robust and computationally efficient. We utilise the method to reveal morphological changes of the corpus callosum at different stages of schizophrenia.
Developing Brain I

Hall B Monday 14:00-16:00  Computer 80

14:00  4374  Static and Dynamic Characteristics of Resting State CBF in Newborn Infants

Feng Liu1,2, Zhishun Wang1,2, Yunsuo Duan1,2, Fernando Zelaya1, David J. Lythgoe1, Alayar Kangarlu1,2, Bradley S. Peterson1,2
1Psychiatry, Columbia University, New York, NY, United States; 2New York State Psychiatric Institute, New York, NY, United States; 1Institute of Psychiatry, King’s College London, University of London, London, United Kingdom

Resting-state networks in the infant brain have been studied recently using BOLD fMRI in order to better understand the early developmental phase of default mode network. Perfusion MRI with arterial spin labeling (ASL) has been implemented to study resting-state functional connectivity in the adult brain. We applied pulsed ASL on unsedated, sleeping newborns, and studied the static and dynamic characteristics of cerebral blood flow (CBF) with a method using high-pass filtering and demodulation. We demonstrated the ability to detect the functional connectivity using the CBF fluctuation extracted from ASL signals during the resting state of newborns.

14:30  4375  The Dynamics of Brain and CSF Growth in Normal Versus Hydrocephalic Development in a Mouse Model

Jason Gregory Mandell1,2, Thomas Neuberger3, Corina S. Drapaca1, Andrew G. Webb4, Steven J. Schiff1,5
1Center for Neural Engineering, Department of Engineering Science and Mechanics, Pennsylvania State University, University Park, PA, United States; 2Department of Bioengineering, Pennsylvania State University, University Park, PA, United States; 3Huck Institutes of the Life Sciences, Pennsylvania State University, University Park, PA, United States; 4C.J. Gorter Center for High Field MRI, Department of Radiology, Leiden University Medical Center, Leiden, Netherlands; 5Departments of Neurosurgery and Physics, Pennsylvania State University, University Park, PA, United States

Hydrocephalus has traditionally been quantified by linear measurements of ventricle size. However, clinical outcome is related to brain cognitive function, which is more directly related to brain volume. We quantified brain and ventricular volume growth in normal versus kaolin-induced hydrocephalic development in mice from ages 2-12 weeks using 14T MRI. Hydrocephalic mice responded with brain growth either consistent with or faster than normal, correlating to the absence or presence of parenchymal edema. Clinical measurements were unable to discriminate between these patterns, demonstrating the clinical importance of brain volume measurements and the feasibility of constructing normative brain and fluid growth curves.

15:00  4376  CSF and Cerebral Blood Flows in Paediatric: Evaluation with Phase Contrast MRI

Olivier Balèdent1, Véronique Courtois2, Béatrice Kreppicicz2, Julie Schauvliege3, Anthony Fichten4, Roger Bouzerar1, Catherine Gondry-Jouet3
1image processing, university hospital, Amiens, Picardie, France, Metropolitan; 2Ecole supérieure d’ostéopathie et de biomécanique, Paris; 3radiology, university hospital, Amiens, Picardie, France, Metropolitan; 4image processing, neurosurgery, Amiens, Picardie, France, Metropolitan; 5pediatry, university hospital, Amiens, Picardie, France, Metropolitan

The purpose of this study is to quantify with PC-MRI, CSF and cerebral vascular flows maturation in paediatric population and demonstrate how altered flows in children with hydrocephalus can be pointed. 36 children (5days-8years) were defined as a paediatric control group. 6 newborns (9days-6weeks) with ventricular dilation associated to intra ventricular haemorrhage (IVH) were individually studied. Arterial, venous, cervical CSF and aqueductal CSF flows were presented function of age. The 6 IVH newborn presented alterations of their cerebral flows. Quantitative assessments of CSF and blood flows indicate the potential usefulness of PC-MRI in paediatric hydrocephalus.

15:30  4377  Direct Phase Imaging in Neonate

Kai Zhong1, Lynn Anderson2, Linda Chang2, Thomas Ernst2, Oliver Speck1
1Biomedical Magnetic Resonance, Otto-von-Guericke University, Magdeburg, Saxony-Anhalt, Germany; 2Department of Medicine, University of Hawaii, Honolulu, HI, United States

Direct phase images have been shown to yield superior gray (GM) and white matter (WM) contrast at high field compared to conventional magnitude images. However, the contrast mechanisms are still being discussed. Previous studies are limited to high field and adult volunteers or patients. In this study, phase imaging in neonates is demonstrated for the first time and provides insights to the various factors contributing to phase contrast, such as water macromolecule exchange (WME) and myelination. Phase differences between GM and WM are significantly reduced in neonates prior to myelination and seem to originate primarily from WME contrast. Therefore, direct phase imaging can study brain development and related pathologies in neonates.
The integrated action between functionally connected yet spatially distributed regions to form different "modules" is central to normal brain function. Numerous studies have been performed to detect possible brain modules supporting specific functions including sensory processing and the higher level cognition in adults. However, the formation of modular structures is likely to be substantially influenced by both structural maturation and learning, particularly during the early stage of brain development. In this study, healthy pediatric subjects 2 wks to 2 yrs of age were recruited and modularity analysis was performed to discern whole brain functional networks so as to delineate the emerging and developing trajectory of brain modular structures in a critical time period of early brain development.

Neonatal brain is highly vulnerable to injury resulting in subsequent cognitive and motor disabilities. Our goal was to show that there are microstructural abnormalities in regions of the brain separate from the focal necroses in non-cystic periventricular leukomalacia. A diverse cohort of neonates was scanned at term equivalent age using DTI. We found that there is microstructural injury in white matter both proximal and distant from necrotic foci.

Image quality of standard gradient echo T1-weighted fetal brain MRI acquisitions is poor because of artefacts relating to fetal and maternal motion. The Snapshot Inversion Recovery (SNAPIR) sequence, an optimised T1-weighted protocol using single shot techniques, offers a potential robust alternative to standard T1-weighted methods. Qualitative analysis showed that significantly increased visualisation of the fetal brain anatomy was achieved with SNAPIR in 24 out of 32 anatomical structures studied, compared to the reference protocol. Additionally, quantitative analysis showed that SNAPIR presented with significantly increased contrast ratios between grey and white matter in the upper (p=0.01) and lower cerebrum (p=0.0001).

Probabilistic atlases have been established in the literature as a standard tool for enhancing the intensity-based classification of brain MRI. The rapidly growing neonatal brain requires an age-specific spatial probabilistic atlas to guide the segmentation process. In this paper we describe a method for dynamically creating a probabilistic atlas for any chosen stage of neonatal brain development. We present an atlas created from the segmentations of 153 subjects providing prior tissue probability maps for six structures - cortex, white matter, subcortical gray matter, brainstem and cerebellum, for ages of 29 to 44 weeks of gestation.

Normal infant brain development was evaluated using both DTI and MRS. Apparent diffusion (ADC) and fractional anisotropy (FA) were correlated to brain metabolites within the same MRS voxel in 5 brain regions. With increasing postconceptional age, increases in FA and decreases in ADC were associated with increases in NA, in the frontal white matter, which reflect more coherent fiber organization and axonal growth. Similar age-related changes in DTI measures in the CST were associated with decreased MI which
suggests myelination or a reduction in radial glia. Decreased tCr and CHO in the FGM combined with decreased ADC suggest cellular pruning.

14:00 4383. More Than Meets the Eye: Age and Pathology-Related MTR Changes in Very Preterm Brains
Andrew David Chung1, Revital Nossin-Manor1,2, Hilary E. A. Whyte2,3, Margot J. Taylor1,2, Manohar M. Shroff1, John G. Sled4,5
1Diagnostic Imaging, Hospital for Sick Children, Toronto, ON, Canada; 2Neurosciences & Mental Health, Research Institute, Hospital for Sick Children, Toronto, ON, Canada; 3Neonatology, Hospital for Sick Children, Toronto, ON, Canada; 4Physiology Experimental Medicine, Research Institute, Hospital for Sick Children, Toronto, ON, Canada; 5Medical Biophysics, University of Toronto, Toronto, ON, Canada

Our study compared MTR values of the basal ganglia (BG), thalami, and pons in the very preterm (<32 weeks GA) brain. Forty-four infants were separated into four groups based on radiological findings on conventional MR scans: normal, WM-injury, Grade I GMH + WM-injury, Grade II GMH + WM-injury. MTR increased with GA in both the BG and thalami in the normal and WM-injury groups. This relation was not seen in the pons in any of the groups. In the BG, the normal group demonstrated consistently higher MTR values than the WM-injury group, indicating GM effects not detected on conventional MRI.

14:30 4384. Investigating the Relationships Between T1 and T2 Relaxation Times and Myelin Water Fraction During Neurodevelopment
Sean CL Deoni1, Evelynne Mercure1, Anna Blast2,3, David Gasston2, Mark Johnson3, Steven CR Williams2, Declan G. Murphy5
1Centre for Neuroimaging Sciences, Institute of Psychiatry, London, United Kingdom; 2Centre for Neuroimaging Sciences, Institute of Psychiatry, London, England, United Kingdom; 3Centre for Brain and Cognitive Development, Birkbeck University, London, England, United Kingdom; 4Department of Psychological Medicine, Institute of Psychiatry, London, England, United Kingdom

T1 and T2 are commonly cited as reflecting myelin content and used as surrogate markers. However, the relationships between myelin content changes and changes in these relaxation parameters have not yet been established. In this study, we investigated the relationship between brain T1, T2 and myelin water fraction (MWF) during the developmental period from 3 through 8 months of age in healthy infants. We demonstrate that while T1 is generally correlated with MWF, T2 is a poor predictor of myelin content. Results of this study suggest care should be taken in using relaxation parameters to infer alterations in myelin content.

15:00 4385. Altered Small-World Properties in Newborns at High Risk for Schizophrenia
Feng Shi1, Yong Fan1, Pew-Thian Yap1, Weili Lin1, John Gilmore2, Dinggang Shen1
1Department of Radiology and BRIC, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States; 2Department of Psychiatry, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

We evaluated the brain structural networks on three groups of subjects, as high risk newborns of schizophrenic parents, healthy newborns, and healthy adults. All three groups showed small-world network properties. From healthy newborns to healthy adults as brain develops, global efficiency is increased while local efficiency is decreased, with reduced regularity and enhanced randomness. This suggests that brain networks develop from a “local to distributed” organization. However, high risk newborns showed a more localized pattern and lack global integration compared with healthy newborns. This indicates that a delay might have occurred during brain development of the high risk group.

Thursday 13:30-15:30  Computer 80

13:30 4386. Age Norms for Diffusion Tensor Data - Evaluation with TBSS
Nancy Rollins1,2, Paul Glasier1, Leanne Tamm4, Linda Butwell, Jonathan Chia1, Michael Morriss, Zhiyue Jerry Wang
1Radiology, Childrens Medical Center, Dallas, TX, United States; 2University Texas Southwestern Medical Center, Dallas, TX, United States; 3Psychiatry, paul.glasier@childrens.com, Dallas, TX, United States; 4Psychiatry, University Texas Southwestern Medical Center; 5Philips HealthCare Systems

Using TBSS, variable age effects on tensor metrics are seen across the brain in school-aged children suggesting valid comparisons of FA and diffusivities between typically developing children and children with neuro developmental or psychiatric conditions probably require age-matched cohorts unless the affects of the disease are known to be large in comparison to the scale of age effects.

14:00 4387. Exploring Developmental Structural Connectivity Patterns by in Vivo Diffusion Tensor Imaging Tractography on Longitudinal Pediatric Data
Pew-Thian Yap1, Yong Fan1, Yasheng Chen1, John H. Gilmore2, Weili Lin1, Dinggang Shen1
1Department of Radiology, University of North Carolina, Chapel Hill, NC, United States; 2Department of Psychiatry, University of North Carolina, Chapel Hill, NC, United States

Our objective is to study pediatric brain networks by applying DTI based fiber tractography on 39 healthy pediatric subjects with longitudinal data collected at the average ages of 2 weeks, 1 year, and 2 years. Our results indicate that the small-world architecture exists at birth, with low global and local efficiencies, and is strengthened in later stages of development. In addition, we found that the node degree distributions of the networks have Gaussian tails, signifying their single-scale nature. We also observe, across
development, that the brain network seems to evolve progressively from a local, predominantly proximity based, connectivity pattern to a more distributed, predominantly functional based, connectivity pattern.

14:30 4388. Imaging Myelination in Infant Neurodevelopment
Sean CL Deoni1, Evelyne Mercure2-3, Anna Blasi2-3, David Gasston1, Alex Thomson3, Mark Johnson2, Steven CR Williams3, Declan GM Murphy3
1Centre for Neuroimaging Sciences, King's College London, Institute of Psychiatry, London, United Kingdom; 2Centre for Brain and Cognitive Development, Birkbeck University of London, London, United Kingdom; 3Department of Psychological Medicine, King's College London, Institute of Psychiatry, London, United Kingdom

We report on the use of multi-component relaxation time measurement (MCR) to investigate myelination during human neurodevelopment. Using the mcDESPOT MCR technique, we present the first ever in vivo visualization of healthy white matter myelination from 3 through 8 months of age. Obtained results faithfully reproduce the spatio-temporal sequence established via post-mortem histological studies.

15:00 4389. Cortical Development in Children Between 6 and 11 Years
L. Tugan Muftuler1, Kevin Michael Head2, Claudia Buss3, Orhan Nalcioglu1, Curt A. Sandman2, Elysia Poggi Davis2
1Center for Functional Onco-Imaging, University of California, Irvine, CA, United States; 2Psychiatry & Human Behavior, University of California, Orange, CA, United States

There is evidence that various cognitive and psychiatric disorders might stem from abnormal cerebral development during childhood. Therefore, understanding normal cortical development is important to study these abnormalities. For that purpose, we analyzed high resolution MRI images from 129 normally developing children between ages 6 and 11 years. Cortical development between 6 an 11 years as well as within 2 year windows was investigated. The results demonstrated that the cortical development was expressed in different anatomical locations within each time frame. The findings reveal the cortical development in a much finer spatial and temporal detail than has been previously reported.

Developing Brain II
Hall B Monday 14:00-16:00 Computer 81

14:00 4390. Evidence of Neuronal Growth Spurts During Development in Healthy Children and Adolescents Using a Multi-Voxel In Vivo 31P Spectroscopy at 4 Tesla
Jeffrey A. Stanley1, Dalal Khatib1, Rachel M. Dick1, Olivia A. McGarragle1, Frank P. MacMaster1, Arthur L. Robin1, David R. Rosenberg1, Brian Martis2, Vaibhav A. Diwadkar1
1Psychiatry and Behavioral Neurosciences, Wayne State University School of Medicine, Detroit, MI, United States; 2Psychiatry, VA Ann Arbor HCS, University of Michigan, Ann Arbor, MI, United States

The high prevalence of the onset of many psychiatric disorders during childhood and adolescence highlights the importance of understanding the molecular biochemistry of healthy neurodevelopmental trajectories in the maturing brain. In vivo 31P spectroscopy is a neuroimaging method that is sensitive in detecting biochemical changes as the brain develops. The purpose of this study is to investigate changes in membrane phospholipid metabolites of healthy children and adolescents to discern developmental growth spurts in cortical and subcortical structures using in vivo 31P spectroscopy at a higher magnetic field strength.

14:30 4391. An MR/CT Compatible Neonatal Incubator
Martyn Paley1, Anthony Hart1, Mark Lair2, Paul Griffiths1
1Academic Radiology, University of Sheffield, Sheffield, Yorkshire, United Kingdom; 2Advanced Health Technology, Hertford, Hertfordshire, United Kingdom

A lightweight MR/CT compatible neonatal incubator has been developed to allow scanning of neonates on whole body MRI systems.
The ability to diagnose abnormal MR-signal in the infant's brain is challenging. The aim of this study is to present a methodology that enables quantification and comparison between infants' brains, by creating a standard space that includes the imaging data and templates and atlases adjusted to infants. Preliminary results of DTI in HIE infants with and without hypothermia (cooling to 33°C for 72 hours) compared with normal controls are presented, demonstrating the applicability of this methodology in the pathological brain. Diffusivity values in different VOs and histogram analysis show the effect of the therapeutic hypothermia in HIE.

**Tuesday 13:30-15:30 Computer 81**

**4394. Value of Susceptibility-Weighted Imaging for Diagnosing Intracranial Hemorrhage in Neonates According to Anatomic Location**

Tetsu Niwa1, Taro Takahara2, Thomas Kwee1, Manon Benders2, Linda de Vries2, Vincent O. Boer1, Freddy Visser1, Peter R. Luijten1, Floris Groenendaal2

1Radiology, University Medical Center Utrecht, Utrecht, Netherlands; 2Neonatology, Wilhelmina Children’s Hospital/University Medical Center Utrecht, Utrecht, Netherlands

Susceptibility-weighted imaging provides additional value for increasing certainty to detect or rule out hemorrhage in neonates.

**14:00 4395. Correlations Between Increased ASL Perfusion and Decreased ADC in Newborns with Hypoxic Ischemia**

Rudolph Pienaar1,2, Neel Madan,2, Patricia Ellen Grant1,2

1Radiology, Childrens Hospital Boston, Boston, MA, United States; 2Radiology, Harvard Medical School, Boston, MA, United States

We have developed a methodology to detect correlations between increased ASL-CBF perfusion and decreased ADC values in areas of hypoxic ischemia.

**14:30 4396. Specific White Matter Diffusion Characteristics in the Newborn Period Correlate with Either Neuromotor or Neurocognitive Outcome at 2 Years, a Voxel Based Analysis**

Tamara Faundez1, Rebecca Recker1, Cristina Borradori Tolsa1, Gregory Lodygensky1, Francois Lazeurus2,3, Petra Susan Huppi1

1Division of Child Growth & Development, University of Geneva and University Hospitals, Geneva, Switzerland; 2Service of Radiology, University of Geneva and University Hospital of Geneva, Geneva, Switzerland; 3Center for Biomedical Imaging (CIBM), Lausanne and Geneva, Switzerland

The goal of this study is to assess by diffusion MRI, neonatal structural deficit of premature babies related to neurocognitive deficits later in life. Using voxel-based analysis, we correlate ADC measures at birth with neuromotor and neurocognitive outcome at the age of 2 years. We observed distinct ADC changes with respect to mental and physical scores. Mental score is correlated with regions linked to future cognitive function like language. Neuromotor-related regions include precentral white matter linked to motor pathways. ADC changes are negatively correlated with cognitive scores, which speak in favour of a possible myelination delay already present at birth.
Effects of the Cumulative Exposure to Lipopolysaccharide and Hyperoxia on the Developing Rat Brain Assessed by High-Field Diffusion Tensor Imaging

Yohan van de Looij1,2, Marco Sifringer3, Felix Brehmer4, Bettina Gerstner5, Petra S. Hüppi1, Rolf Gruetter2,6, Ursula Felderhoff-Müser2, Stéphane V. Sizonenko1

1Division of Child Growth & Development, Department of Pediatrics, University of Geneva, Geneva, Switzerland; 2Laboratory for Functional and Metabolic Imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; 3Department of Anesthesiology, Charité-Universitätsmedizin Berlin, Berlin, Germany; 4Department of Neonatology, Charité-Universitätsmedizin Berlin, Berlin, Germany; 5Department of Radiology, University of Geneva and Lausanne, Geneva and Lausanne, Switzerland; 6Department of Pediatrics, University Hospital Essen, Essen, Germany

In premature infants, periventricular leukomalacia (PVL) is a common type of cerebral white matter injury and animal models of PVL can be achieved by lipopolysaccharide (LPS) exposure. Furthermore, premature infants are subjected much earlier to relative hyperoxia, because of a dramatic rise of oxygen tissue tension compared with intrauterine conditions but hyperoxia is supposed to negatively influence brain development and maturation. The goal of this study was to characterize changes in the pup rat brain following LPS and/or hyperoxia exposure by DTI derived parameters. This study confirmed white matter damages following LPS injection and/or Hyperoxia revealed by DTI derived parameters.

Wednesday 13:30-15:30  Computer 81

A Combined Brain Proton MR Spectroscopy and Amplitude-Integrated Electroencephalography Study in Term Newborns with Hypoxic-Ischemic Encephalopathy

Caterina Tonon1, Claudia Testa1, David Neil Manners1, Emil Malucelli2, Gina Ancora2, Giovanni Tani3, Paolo Ambrosetto1, Bruno Barbieri1, Raffaele Lodì1

1MR Spectroscopy Unit, Department of Internal Medicine, Aging and Nephrology, University of Bologna, Bologna, Italy; 2Institute of Neonatology, Department of Woman, Child and Adolescent Health, Policlinico S’Orsola-Malpighi, Bologna, Italy; 3Paediatric Radiology Unit, Department of Woman, Child and Adolescent Health, Policlinico S’Orsola-Malpighi, Bologna, Italy

Perinatal hypoxic ischemic encephalopathy (HIE) remains a frequent cause of neurological sequelae and death. The accurate assessment of HIE is crucial for determining the prognosis. The aim of the study was to relate the brain metabolic changes detected by 1H-MRS to the amplitude integrated-electroencephalogram (a-EEG) time course findings in newborns at term and to evaluate their correlation with outcome. Both 1H-MRS and a-EEG findings showed a good correlation with the severity and the outcome of cerebral HI injury. These data, obtained from 1H-MRS and a-EEG in non-treated infants, represent reference data for future investigations to select candidates for cool cap therapy.

Anisotropy of Callosal Motor Fibers Predicts Functional Impairment in Children with Periventricular Leukomalacia

Inga Koerte1,2, Paula Pelavin1, Martha E. Shenton2, Marek Kubicki3, Berit Kirmess3, Steffen Berweck3, Maximilian Reiser1, Florian Heinen1, Birgit Ertl-Wagner1

1Institute of Clinical Radiology, Ludwig-Maximilians-University, Munich, Germany; 2Psychiatry Neuroimaging Laboratory, Brigham and Women's Hospital, Boston, MA, United States; 3Dr. von Hauners Children's Hospital, Ludwig-Maximilians-University, Munich, Germany

Patients with periventricular leukomalacia are known to have altered white matter structure of motor tracts. We aimed to evaluate the microstructure (DTI), interhemispheric inhibitory competence as measured by transcranial magnetic stimulation (TMS) and hand motor function in children with mild cerebral palsy compared to normal controls. Anisotropy values of transcallosal motor fibers appear to correlate with functional impairment of hand motor function in children with PVL. The microstructure of transcallosal motor fibers could serve as a potential predictor for hand motor function in patients with cerebral palsy.

Preliminary Experience with DTI and Multi-Exponential T2 Relaxation Imaging of Myelin in Children Treated for ALL

Wilburn E. Reddick1, Qing Ji1, David C. Carver1, John O. Glass1, Jun-Yu Guo1, Zoltan Patay2

1Division of Translational Imaging Research, St. Jude Children's Research Hospital, Memphis, TN, United States; 2Division of Diagnostic Imaging, St. Jude Children's Research Hospital, Memphis, TN, United States

We investigated the feasibility and utility of performing DTI (FA, Dradial) and multi-exponential T2 relaxation imaging (MWF, long-T2) to assess differing degrees of myelin disruption early in the course of therapy for ALL in two 4 year old patients with varying degrees of leukoencephalopathy. Relatively low FA, increased Dradial, and decreased MWF were evident in regions of the T2 hyperintensities. Long-T2 maps demonstrated that one patient had more severe myelin and axonal damage than the other patient. This study is the first to conduct DTI and multi-exponential T2 relaxation imaging during ALL therapy and provides support for additional prospective studies.
We developed a new method to provide a comprehensive quantitative analysis of brain anatomy in cerebral palsy patients, based on two technical points: diffusion tensor imaging and an automated 3D whole brain segmentation based on our brain atlas and a nonlinear normalization technique (large-deformation diffeomorphic metric mapping). This method was applied to thirteen patients and the reliability of the automated segmentation measured by Kappa revealed "almost perfect" agreement with the manual segmentation. We illustrate some potential applications on individual characterization and group comparison. This technique also provides a framework to determine the impact of various neuroanatomic features on brain functions.

**Thursday 13:30-15:30 Computer 81**

**13:30 4402. Metabolic Abnormalities in Perituberous Tissue: Initial Results of a Proton MR Spectroscopy Study of Pediatric Tuberous Sclerosis Complex**

Ivan Kirov, Joseph Oved, Sarah Milla, Orrin Devinsky, Howard Weiner, Oded Gonen

While traditionally the MRI-defined tuber has been the primary surgery target for abolishing seizures in Tuberous Sclerosis Complex (TSC), there is evidence that non-tuberous tissue, specifically surrounding the active tuber, may also be epileptogenic. We use 3D proton MR spectroscopy (1H-MRS) to characterize tubers and normal-appearing tissue. Initial results reveal metabolic abnormalities in tubers and its adjacent tissue (peritubers). In one case electro-encephalography identified a seizure locus and 1H-MRS showed high lipid signal in its perituberous tissue. In all, these findings have implications for improved identification and definition of the epileptogenic zone in TSC.

**14:00 4403. White Matter Microstructure Correlates with Reading Ability in Healthy Subjects and Those with Fetal Alcohol Spectrum Disorder**

Catherine Lebel, Carmen Rasmussen, Katy Wyper, Gail Andrew, Christian Beaulieu

Diffusion tensor imaging (DTI) studies of reading consistently highlight left temporal-parietal white matter. We used DTI to correlate fractional anisotropy (FA) with reading ability in 40 subjects with fetal alcohol spectrum disorder (FASD) aged 5-19 years and 40 healthy controls. The control group had three significantly correlated clusters in the left temporal-parietal area and one in the genu (all positive), in good agreement with previous findings. The FASD group had 9 clusters with significant correlations (3 negative, 6 positive). These included 3 left temporal-parietal clusters, showing consistent involvement in this area, but also demonstrating more widespread correlations than controls.

**14:30 4404. Pituitary Volumes and Functions in Children with Growth Hormone Deficiency: Volumetric Magnetic Resonance Data**

Miyuki Takasu, Chihiro Tani, Masaki Ishikawa, Keizo Tanitame, Hiroshi Fukuda, Jun Horiguchi, Atsushi Tamura, Yoshikazu Nishi

We investigated correlations between pituitary volumes measured from 3D volumetric MR imaging and the severity of the clinical and biochemical features in 69 patients with growth hormone deficiency. Pituitary volumes of all patient groups were smaller than the age-matched published norms. Pituitary volumes of both female groups were significantly smaller than that of controls. Pituitary volumes of male pubertal or postpubertal group were significantly larger than that of prepubertal one, but this difference was not significant between female groups. IGF-1 levels were significantly correlated with pituitary volumes. LH levels were significantly correlated with pituitary volumes in male patients.

**15:00 4405. MRI Assessment of Iron-Mediated Pathology Following Juvenile Traumatic Brain Injury**

Lei Huang, Arash Adami, Andre Obenaus

In a rat model of graded juvenile traumatic brain injury (jTBI), we characterized iron mediated neuropathology using multi-modal MRI that correlated with histology and tissue iron measures. Our results showed that SWI was sensitive to monitor pathological iron
accumulation in vivo following increasing jTBI severity that correlates with increased tissue iron deposition, especially, non-heme iron concentration. The iron-mediated neuropathology was dominant in corpus callosum at this age.

Clinical Stroke Imaging

Hall B Monday 14:00-16:00 Computer 82

14:00  4406. High Resolution Wall and Lumen MRI of the Middle Cerebral Arteries at 3-Tesla

Chang-Woo Ryu¹, Geon-Ho Jahng², Eui-Jong Kim³, Woo Suk Choi³, Dal-Mo Yang²

¹Radiology, East-West Neo Medical Center, Kyung Hee University, Seoul, Korea, Republic of; ²Radiology, Kyung Hee University Hospital, Kyung Hee University, Seoul, Korea, Republic of

We imaged the walls of stenotic MCAs in symptomatic and asymptomatic patients using high resolution BB-MRI, in order to characterize vulnerable plaques. Multi-contrast (T1-, T2-, and proton density)-weighted BB-MRIs were acquired in 16 MCA stenoses. The plaque signal intensity was interpreted and the total wall thickness was measured at the most stenotic segment. Hyperintense foci were demonstrated more frequently within the plaques of symptomatic stenoses than within the plaques of asymptomatic stenoses. Total wall thickness in the symptomatic plaques was significantly higher than that seen in the asymptomatic stenoses. High-resolution, multi-contrast-weighted BB-MRI has the potential to characterize intracranial atherosclerotic plaques.

14:30  4407. Carotid Plaque Imaging with BLADE and SPACE

Masahiro Ida¹, Kenji Saitoh², Shunsuke Sugawara¹, Yuko Kubo¹, Keiko Hino¹, Naoya Yorozu¹

¹Department of Radiology, Tokyo Metropolitan Ebara Hospital, Tokyo, Japan

BLADE is a self-navigating method for motion correction by repeated acquisition of the center of k-space. BLADE reduces physiological motion artifact. SPACE is based on 3D fast SE sequence with high turbo-factor and exploits refocusing pulses with variable flip-angle. This study attempts to estimate clinical utilities of BLADE and 3D SPACE for the evaluation of carotid plaques. BLADE sequences without cardiac gating are feasible for detecting not only atherosclerotic plaque but also the neighboring turbulent flow. Multi-slice BLADE sequences and 3D SPACE are useful methods and the initial sequences of choice for screening of carotid plaque and its risk factors.

15:00  4408. High-Resolution Vessel Wall MRI of Chronic Unilateral MCA Occlusion

Chang-Woo Ryu¹, Geon-Ho Jahng², Dal-Mo Yang², Woo-Suk Choi³

¹Radiology, East-West Neo Medical Center, Kyung Hee University, Seoul, Korea, Republic of; ²Radiology, Kyung Hee University Hospital, Seoul, Korea, Republic of

We acquired high-resolution vessel wall MRI of MCA in patients with chronic unilateral MCA occlusion and evaluated the characteristics of MRI and clinical findings. We selected 17 consecutive patients who presented with unilateral MCA occlusion. High resolution PD-weighted TSE MRI with the saturation of arterial flow, were acquired the occluded MCA using 3T MRI. As the presence of MCA on MRI, MCA occlusion was classified plaqued MCA (13/17): the clear demonstration of MCA and atrophic MCA group (4/17): no MCA in the sylvian fissure. The vessel wall MRI might be a useful imaging tool that characterizes MCA occlusion in vivo.

15:30  4409. Identification of Basilar Plaque Components Using Multicontrast High-Resolution 3-Tesla MRI

Xin Lou¹, Lin Ma¹, weijian Jiang², Ning Ma², Tingqiang Zhao³

¹PLA General Hospital, Radiology Department, Beijing, China; ²Beijing Tiantan Hospital, Interventional Neuroradiology, Beijing, China

Multicontrast high-resolution MR imaging (HRMRI) is an effective tool for the assessment of carotid plaque vulnerability, but there has been no report on identification of plaque components of basilar atherosclerosis. We therefore performed this prospective cohort study on 3T multicontrast HRMRI for 24 patients with >70% symptomatic atherosclerotic stenosis of basilar artery (BA). Our preliminary results revealed that multicontrast HRMRI (TOF, T1W, PDW, and T2W) can be used to study plaque components of severe basilar atherosclerosis with good interobserver and intraobserver agreements for the identification of LR/NC, IH and calcification.

Tuesday 13:30-15:30 Computer 82


Iris Asllani¹, Sophia Ryan, Eric Zarahn, John W. Krakauer

¹Columbia University, New York, NY, United States

Stroke leads to a reduction in cerebral blood flow (CBF) in areas remote from the focal infarct, often in another arterial territory. This phenomenon is called diaschisis and is thought to reflect a reduction in neuronal metabolism mediated transsynaptically from the infarct region. Our study has two main goals: 1) To characterize diaschisis after subacute strokes using partial volume corrected (PVEs) arterial spin labeling (ASL) MRI. 2) To determine if resolution of diaschisis correlates with recovery from hemiparesis. We present ASL CBF images in stroke patients in the first month and then again at 6 months. The change in CBF is correlated with...
improvements in motor deficit over the same time period. ASL CBF images from each patient are also compared with age-matched stroke-free controls via a one-to-many statistical analysis.

14:00  **4411. Recovery Pattern in Chronic Stroke Post-Physiotherapy: An FMRI Study**  
Ashu Bhasin¹, Senthil S. Kumaran², M.V. Padma³, Sujata Mohanty³, Rohit Bhatia¹  
¹Department of Neurology, All India Institute of Medical Sciences, New Delhi, India; ²DEPARTMENT OF N.M.R., ALL INDIA INSTITUTE OF MEDICAL SCIENCES, NEW DELHI, DELHI, India; ³Stem Cell Facility, All India Institute of Medical Sciences, New Delhi, India  

Synopsis: Physiotherapy based on mirror therapy concept was administered to stroke patients for 8 weeks. BOLD mapping was carried out for fist-clenching tasks of paretic hand. It has been observed that during observation of a movement, motor areas in the primary and premotor cortex show enhanced activation when a subject observes the unaffected hand in a mirror or in simulated environments.

14:30  **4412. Voxel Based Lesion Symptom Mapping for the Identification of Critical Regions for Motor Recovery After Stroke**  
Peter Chang¹, Xue Wang¹, Darren Gitelman¹,², Ryan Lo¹, Robert Levy¹,³, Justin Hulvershorn¹, Todd Parrish¹  
¹Radiology, Northwestern University, Chicago, IL, United States; ²Neurology, Northwestern University; ³Neurological Surgery, Northwestern University; ⁴Northstar Neuroscience, Seattle, Wa  

VLSM was conducted on 151 chronic stroke subjects from 26 imaging centers with different MR vendors and field strengths. The results identify regions in the corona radiata that appear to assimilate motor, pre-motor and sensory information similarly for right and left hemisphere lesions. There were significant results for dominant lesions but not non-dominant lesions. This indicates that following stroke of the non-dominant hemisphere, reorganization of the dominant hemisphere occurs to a greater degree than the reorganization of the non-dominant hemisphere following a dominant lesion. This population-based study may improve the ability to give an accurate prognosis and optimize treatment.

15:00  **4413. Autologous Intravenous Stem Cells Infusion in Chronic Stroke: A Pilot Study in Indian Patients**  
Ashu Bhasin¹, Senthil S. Kumaran², M.V. Padma³, Sujata Mohanty³, Rohit Bhatia¹  
¹Department of Neurology, All India Institute of Medical Sciences, New Delhi, India; ²Department of N.M.R., All India Institute of Medical Sciences, New Delhi, Delhi, India; ³Stem Cell Facility, All India Institute of Medical Sciences, New Delhi, India  

Autologous mesenchymal stem cells were infused intravenously in chronic stroke patients with a dose of 5 x 10⁸ cells through median cubital vein in 4-6 hours. The experimental group was treated with stem cells and a focused physiotherapy regime and the control group with only physiotherapy regime. It was observed that stem cell transplantation leads to therapeutic benefits as measured on clinical (fugl meyer & barthel index) and functional markers (BOLD, DTI) augmenting neural plasticity.

**Wednesday 13:30-15:30  Computer 82**

13:30  **4414. Where Is the “Clinical Relevant” Penumbra? a Voxel-Based Analysis in Acute Stroke Patients**  
Charlotte Rosso¹,², Yohan Atta³, Sophie Crozier¹, Romain Valabrègue¹, Dider Dormont, ²,³, Sylvain Bailler¹, Stepanne Lehericy¹,²,³, Yves Samson¹  
¹Urgences Cerebro-Vasculaires, Pitie-Salpetriere Hospital, Paris, France; ²CRICM, INSERM UMR S_975, CNRS UMR_7225, Equipe COGIMAGE, Pitie-Salpetriere Hospital, Paris, France; ³Centre for Neuroimaging Research – CENIR, Pitie-Salpetriere Hospital, Paris, France; ⁴Neuroradiology Department, Pitie-Salpetriere Hospital, Paris, France; ⁵Neuroradiology Department, Pitie-Salpetriere, Paris, France  

In this study, we used, in 43 MCA acute stroke patients with initial and follow-up MRI, ADC maps to study the tissue-at-risk location. To investigate this issue, time course of ADC changes between initial and follow-up MRI, impact of recanalization in final ADC-defined infarct areas, and relationship with key regions associated with poor outcome were assessed. Infarct expansion concerns perisylvian regions but also the deep MCA territory and part of the CST. The comparison of ADC maps of recanализed vs. non-recanализed and good vs. poor outcome patients shows a great overlap and involved the lenticular nucleus and the CST.

14:00  **4415. Acute Change of Tissue Perfusion in Acute Stroke Patients After TPA Treatment**  
Hongyu An¹, Andria Ford², Cihat Eldeniz³, Katie Vo¹, Rosana Ponisio³, Yasheng Chen¹, William Powers¹, Jin-Moo Lee², Weili Lin¹  
¹University of North Carolina at Chapel Hill, Chapel Hill, NC, United States; ²Washington University in St. Louis, St. Louis, MO, United States  

Spatial heterogeneity of tissue perfusion change was detected in acute patients after tPA treatment. Concurrent development of reperfusion and new hypoperfusion were observed. Compared to the reperfused region, the nonreperfused region had a significantly greater MTT prolongation, suggesting that tissue with a more severe initial injury is more likely to remain hypoperfused. Moreover, the nonreperfused regions had the highest risk of infarction, followed by new hypoperfused and reperfused regions.
14:30  **4416.** ADC-Based Prediction of MCA Infarct Growth: Validation in 216 Acute Stroke Patients

Charlotte Rosso1,2, Yohan Attal2, Sandrine Deltour1, Nidiyare Hevia-Montiel2, Eric Bardinet1,2, Dider Dormont1,2, Stephane Lehericy3,4, Sylvain Baillet2, Yves Samson1,5

1Urgences Cerebro-Vasculaires, Pitie-Salpetriere Hospital, Paris, France; 2CRICM, INSERM UMR S_975, CNRS UMR_7725, Equipe COGIMAGE, Pitie-Salpetriere Hospital, Paris, France; 3Centre for NeuroImaging Research – CENIR, Pitie-Salpetriere Hospital, Paris, France; 4Neuroradiology Department, Pitie-Salpetriere Hospital, Paris, France; 5CRICM, INSERM UMR S_975, CNRS UMR_7725, Equipe COGIMAGE, Pitie-Salpetriere, Paris, France

In this work, we used ADC maps to predict infarct growth. The method is based on an algorithm able to make the initial infarct lesion growing up, taking in account the slight ADC decrease which occurs in the at-risk tissue. Patients (n=216) with MCA acute stroke confirmed by an initial (<6H) and a control MRI have been tested. Predicted vs. final infarct sizes and growths were significantly correlated. The accuracy to predict infarct growth status (patients with or without infarct growth) reached 76%. The ADC-defined tissue-at-risk is a hallmark of the penumbra since MCA recanalization could spare it.

15:00  **4417.** Change in Axial and Radial Diffusional Kurtoses for Ischemic Stroke

Jens H. Jensen1, Maria F. Falangola1,2, Caixia Hu1, Ali Tabesh1, Calvin Lo1, Otto Rapalino1, Joseph A. Helpern1,2

1Radiology, New York University School of Medicine, New York, NY, United States; 2Center for Advanced Brain Imaging, Nathan S. Kline Institute, Orangeburg, NY, United States; 3Department of Radiology, Massachusetts General Hospital, Boston, MA, United States

Diffusional kurtosis imaging was applied to measure the axial and radial diffusional kurtoses for three patients with subacute focal ischemic stroke. For all three patients, the axial diffusional kurtoses increased substantially in the affected regions (relative to the contralateral side), but for two of the subjects, the radial diffusional kurtoses showed little change. In these two cases, the affected regions appeared to be primarily in white matter, suggesting that for white matter ischemia mainly alters the diffusional kurtosis in the axial direction.

**Thursday 13:30-15:30**  
**Computer 82**

13:30  **4418.** Arterial Spin Label Imaging of Transient Ischemic Attack

Greg Zaharchuk1, Jean-Marc Olivo1, Roland Banmer1, Ajit Shankaranarayanan1, Michael Mlynash2, Gregory W. Albers1, Michael E. Moseley1

1Department of Radiology, Stanford University, Stanford, CA, United States; 2Department of Neurology and Neurological Sciences, Stanford University, Stanford, CA, United States; 3Applied Sciences Laboratory - West, GE Healthcare, Menlo Park, CA, United States

ASL can detect subtle alterations in CBF and arterial arrival times. ASL abnormalities (including the borderzone sign) can be detected in the majority of acute hemispheric TIA patients and may therefore be able to provide objective evidence of a true vascular event.

14:00  **4419.** Susceptibility Weighted Imaging in Patients with Occlusion of Middle Cerebral Artery

Bum-soo KIM1, Jae-Young Byun1, Yoon-joo Lee1, So-lyung Jung1, Kook-jiun Ahn1, Won-san Jung1, Won-jong Yoo1, Young-joo Kim1

1Department of Radiology, The Catholic University of Korea, Seoul, Korea, Republic of Korea

In this study, imaging findings of SWI were retrospectively reviewed and analyzed for 12 consecutive patients with occlusion of middle cerebral artery. Total or partial loss of arterial bright signal intensity in ipsilateral sylvian fissure was most frequently seen, followed by dark blooming of intravascular clot, prominent venous hypointense signal of the medullary / cortical vein, global hemorrhagic transformation. SWI provides valuable information in diagnosis and evaluation of patient with middle cerebral artery stroke.

14:30  **4420.** PC-MRI Study of Cerebral Blood and CSF Flow Patterns in Patients with Diagnosed Cerebral Venous Thrombosis.

Souraya Stoquart-Elsankari1, Marek Czosnyka2, Pierre Lehmann3, Hervé Deramond4, Olivier Balédent1

1Biophysics and Image Treatment, Amiens University Hospital, Amiens, France; 2Department of Neurosciences, University of Cambridge, Addenbrooke's hospital, Cambridge, United Kingdom; 3NeuroRadiology, Amiens University Hospital, Amiens, France

Our objectives were to study by PC-MRI intracranial flow alterations in patients with cerebral venous thrombosis (CVT). Thanks to a specific selection of MRI parameters, and of key-parameter velocity encoding values, intracerebral and cervical arterial and venous flows, as well as cervical and ventricular CSF flows were evaluated in 6 patients with diagnosed CVT on MR Venography. PCMRI did not detect any venous flow in the veins and/or sinuses with thrombosis detected on Venography, and it showed alterations of CSF flows in 5/6 patients. PC-MRI is a complementary tool in the evaluation of venous thrombosis effects on intracranial dynamics.
Clinical Significance of Ischemic Hypointense Findings in Vessels and Tissue in Gradient Echo T2*-Weighted Images at 3 Tesla Evaluated by Simple Visual Estimation in Stroke Patients Treated with Intravenous Rt-PA
Masafumi Harada, Hitoshi Kubo, Naomi Morita, Hiromu Nishitani, Tsuyoshi Matsuda
1Department of Medical Imaging, University of Tokushima, Institute of Health Biosciences, Tokushima City, Tokushima, Japan; 2Department of Radiology, University of Tokushima, Institute of Health Biosciences, Tokushima City, Tokushima, Japan; 3GE Healthcare Japan, Hino, Tokyo, Japan

The purpose of this study was to determine the clinical significance of Ischemic vessels (IschV) and tissue (IschT) signs in gradient echo T2*-weighted images (Gre T2*-WIs) and the correlation of clinical outcome with visual recognition of these signs. The current study may indicate that IschT sign in Gre T2*-WI at 3 tesla would include more severe ischemia than IschV sign and is therefore a candidate for determination of risk for deteriorated outcome with Gre T2*-WI at 3 tesla.

MRA & CSF Studies with Clinical Applications

MRA Hall B Monday 14:00-16:00 Computer 83

Resolving Arterial Contributions in Vessel Encoding Dynamic Angiography
Michael A. Chappell, Tom W. Okell, Peter Jezzard, Mark W. Woolrich
1FMRIB Centre, University of Oxford, Oxford, United Kingdom; 2Institute for Biomedical Engineering, University of Oxford, Oxford, United Kingdom

Using a Vessel Encoded Arterial Spin Labelling preparation it is possible to provide non-invasive vessel selective angiography. However, the ability to separate the contributions from all the labelled arteries, e.g. all four carotids and vertebrais, can be limited by the specification of the acquisition. Here a new analysis method for VE-ASL data, that can separate different vessel contributions with even limited data, is modified and applied to angiographic images. Results for separation of carotids and vertebral are presented indicating that this is a viable alternative to highly invasive intra-arterial contrast methods.

Flow Velocity Measurement in the Carotid Bifurcation Using 4D Flow-Sensitive MRI and Doppler Ultrasound
Andreas Harloff, Timo Zech, Felix Wegent, Simon Bauer, Martin Schumacher, Michael Markl
1University Hospital Freiburg, Freiburg, Baden-Württemberg, Germany

Flow-sensitive 4D MRI was used to assess absolute blood flow velocities within the carotid bifurcation in healthy volunteers and patients with high-grade internal carotid artery (ICA) stenosis before and after carotid endarterectomy. MRI data were compared with Doppler ultrasound as the reference method. Reliability and reproducibility of MRI based measurements were tested. Velocity measurement was feasible at any desired site of the carotid bifurcation. Compared to Doppler ultrasound, however, MRI underestimated systolic blood flow velocity by approximately 30%.

Implementing VERSE for Time of Flight RF Pulses at 7Tesla: Methodological Considerations
Sebastian Schmitter, Soeren Johst, Michael Bock, Kamil Ugurbil, Pierre-Francois van de Moortele
1University of Minnesota, Center for Magnetic Resonance Research, Minneapolis, MN, United States; 2German Cancer Research Center, Heidelberg, Germany

It has been shown that successful Time-of-flight (TOF) images can be obtained at 7T benefiting from higher SNR and longer tissue T1. However, because of SAR constraints, magnetization transfer pulses that are used at 1.5T/3T cannot be used at 7T; saturation pulses are often skipped and the flipangle is limited. These issues can be addressed using the VERSE principle to decrease SAR. However, VERSE pulses are more sensitive to B0. Here, we investigate in simulations and in vivo the impact of off-resonance frequencies on RF excitation profile of ramp shaped RF pulses (TON) when applying VERSE at 7T.

Insight Into the Anatomy of Cerebrospinal Fluid Flow in the Human Ventricular System Using MR Velocity Mapping
Andreas Stadlbauer, Wilma van der Riet, Erich Salomonowitz
1MR Physics Group, Department of Radiology, Landesklinikum St. Poelten, St. Poelten, Austria; 2European MRI Consultancy (EMRIC), Strasbourg, France

To study the spatial and temporal dynamics of CSF flow in the ventricular system of 40 normal volunteers using time-resolved 3D magnetic resonance velocity mapping. Classification of CSF flow based on calculation of 3D particle path lines over the cardiac cycle revealed one uniform flow pattern for the lateral ventricles, three categories for the third and two categories for the fourth ventricle. We found no significant aging effects on both the presence of a specific CSF flow pattern and on flow velocities. Our results provide the first detailed demonstration of the anatomy of CSF flow within the human ventricular system.
3D MRA with Dynamic Sequence Switching: Improved Imaging of the Arterial and Venous Phases

Petrice M. Mostardi\textsuperscript{1}, Clifton R. Haider\textsuperscript{1}, Norbert G. Campeau\textsuperscript{1}, Stephen J. Riederer\textsuperscript{1}

\textsuperscript{1}Radiology, Mayo Clinic, Rochester, MN, United States

Time-resolved CE-MRA is widely used for imaging the intracranial arterial system, while a single high spatial resolution acquisition is generally used for the intracranial venous system. The goal of this work was to combine these two studies into a single contrast-enhanced acquisition. A time-resolved CAPR sequence was played out for about 50 sec for arterial phase imaging, providing images every 3.57 sec. Then, by seamlessly switching to a high spatial resolution, 38 sec long scan, data for a venogram was acquired. High speed reconstruction further allows the time of switching to be done in real time on a patient-specific basis.

High-Resolution Non-Contrast Enhanced Dark Blood Brain Vessel Imaging Using a Balanced Steady State 3D Projection Reconstruction Sequence

Aiming Lu\textsuperscript{1}, Keith R. Thulborn\textsuperscript{1}

\textsuperscript{1}Center for MR Research, University of Illinois at Chicago, Chicago, IL, United States

Balanced steady-state free precession (SSFP) sequences have been used for non-contrast enhanced vessel imaging due to its high SNR efficiency and bright blood signal. However, as cerebrospinal fluid (CSF) signal is also bright in SSFP images, the application of these techniques to brain has been limited. In this work, we demonstrate that instead of appearing as bright signal, the vessels in the brain have low signal intensity in high-resolution 3T images. Using a dual-half-echo 3D projection reconstruction based SSFP sequence, our results show that non-contrast enhanced high-resolution vessel imaging can be obtained rapidly along with high quality T2-contrast images.

Automated Calculation of Wall Shear Stress in the Middle Cerebral Arteries of Healthy Volunteers Using PC-VIPR and Spline Interpolation

Warren Chang\textsuperscript{1}, Yijing Wu, Kevin Johnson, Andrew Wentland\textsuperscript{2}, Steven Kecskemeti\textsuperscript{3}, Charles Mistrutt\textsuperscript{1}, Patrick Turski\textsuperscript{1}

\textsuperscript{1}Radiology/Medical Physics, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States; \textsuperscript{2}Medical Physics, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States; \textsuperscript{3}Physics/Medical Physics, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States

Time-average wall shear stress in the M1 segment of the middle cerebral arteries of 10 healthy volunteers was calculated using automated spline interpolation. The velocity measurements were acquired using PC-VIPR, a fast undersampled phase-contrast MRA technique that allows whole-brain imaging in 5 minutes with sub-millimeter spatial resolution. The calculated average WSS for the proximal MCA was 0.20 Pa (S.D. 0.016 Pa) consistent with published values for PC-MRA. This report shows that fast, automated, non-invasive estimation of wall shear stress can be obtained in middle and large-sized intracranial arteries that are prone to the development of atherosclerosis and other cerebrovascular disorders.

Low Dose, Supraortic 3D Time-Resolved MR Angiography at 3T: Comparison with High Spatial Resolution 3D Contrast-Enhanced MR Angiography

Yoon-joo Lee\textsuperscript{1}, Jae-young Byun\textsuperscript{1}, So-lyung Jung\textsuperscript{1}, Won-jong Yoo\textsuperscript{1}, Young-joo Kim\textsuperscript{1}, Kook-jin Ahn\textsuperscript{1}, Bum-soo KIM\textsuperscript{1}

\textsuperscript{1}Department of Radiology, The Catholic University of Korea, Seoul, Korea, Republic of

This study evaluates feasibility and effectiveness of low-dose TR-CEMRA (with injection of 1cc of Gadobutrol followed by 20cc of saline) performed in the assessment of supraaortic vessel, acquired with combination of parallel imaging (GRAPA) and view-sharing technique (TWIST) at 3T. Retrospective evaluation of image quality and stenosis grade by two neuroradiologist was done, and compared with the results from high-resolution single-phase CEMRA. The overall image quality for low-dose TR-CEMRA was in diagnostic range, comparable to HR-CEMRA. In grading of stenosis, TR-CEMRA showed concordant results with HR-CEMRA in 90.8%, with relatively more number of overestimation than underestimation.

Non-Contrast Dynamic MRA Using TrueFISP Based Spin Tagging with Alternating Radiofrequency (TrueSTAR) in Cerebral Arteriovenous Malformation

Sumei Wang\textsuperscript{1}, Lirong Yan\textsuperscript{2}, Yan Zhuo\textsuperscript{1}, Ronald L. Wolf\textsuperscript{1}, Michael F. Stiefel\textsuperscript{1}, Jing An\textsuperscript{1}, Elias R. Melhem\textsuperscript{1}, Jiongjiong Wang\textsuperscript{1}

\textsuperscript{1}Radiology, University of Pennsylvania, Philadelphia, PA, United States; \textsuperscript{2}State Key Laboratory of Brain and Cognitive Science, Institute of Biophysics, Chinese Academy of Sciences, Beijing, China; \textsuperscript{3}Siemens Mindit Magnetic Resonance Ltd., Shenzhen, China

Five patients with arteriovenous malformations (AVMs) were evaluated using a novel dynamic MRA (dMRA) technique termed TrueFISP based Spin Tagging with Alternating Radiofrequency (TrueSTAR). The results are compatible with time-of-flight (TOF) MRA results. Dynamic MRA demonstrated the blood flow pattern through feeding arteries, nidus and draining veins with high temporal resolution (<100ms), and may provide complementary information in the clinical evaluation of AVMs.
14:00 4431. Assessment of Cervical Venous Stenosis in Multiple Sclerosis Patients Using 4D Flow MRI
Albert Hsiao¹, Greg Zaharchuk¹, Robert Herfkens¹, Nancy J. Fischbein¹, Marcus T. Alley¹, Michael Duke²
¹Department of Radiology, Stanford University, Stanford, CA, United States; ²Department of Cardiothoracic Surgery, Stanford University, Stanford, CA, United States

Multiple sclerosis patients have unusual venous drainage patterns, which we have characterized using 4D velocity-encoded cine phase contrast MRI.

14:30 4432. High Field in Vivo Magnetic Resonance Imaging of Lenticulostriate Arteries in CADASIL
Michael K. Liem¹, Saskia A.J. Lesnik Oberstein², Maarten J. Versluis¹, Joost Haan³, Andrew G. Webb¹, Michel D. Ferrari³, Mark A. van Buchem¹, Jeroen van der Grond⁴
¹Radiology, Leiden University Medical Center, Leiden, Netherlands; ²Clinical Genetics, Leiden University Medical Center, Leiden, Netherlands; ³Clinical Genetics, Leiden University Medical Center, Leiden, Netherlands; ⁴Neurology, Leiden University Medical Center, Leiden, Netherlands

In this study we examined luminal diameters of lenticulostriate arteries in patients with cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL). Twenty-two CADASIL patients and 11 controls were examined using high resolution 3D-time-of-flight magnetic resonance angiography (TOF MRA) imaging on a 7-Tesla MRI scanner. No differences between CADASIL patients and controls were found in length, total number or total cross-sectional area of lenticulostriate artery lumina. Measurements of lenticostriate arteries were not associated with lacunar infarct load in the basal ganglia area.

15:00 4433. Comparison Between 3D Phase Contrast MRI and Computational Fluid Dynamics in Unruptured Intracranial Aneurysms.
Joppe Schneiders¹, Pim van Ooij², Joost van den Berg¹, Ed van Bavel², Aart J. Nederveen¹, Charles B. Majoie²
¹Radiology, Academic Medical Center, Amsterdam, Netherlands; ²Biomedical Engineering & Physics, Academic Medical Center, Amsterdam, Netherlands

In this study we compare time averaged 4D MRI of intracranial aneurysms and surrounding vessels with simulations created using Computational Fluid Dynamics(CFD). The vessel geometry is obtained from high resolution 3D rotational angiography and inflow velocity is derived from 2D PC MR velocity measurements. We compared 4 patients with unruptured aneurysms, visualising the intra-aneurysmal flow pattern. With both modalities it is possible to visualise intra-aneurysmal flow patterns, with good agreement between the two different techniques.

Thursday 13:30-15:30 Computer 83

13:30 4434. Global Pulse Wave Velocity in 87 Patients with Acute Ischemic Stroke and Aortic Atherosclerosis
Andreas Harloff¹, Wolf Wallis, Christoph Strecker, Stephanie Brendecke, Jan Simon, Cornelius Weiller, Jürgen Hennig², Michael Markl²
¹Neurology, University Hospital Freiburg, Freiburg, Baden-Württemberg, Germany; ²Diagnostic Radiology/MR Physics

The aim was to evaluate the feasibility of a new method for estimating aortic pulse wave velocity (PWV) using flow-sensitive 4D MRI. PWV was calculated by fitting a plane to all available data of the upslope portion of multiple flow waveforms along the entire aorta. The value for the assessment of pulse wave velocity in the thoracic aorta was tested in 12 normal subjects and in 87 patients with advanced aortic atherosclerosis. Analysis included a systematic evaluation of reproducibility, inter- and intra-observer variability. Results indicate a relationship of the estimated compliance with age, aortic shape and the presence of disease.

14:00 4435. Flow Residence Time Predicts the Location of Intra-Aneurysmal Thrombus: Numerical Modeling Based on MRA and MRV Data
Vitaliy L. Rayz¹, Loic Boussel², Liang Ge³, Joe R. Leach¹, Alastair J. Martin¹, Michael T. Lawton¹, David Saloner¹
¹Radiology, University of California San Francisco, San Francisco, CA, United States; ²Creatis-LRNM (LB, PCD), Lyon, France; ³Surgery, University of California San Francisco; ⁴Neurological Surgery, University of California San Francisco

Thrombus deposition in cerebral aneurysms presents an increased risk of thrombo-embolism. The effect of increased flow residence time (RT) on thrombus deposition was investigated using a new numerical flow visualization technique. MR angiography and MR velocimetry data were used to construct patient-specific numerical models of the flow in three basilar aneurysms with known regions of thrombus deposition. The flow RT maps computed with CFD in the base-line geometries were compared with intra-aneurysmal regions that were observed to clot at the follow-up MRI studies. The results show that intra-aneurysmal regions with increased flow residence time are prone to thrombus deposition.
MR Velocity Mapping of 3D Cerebrospinal Fluid Flow in the Patients with Enlarged Ventricular System: Preliminary Results

Andreas Stadlbauer1, Wilma van der Riet2, Erich Salomonowitz1
1MR Physics Group, Department of Radiology, Landesklinikum St. Poelten, St. Poelten, Austria; 2European MRI Consultancy (EMRIC), Strasbourg, France

To study the CSF-flow dynamics in nine patients with enlarged ventricular system and nine volunteers using time-resolved 3D MR velocity mapping. Particle-path-lines were calculated to visualize CSF-flow patterns. From six patients with suspected hydrocephalus internus, four showed a hypomotile and two showed a hypermotile CSF-flow. From two patients with suspected normal pressure hydrocephalus, one showed hypomotile and the other hypermotile CSF-flow. One patient who had undergone a ventriculostomy 10 yrs ago showed normal CSF-flow dynamics. These preliminary findings indicated changes in CSF-flow dynamics in patients with enlarged ventricular system, but further and more detailed studies are necessary.

Variability in Growth Rates of Fusiform, Dysmorphic Intracranial Aneurysms as Evaluated by CE-MRA

David Saloner1,2, Loic Boussel3, Vitaliy Rayz1, Alastair Martin1, Michael Lawton4
1Radiology, UCSF, San Francisco, CA, United States; 2VA Medical Center, San Francisco, CA; 3Radiology, CREATIS-LRMN, Lyon, France; 4Surgery, UCSF, San Francisco, CA, United States

Estimation of the stability of dysmorphic fusiform aneurysms of the intra-cranial internal carotid artery requires precise monitoring of their volumes. We used MRA and 3D post-processing to study the evolution of these aneurysms on a prospective cohort of patients with fusiform aneurysms of the intra-cranial internal carotid artery who were studied over multiple time points. The study found that MRA is an excellent method to monitor growth and that 3D quantitative volumetric methods should be employed to monitor whether any growth has occurred. In dysmorphic, fusiform aneurysms of the anterior circulation growth rate was very slow supporting “watchful waiting”.

High Resolution Brain Imaging

Hall B Monday 14:00-16:00  Computer 84

Increased Detectability of Alzheimer Plaques at 7T Vs. 3T Using High Resolution BSSFP

Michael Zeineh1, Hagen Kitzler2, Scott Atlas3, Brian Rutt1
1Radiology, Stanford University Medical Center, Stanford, CA, United States; 2Neuroradiology, Technische Universitaet Dresden, Dresden, Germany

Beta amyloid plaques may have a significant role in the development of Alzheimer’s disease. MRI has been used to visualize these plaques in humans ex vivo, but the etiology of the signal changes associated with plaques is unclear. We imaged 5 human AD specimens and 5 normal specimens at 3.0T and 7.0T with a 3.5 hour bSSFP sequence tailored to visualize plaques. While image SNR was approximately 1.7 times higher at high field, presumed plaque CNR was three times higher. This nonlinear increase may be explained by a field-sensitive microscopic component of amyloid plaques.

Reliable Amygdala Segmentation Using Clustering of Multimodal Data at 7 Tesla.

Eugenia Solano-Castiella1, Gabriele Lohmann2, Andreas Schäfer1, Robert Trampel1, Robert Turner1
1Neurophysics, Max Planck Institute, Leipzig, Sachsen, Germany

The amygdala is a relatively small brain structure. Its location next to the sphenoidal sinus results in a variety of MR image artifacts, which increase with field strength. However, brain scanning at 7T provides considerable improvement of SNR and CNR having the potential for in vivo parcellation of amygdala images into neurologically significant subdivisions that may improve interpretation of fMRI-based neuropsychological studies. To improve clustering we used the strategy of combining images (GRE and TSE) having different contrast mechanisms. The analysis and clustering techniques we have developed for this purpose may assist parcellation of other deep brain structures.

Segmentation of the Frontal Lobe Using Inversion Recovery Cortical Layers Imaging

Daniel Barazany1, Ory Levy3, Yaniv Assaf3
1Neurobiology, Tel Aviv University, Tel Aviv, Israel

Inversion recovery (IR) MRI provides a unique contrast that enables segmentation of the cortex in a laminar way. In this work we used multi IR images to cluster the frontal lobe into 5 distinct laminar sub-cortical structures. We found that each cluster has its own relaxation curve. Statistical analysis on the composition of 6 Brodmann's areas (BA) along the frontal lobe has shown that there is an interaction between different BAs and the MRI clusters. To validate our methodology, we were capable to identify the stripe of Gennari at BA17 in the visual cortex using this framework.
15:30 4441. **Anatomical Imaging at 7 T Using 2D GRASE – a Comparison with 2D TSE**

*Robert Trampel*, Robin Martin Heidemann*, Robert Turner*

Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

Specific absorption rate (SAR) is a serious problem at high field strengths, especially for sequences such as Turbo Spin-Echo (TSE). For a given desired tissue contrast, SAR reduction can provide either faster imaging or greater spatial coverage per unit time. By omitting most of the refocusing pulses of TSE, and replacing them with segmented EPI readouts, GRASE (Gradient-and-Spin-Echo) incurs much less SAR. Careful comparison of TSE and GRASE images at 7 T showed very similar SNR and contrast. The very slight decrease in GRASE image quality is balanced by a significant reduction in scan time (x 1/3) or increase in spatial coverage (x 3) as compared with TSE.

**Tuesday 13:30-15:30 Computer 84**

13:30 4442. **MEG-Guided Surface Coil Imaging at 3 Tesla in Patients with Refractory Epilepsy: Preliminary Results**

*Samuel Lapere*, Evelien Carrette*, Paul Boon2, Kristl Vonck2, Xavier De Tiège3, Eric Achten4, Karel Deblaere5

1. Department of Radiology, Ghent University Hospital, Ghent, Belgium; 2. Reference Center for Refractory Epilepsy, Department of Neurology, Ghent University Hospital; 3. Laboratoire de Cartographie Fonctionnelle du Cerveau, ULB Erasmus Hospital Brussels, Belgium

Patients with refractory epilepsy in whom the epileptogenic zone cannot be precisely identified are not likely to undergo resective surgery. This study aims to assess the potential of surface coil imaging at 3T guided by magnetoencephalography (MEG) to locate the epileptogenic zone. Fifteen patients with dipole clustering on MEG (indicating the possible epileptogenic zone) were scanned with a surface coil at 3T. MEG-guided surface coil imaging at 3T showed an added value in the detection of lesions previously not visible or missed on 3T MRI, and demonstrated an improved delineation and electrophysiological validation of previously known lesions.

14:00 4443. **Increased Gray Matter Volume and Cortical Surface Area of Left Pars Opercularis in Male Orchestral Musicians Correlated Positively with Years of Musical Performance**

*Ihsan Abdul-Kareem*, Andrej Stancak*, Laura Parkes1, Vanessa Sluming1

1. School of Health Sciences, Magnetic Resonance and Image Analysis Research Centre, University of Liverpool, Liverpool, United Kingdom; 2. Department of Psychology, University of Liverpool, Liverpool, United Kingdom; 3. Department of Imaging Science and Biomedical Engineering, School of Cancer and Imaging Sciences, University of Manchester, Manchester, United Kingdom

Musicians’ brains have long been studied for possible structural brain differences in response to skill acquisition. Broca’s region is crucial for several musically relevant abilities. We compare manual gray and white matter volume measurements and automatic cortical surface area measurements of Broca’s region subparts: pars opercularis (POP) and pars triangularis between 26 musicians and 26 non-musicians, all right handed. Musicians have significantly increased gray matter volume and cortical surface area of left POP which was positively correlated with years of musical performance. We hypothesize that prolonged skill acquisition is an environmentally enriching activity resulting in structural reorganization of left POP.

14:30 4444. **High Resolution Magnetization Transfer Imaging at 3T VS. 1.5T**


The increased field strength at 3T significantly improved image quality of high resolution Magnetization Transfer Images, while the increased scan variation at higher field strength is a potential concern; this investigation indicated that relative to 1.5T, the 3T scanner is conducive to more consistent MTR measurement over time. Importantly, our findings in the human study indicate excellent reproducibility in regions such as the hippocampus that are critical regions for detecting early changes in Alzheimer’s disease and other neurological disorders. Our results demonstrate the promising potential of high resolution MT for clinical application.

15:00 4445. **Complex Histogram Based Analysis for Visualization of MRI Data**

*Peter Arjan Wassenaar*, Michael V. Knopp*, Petra Schmalbrock1

1. Radiology, The Ohio State University, Columbus, OH, United States

Especially at high fields, MRI data contain useful information stemming from the presence of paramagnetic material. This work introduces a new approach to visualizing complex MRI data based on the concept of complex histograms. Complex histograms provide a representation of both magnitude and phase data simultaneously. Furthermore, a complex color mapping scheme is introduced for the visualization of complex images, while retaining both magnitude and phase information. Finally, complex histograms may provide the starting point to tissue segmentation through constraints defined in the complex plane.
Wednesday 13:30-15:30   Computer 84

13:30  4446. Imaging at 7T Reveals New Septated Fine Structure in the Human Corpus

Chris Wiggins¹, Andreas Schaefer², Bibek Dhital², Denis Le Bihan¹, Robert Turner²
¹CEA NeuroSpin, Gif-sur-Yvette, France; ²Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

At 7 T, high resolution structural imaging shows fine details of brain structures in vivo. Examining such images of the adult human corpus callosum, we have discovered two-dimensional planar structures never previously described with traditional histological techniques. Analysis of good quality DTI data at 3T supports this observation, showing a second preferred direction of water diffusion. Interhemispheric axonal connections show detailed laminar ordering at submillimeter scale.

14:00  4447. Magnetic Resonance Imaging of Cranial Nerves at 7 Tesla

Astrid Ellen Grams¹,², Oliver Kraff,¹², Stephan Orzada,¹², Stefan Maderwald,¹², Janine Kalkmann¹, Mark E. Ladd,¹², Michael Forsting¹, Elke Ruth Gizewski¹²
¹Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, NRW, Germany; ²Erwin L. Hahn Institute for Magnetic Resonance Imaging, University Hospital Essen, Essen, NRW, Germany

In the present study the feasibility of cranial nerve imaging with a 7 Tesla whole body scanner was investigated. For this purpose four sequences were evaluated. A 3D-TrueFISP sequence allowed the best cranial nerve detection rate in a reasonable scan time. This sequence seems to be superior at the moment as in the 3D-CISS, the “gold standard” sequence at lower magnetic field strengths, no parallel imaging could be performed.

14:30  4448. Imaging of the Inner Ear at 7T: Initial Results

Taro Takahara¹, Hans Hoogduin¹, Fredy Vissor¹, Shinji Naganawa², Thomas Kwee¹, Peter Luijten¹
¹Radiology, University Medical Center Utrecht, Utrecht, Netherlands; ²Radiology, Nagoya University, Nagoya, Aichi, Japan

To our knowledge, this is the first time the inner ear was imaged at 7T using a 3D-turbo spin echo sequence. Although not all parts of the inner ear could be visualized well due to inhomogeneities, our results are promising and may have a positive impact for future (MR) studies of cochlear implants. Improvement in B1 shimming and dedicated RF pulses are expected to further improve image quality.

15:00  4449. Anatomical Phenotyping of Cerebellum and Vestibulo-Cochlear Organ in Mice Using Contrast Enhanced Micro-MRI

Kamila Urszula Szulc¹, Edward Joseph Houston¹, Roy V. Sillitoe², Alexandra L. Joyner³, Daniel H. Turnbull¹,⁴
¹Skirball Institute, NYU School of Medicine, New York, NY, United States; ²Neuroscience, Albert Einstein College of Medicine, New York, NY, United States; ³Developmental Biology Program, Sloan-Kettering Institute, New York, NY; ⁴Radiology, NYU School of Medicine, New York, NY, United States

In this study we demonstrate a potential of contrast enhanced micro-MRI approach for simultaneous anatomical phenotyping of the cerebellum and the vestibulo-cochlear organ in wild type mice and Gbx2-CKO mutant mice, which have severe defects in the Cb in the form of deletion of its central part. Additionally, these mice display abnormalities in the anatomy of flocculus-paraflocculus complex, a region of the Cb that receives projections from the vestibular organs and is critical for normal vestibular function. It was therefore of interest to determine whether the Cb defects were accompanied by additional, previously overlooked abnormalities in the vestibulo-cochlear organ.

Thursday 13:30-15:30   Computer 84

13:30  4450. The Reproducibility of Phase and R2* Acquired with Multi Echo Susceptibility Weighted Imaging

Christian Denk¹, Alexander Rauscher¹
¹UBC MRI Research Centre, University of British Columbia, Vancouver, BC, Canada

Due to their high sensitivity to changes in iron content, phase images and maps of R2* relaxation obtained with gradient echo techniques have been gaining popularity in the imaging of neurodegenerative diseases. However, the reproducibility of these techniques has not been investigated yet. Therefore, we determined the reproducibility of phase and R2* maps acquired with multi echo susceptibility weighted imaging and found that the intersession coefficient of variation is much smaller in phase images than in R2* maps.
Vessel Contrast in Susceptibility Weighted Imaging (SWI) Under Inhalated Anesthesia with Different Oxygen Pressure
Marina Benito¹, Alexia Rodríguez-Ruano¹, Cristina Chavarrias¹, Paula Montesinos¹, Manuel Desco¹
¹Unidad de Medicina y Cirugía Experimental, Hospital General Universitario Gregorio Marañón, Madrid, Spain; ²Unidad de Medicina y Cirugía Experimental, Hospital General Universitario Gregorio Marañón, Madrid, Spain

SWI allows to delineate the cerebral veins in high quality, however during the MRI exam animals are anaesthetized. Anesthetics make vary the venous contrast depending on the depthness of anesthesia, but when using inhalated anesthesia the venous response on SWI also depends on the partial pressure of oxygen (pO2) in the supplied gas. This study investigates how the pressure of oxygen in the supplied gas affects the venous contrast in SWI in order to study the microvasculature of the rat brain.

Detection of Cerebral Microbleeds with Dual Echo T2*-Weighted MR Imaging at 7.0 Tesla
Mandy Conijn¹, Mirjam Geerlings, Peter Luijten, Jaco Zwanenburg, Jeroen Hendriks
¹Radiology, University Medical Center Utrecht, Utrecht, Netherlands

The interest in microbleeds is increasing, however, prevalence estimates differ substantially between studies, due to differences in image protocols and field strengths. This study assessed the visualization of cerebral microbleeds with dual-echo T2*-weighted imaging at 7T MRI in ten patients with vascular disease. The first echo images showed a large contrast between microbleeds and the surrounding tissue. On the second echo images microbleeds were larger in size, but some were not visible due to overlap with structures with a high susceptibility. Dual-echo T2*-weighted imaging combines the advantages of the first and second echo time for the visualization of microbleeds at 7T.

High Spatiotemporal Resolution Whole Brain Susceptibility Weighted Imaging Using Parallel Imaging
Song Lai¹, John Lackey¹
¹Radiology, Thomas Jefferson University, Philadelphia, PA, United States

Parallel imaging was explored for speeding up data acquisition of susceptibility-weighted imaging (SWI). Combination of SENSE with segmented EPI lead to sub-minute data acquisition with whole brain coverage and 1mmx1mmx1mm isotropic voxels, making SWI a completely clinically applicable technique for many applications.

fMRI in Brain Disorders
Hall B Monday 14:00-16:00 Computer 85

Compensatory Mechanisms During Motor Sequence Learning in Parkinson’s Disease. a FMRI Study.
Maite Aznarez-Sanado¹, Maria Asuncion Fernandez-Seara¹, Federico Villagra¹, Francis R. Loayza¹, Jaione Irigoyen¹, Gonzalo Arrondo¹, Elena Erro², Maria Asuncion Pastor¹
¹Neuroscience, Center for Applied Medical Research, University of Navarra, Pamplona, Navarra, Spain; ²Servicio de Neurología, Hospital de Navarra, Pamplona, Navarra, Spain

We aimed to study using fMRI differences in neural patterns during motor sequence learning and automatic performance in Parkinson’s disease (PD) patients. The comparison of the early learning phase in the PD group with the control group revealed increased activity in cortical and cerebellar areas and right putamen in the PD group. The most affected hand recruited contralateral basal ganglia more significantly than the non affected hand in the PD group.

Differential Brain Activation Pattern for a Simple Motor Task in Parkinsonism: An FMRI Study
Mohit Saxena¹, Senthil S. Kumaran², Sumit Singh¹, Madhuri Behari¹
¹Department of Neurology, All India Institute of Medical Sciences, New Delhi, India; ²Department of N.M.R., All India Institute of Medical Sciences, New Delhi, Delhi, India

Parkinsonism including Parkinson’s disease, multiple system atrophy and progressive supranuclear palsy, is characterized by motor dysfunction. In this fMRI study, we observed differential activation pattern among the above three categories. Also, motor dysfunction improved with the intake of dopaminergic drugs.
Levodopa Differentially Modulates Subcortical Activity in Parkinson’s Disease During Self-Initiated Internally Timed Movements Compared to Movements Following a Cued Period.

Jolyn NA D’Andrea¹, Angela Haffenden², Sarah Furtado³, Oksana Suchowersky²,³, Bradley G. Goodyear¹,²,4
¹Medical Science, University of Calgary, Calgary, AB, Canada; ²Department of Clinical Neurosciences, University of Calgary, Calgary, Alberta, Canada; ³Medical Genetics, University of Calgary, Calgary, Alberta, Canada; ⁴Radiology, University of Calgary, Calgary, Alberta, Canada

Parkinson’s patients have difficulty performing self-initiated movements. Levodopa can reduce this functional deficit by focusing brain activity to areas necessary for task performance. The current study investigates how levodopa modulates brain activity in Parkinson’s patients during the performance of internally timed motor tasks, with and without a preceding cue. Our results show that levodopa has a differential effect on the involvement of ipsilateral basal ganglia and thalamus depending on whether internally driven movements are self-initiated or initiated by a cue. This has practical implications for helping Parkinson’s patients cope with behavioral deficits, and could impact future pharmacological interventions.

Gender Dependent Response of Dopaminergic Administration in Parkinson’s Disease: A FMRI Study

Mohit Saxena¹, Senthil S. Kumaran², Sumit Singh¹, Madhuri Behari¹
¹Department of Neurology, All India Institute of Medical Sciences, New Delhi, India; ²Department of N.M.R., All India Institute of Medical Sciences, New Delhi, Delhi, India

Parkinson’s Disease is a neurodegenerative disorder characterized by tremors apart from bradykinesia, rigidity and postural imbalance. The tremors often present motor dysfunction. We carried out this fMRI study to distinguish the brain activation pattern in the male and female Parkinson’s disease patients and the response of dopaminergic drugs in male and female patients.

Prenatal Alcohol Exposure Alters Cortical Functioning in Sustained and Shifting Attention Tasks

Xiangchuan Chen¹, Claire D. Coles², Mary E. Lynch², Xiaoping Hu¹
¹Biomedical Imaging Technology Center, Emory University, Atlanta, GA, United States; ²Department of Psychiatry and Behavioral Sciences, Emory University, Atlanta, GA, United States

Neural basis underlying behavioral alterations induced by prenatal alcohol exposure (PAE) remains unclear. In this study, fMRI was used to investigate the cortical functioning of individuals with PAE in sustained and shifting attention tasks. The results suggest that the composition of the cortical attention network is not significantly changed by PAE. Instead, the neural activity of some critical regions in this network (FEF and IPS) is significantly reduced, resulting in more involvement of other regions when PAE individuals are performing more difficult tasks. PAE individuals with or without external features may have different functional reorganization and compensation mechanisms.

Neural Underpinning from Goal-Directed Drug Seeking to Dysfunctional Stimulus-Response Habit: Increased Nucleus Accumbens – Caudate Connectivity in Heroin Addicts

Alexander D. Cohen¹, Chunming Xie², Wenjun Li³, Theodore Tianrun Zhang¹, Zheng Yang¹, Shi Jiang Li¹
¹Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States; ²Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States; ³Beijing Institute of Basic Medical Science, Beijing, China

This abstract compares resting state functional connectivity (FC) in heroin addicts to matched-control subjects using the nucleus accumbens (NAC) as a seed in an attempt to better understand the underlying processes of addiction. Correlation values were obtained for each subject on a voxelwise basis in 13 addiction associated regions, and then compared via t-test between groups. Increased positive correlation was seen in the left insula, left precentus, left posterior cingulate cortex, and bilateral caudate body in heroin subjects vs. controls. These results suggest increased NAc – caudate connectivity may underlie the shift from goal directed to habitual behavior in drug addiction.

Cocaine Exposure History Leads to Distinct Spatial and Temporal Response Patterns to Acute Cocaine Challenge in Rats

Hanbing Lu¹, Svetlana Chefer¹, Pradeep Kurup¹, Karine Guilmot², D. Bruce Vaupel¹, Thomas J. Ross³, Yihong Yang¹, Laura L. Peoples², Elliot A. Stein¹
¹Neuroimaging Research Branch, National Institute on Drug Abuse, NIH, Baltimore, MD, United States; ²Department of Psychiatry, University of Pennsylvania School of Medicine, Philadelphia, PA

Drug abuse remains a serious social problem. Long-lasting neuroadaptations following repeated drug exposure are thought to mediate compulsive drug seeking and taking behavior. In the present study, rats were trained to self-administered (SA) either I.V. cocaine (n=10) or oral sucrose (n=13) for 20 days using a long-access exposure regimen (6-h sessions), followed by 30 days of abstinence. A third untreated group (naïve rats, n=10) served as a control. Following an acute cocaine challenge, rats with repeated cocaine exposure history demonstrate significantly reduced response. In particular, in such regions as the prelimbic cortex, the infralimbic cortex and the ACC, cocaine SA rats have negative fMRI response, in contrast to positive response in cocaine naïve rats. These findings reinforce the role of prefrontal cortex in translation of motivational stimuli into adaptive motor response.
15:00  4461. **Altered Prefrontal-Amygdala Structural Connectivity in Adolescents Prenatally Exposed to Cocaine**

*Priya Santhanam*¹, *Zhihao Li*¹, *Longchuan Li*¹, *Claire Coles*², *Mary Ellen Lynch*², *Xiaoping Hu*¹

¹Department of Biomedical Engineering, Georgia Institute of Technology/Emory University, Atlanta, GA, United States; ²Department of Psychiatry and Behavioral Sciences, Emory University

As prenatal cocaine exposure (PCE) is known to affect emotional regulation, and since we have previously shown a functional disconnect in the PCE group between regions responsible for such regulation (VMPFC: ventral medial prefrontal cortex and bilateral amygdala), the present study examined the effect of PCE on structural connectivity between the VMPFC and amygdala. Using probabilistic tractography to identify tracts, results showed significantly lower tract volume and FA along the tracts connecting the VMPFC and left amygdala in the PCE group versus controls. This reduced structural integrity may affect functional connectivity and thus emotional regulation in individuals with PCE.

**Wednesday 13:30-15:30   Computer 85**

13:30  4462. **Evidence for a Decreased Activity of the Resting State Motor Network in Patients with ALS**

*Massimo Filippi*¹, *Martina Absinta*¹, *Federica Agosta*¹, *Maria A: Rocca*¹, *Paola Valsasina*¹, *Stefania Sala*¹, *Nilo Riva*², *Alessandro Pellegrini¹, *Domenico Caputo*⁴, *Michele Perini², Raffaella Fazio², Giancarlo Coni²*

¹Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; ²Department of Neurology, Scientific Institute and University Hospital San Raffaele, Milan, Italy; ³Dino Ferrari Center, Department of Neuroscience, University of Milan, Milan, Italy; ⁴Department of Neurology, Scientific Institute Fondazione Don Gnocchi, Milan, Italy; ⁵Department of Neurology, Ospedale di Gallarate, Gallarate, Italy

Functional connectivity within the sensorimotor networks during rest were explored in 19 amyotrophic lateral sclerosis (ALS) patients. Relationship between resting state (RS) fMRI and corticospinal tract (CST) damage was assessed. ICA analysis revealed two networks related to the sensorimotor system. ALS patients had voxels of decreased RS connectivity in the left primary sensorimotor cortex (SMC). Compared with controls, ALS patients also showed decreased average percentage RS signal change in several sensorimotor regions. Decreased RS activity in the SMC correlated with CST damage. Dysfunction of RS sensorimotor connectivity in ALS is likely to be a response to a selective CST damage.

14:00  4463. **Comparison of Cortical Stimulation and FMRI for Language and Motor Localization in Pediatric Patients**


¹Radiology, Seattle Children's Hospital, Seattle, WA, United States; ²Radiology, Seattle Children's Hospital, Seattle, WA, United States; ³Neurology, Seattle Children's Hospital, Seattle, WA, United States; ⁴Clinical&Translational Science, Seattle Children's Hospital, Seattle, WA, United States; ⁵Neurological Surgery, Seattle Children's Hospital, Seattle, WA, United States

We review our experience comparing fMRI to ESM for surgical planning in pediatric patients with intractable epilepsy.

14:30  4464. **Clinical FMRI Memory Evaluation in Pediatric Patients**


¹Radiology, Seattle Children's Hospital, Seattle, WA, United States; ²Neurology, Seattle Children's Hospital, Seattle, WA, United States; ³Integrative Brain Research, Seattle Children's Hospital, Seattle, WA, United States

We developed a evaluated and fMRI paradigm for visual-spatial memory testing in pediatric patients.

15:00  4465. **Altered Brain Activity of Default Mode Network in Patients with Liver Cirrhosis**

*Tun Wei Hsu*¹, *Wei Chie Lin*², *Ching Po Lin*¹

¹Institute of Biomedical Imaging and Radiological Sciences, National Yang-Ming University, Taipei, Taiwan; ²Department of Diagnostic Radiology, Taipei Veterans General Hospital, Taipei, Taiwan; ³Department of Diagnostic Radiology, Chang Gung Memorial Hospital, Kaohsiung, Taiwan

Hepatic encephalopathy (HE) is one of the major complications of liver cirrhosis and a complex neurophysiological syndrome. It will be acts of confusion, personality changes, conscious changes and ups and downs of the neurological manifestations. Our purpose of this study is to investigate abnormalities of default mode networks in patients with liver cirrhosis.
Fourteen SLE patients, five APL patients and four normal controls were studied using fMRI and DTI. We found significant DTI and fMRI differences among three groups. In both patient groups, word generation task shows abnormal activation patterns in the frontal areas suggestive of recruitment of these areas during these tasks. In the hippocampal area, there is a significant difference between APL and SLE group during N-back, word generation and rhyming tasks. In addition to regional differences, there is also whole brain diffusion changes between the patient groups and controls.

Retinotopy Extension in Primary Visual Cortex Associated with Perimetry

So far, no clear physiological correlates have been given for the apparent visual field improvements of patients with post-chiasmal lesions after treatment, such as Visual Restoration Therapy (VRT). Using fMRI retinotopic mapping, we assessed a patient with complete homonymous hemianopia before and after VRT. The patient demonstrated residual neurovascular function and limited retinotopic organization around the lesion before therapy. Post therapy, the retinotopic representation around the lesion was modestly extended along with perimetry improvements, which may, to our knowledge, be the first report on primary visual cortex retinotopy recovery via ad hoc treatment of a patient with visual field loss.

fMRI Study of Sound-Color Synesthesia

Synesthesia is a condition that stimulation of one sensory modality will automatically trigger another un-stimulated perception modality. Here we reported the first fMRI study on sound-color synesthesia. The result shows that color center, angular gyrus and superior parietal cortex are involved in some sound-color photisms. Background noise control is critical in the study of sound-color synesthesia using fMRI. Our observation suggests that there may be different levels or subcategories of sound-color synesthesia and attention distraction may be an effective method for defining subcategories of this synesthesia.

fMRI in Patients with Lumbar Disc Disease: A Paradigm to Study Patients Over Time

Using fMRI to study pain has revealed new information about how the brain responds to painful stimuli and what regions of the brain are activated during pain. Unfortunately, many of the paradigms that are used in fMRI studies either fail to replicate the subject’s pain or painful stimuli is used in volunteers without pain. Moreover, longitudinal fMRI studies that follow patients who develop chronic pain from the acute phase of pain have not been performed. We developed an fMRI paradigm that reliably mimics a clinical pain syndrome in patients who have low back pain and leg pain from acute lumbar radiculopathy and lumbar degenerative disc disease.
DTI - Clinical Applications
Hall B Monday 14:00-16:00  Computer 86

14:00 4470  Relationship Between Diffusion Entropy and Axonal Density in Human Brain
Quan Jiang1,2, Niloofar Fozouni1,2, Siamak Pourabdollah-Nejad1, Zheng Gang Zhang1, Norman L. Lehman3, Steven Gu1, Jian Li1, Hassan Bagher-Ebadian1, Michael Chopp1,2
1Neurology, Henry Ford Health System, Detroit, MI, United States; 2Physics, Oakland University, Rochester, MI, United States; 3Pathology, Henry Ford Health System, Detroit, MI, United States; 4Cornell University; 5MR Center, Wayne State University, Detroit

To overcome errors introduced via the assumption of a Gaussian diffusion tensor model when dealing with multiple fiber orientations, a diffusion entropy measurement is introduced to evaluate its relationship with axonal density and its ability to characterize brain tissues in different brain structures. Entropy appears not only to exhibit enhanced dynamic range of contrast compared with FA but also demonstrated a significant correlation with axonal density measured from immunohistological analysis. Our data suggest that entropy may provide important information on axonal reorganization in neurological diseases.

14:30 4471  Comparison of FA Values from TBSS Vs Manual ROI
Nancy Rollins1,2, Michael Morriss1, Jonathan Chia1, Zhiyue Jerry Wang
1Radiology, Childrens Medical Center, Dallas, TX, United States; 2Radiology, University Texas Southwestern Medical Center, Dallas, TX, United States; Philips HealthCare Systems

Operator-indepedent computerized analysis of FA and manual ROI analysis may be complimentary. However, values derived from these 2 techniques may not be in agreement in all regions of the brain and the “gold standard” for determination of FA has not been determined.

15:00 4472  Method for Assessing Reproducibility of Tractography Methods : Comparison Between Algorithms Used in Clinical Routine.
Fatima Tensaouti1,2, Ilissam Lahlou1, Jean Albert Lotterie1,2, Isabelle Berry1,2
1Service Biophysique et Médecine Nucléaire, CHU Toulouse Rangueil, Toulouse, France; 2Université Paul Sabatier, Toulouse III, Toulouse, France

The aim of the study is to evaluate the fiber tracking strategy in terms of acquisition schemes in conjunction with four algorithms: three deterministic (tensor deflection, tensor lines, streamlines) and statistical algorithm. The pyramidal tract was investigated in 12 healthy subjects. Quantitative comparison between tracts was calculated by using boolean operators on tractus volumes. Inter-exam reproducibility was evaluated by comparing fiber tracking results from the same acquisition scheme on the first and second exam. The study highlights growing reliability of reproducibility results based on the number of directions employed during the acquisition and the method of tractography used.

15:30 4473  Novel Standardization Algorithm GAMA for Repetitive Evaluation of Fractional Anisotropy in Diffusion Tensor Imaging
Akira Matsushita1, Satoru Osuka1, Yasushi Shibata1, Kousaku Saotome2, Yasushi Nagatomo3, Yoji Komatsu1, Satoshi Ayuzawa1, Akira Matsumura1
1Department of Neurosurgery, University of Tsukuba, Tsukuba, Ibaraki, Japan; 2Dept. of Radiological Technology, Tsukuba Medical Center Hospital, Tsukuba, Ibaraki, Japan; 3Dept. of Neurosurgery, Mito Gamma House, Katsuta, Ibaraki, Japan; 4Dept. of Neurosurgery, Tsukuba Medical Center Hospital, Tsukuba, Ibaraki, Japan

It is important that the region of interest (ROI) has enough repeatability especially for serial measurement. We developed the novel algorithm and software GAMA using diffusion tensor imaging. The GAMA can point out the regions as corpus callosum or pyramidal tract automatically. Therefore, we can use GAMA with very brief handling. Additionally, GAMA could evaluate FA in that region with higher reproducibility than the conventional ROI methods with the free-handed ROI or the size-fixed sphere ROI.

Tuesday 13:30-15:30  Computer 86

13:30 4474  White Matter Integrity Analyzed by Tract-Based Spatial Statistics in Elderly Subjects Without White Matter Lesions
Daniel Han-En Chang1, L Tugan Muftuler1, Huali Wang1, Orhan Nalcioglu1, Min-Ying Lydia Su2
1Tu & Yuen Center for Functional Onco-Imaging, University of California, Irvine, CA, United States; 2Dementia Care Research Center, Peking University Institute of Mental Health, Beijing, China

Subjects with Alzheimer’s and mild cognitive impairment have decreased white matter integrity in comparison to healthy controls, which can quantified as fractional anisotropic (FA) and mean diffusivity (MD) values by DTI methods. Tract-based-spatial-statistics (TBSS) is a frequently used robust method for comparing FA maps between different subject groups; however, most published studies analyzed subjects without excluding subjects with white matter lesions, which may have an effect on FA and MD values. In order to
examine this possible effect, we excluded subjects with white matter lesions from our study cohort and performed TBSS. Our results were consistent with what literature reports.

14:00  4475  Probabilistic Fiber Tracking from the Pre-SMA and SMA Proper: Implications for Language and Motor White Matter Networks
Kyung K. Peck1, Seyedeh Jenabi2, Robert Young, Lucas Parra2, Andrei Holodny
1Medical Physics and Radiology, Memorial Sloan-Kettering Cancer Center, New York, United States; 2City University of New York

In this study, we seek to expand on this study by using diffusion tensor imaging to compare the pattern of white matter fibers originating from two different fMRI guided seed regions; the pre-SMA and the SMA-proper defined by fMRI language and motor paradigm respectively. We hypothesized that pre-SMA seed derived from the language paradigm will connect more readily to the frontal areas known to be associated with language function including Broca’s Area.

14:30  4476  Correlation of Quantitative Sensori-Motor Tractography with Clinical Grade of Cerebral Palsy
Richa Trivedi1, Shruti Agarwal2, Vipul Shah3, Puneet Goyal4, Vimal K. Paliwal5, Ram KS Rathore6, Rakesh Kumar Gupta7
1NMR Research Centre, Institute of Nuclear Medicine and Allied Sciences, Delhi, India; 2Mathematics and Statistics, Indian Institute of Technology, Kanpur, Uttar Pradesh, India; 3Pediatric Orthopedic Surgery unit, Bhargava Nursing Home, Lucknow, Uttar Pradesh, India; 4Anesthesiology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; 5Neurology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; 6Mathematics and Statistics, Indian Institute of Technology, Kanpur, Uttar Pradesh, India; 7Radiodiagnosis, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

Diffusion tensor tractography using FACT algorithm was performed on 39 children with different grades of cerebral palsy (CP) defined using the Gross Motor Function Classification System (GMFCS) to look for probable correlation between tract-specific DTI metrics in sensorimotor pathways and clinical grades. A significant inverse correlation was observed between fractional anisotropy (FA) in both sensory and motor pathways and clinical grades. In this study we extend our understanding of the pathophysiology of CP by showing that DTI measures in both motor and sensory pathways reflects the degree of motor deficits.

15:00  4477  Study of Neuropsychiatric Systemic Lupus Erythematosus with DTI and FAIR
Xiaozhen Li1, Zhengguang Chen2
1Radiology, Peking Union Medical College Hospital, Beijing, China; 2Radiology, First Hospital of Tsinghua, Beijing, China

Conventional neuroimaging cannot help us either to differentiate between chronic and acute brain lesions or to improve in our understanding of systemic lupus erythematosus (SLE) pathogenesis because of the high probability of a Neuropsychiatric SLE (NPSLE) event. The fMRI including DTI, which demonstrates the tissue water mobility in brain tissue, and flow-sensitive alternating inversion recovery (FAIR), which reveals the relative cerebral blood flow, may help to further assess the possible abnormality in neuronal and neural vascular reactivity in NPSLE. In this study we found in combination of ADC, FA, rCBF have high sensitivity in detecting earlier pathologic changes in NPSLE.

Wednesday 13:30-15:30   Computer 86

13:30  4478  Diffusion Tensor Imaging Permits Detection of Disjunct MD and FA Changes in the Basal Ganglia in Patients with Susac’s Syndrome
Michael Deppe1, Ilka Klenner1, Siawoosh Mohammadi2, Wolfram Schwindt2, Katja Deppe3, Simon S. Keller4, E. Bernd Ringelstein1
1Neurology, University of Münster, Münster, Germany; 2Radiology, University of Münster, Münster; 3Neurology, Franz Hospital Düllmen

By employing a highly effective spatial normalization technique for diffusion weighted images we found evidence that DTI is sensitive in detecting damage to white matter that is of normal appearance in Susac’s Syndrome using conventional MRI methods. Grey matter (GM) alterations in Susac’s syndrome are also detectable by DTI as circumscribed FA and MD increases in the basal ganglia that are also not observed using conventional MRI. The alterations in basal ganglia MD and FA are differentially localized to the pallidum and putamen, respectively.
4479. Voxel-Based Analysis of High- And Standard B-Value Diffusion Weighted Imaging and Voxel-Based Morphometry in Inherited Prion Disease

Enrico De Vita¹², Harpreet Hyare¹³, Gerard Ridgway¹, Simon Mead¹, Peter Rudge³, John C. Collinge¹, Tarek A. Yousry¹², John S. Thornton¹²

¹Lysholm Department of Neuroradiology, National Hospital for Neurology and Neurosurgery, London, United Kingdom; ²Academic Neuroradiological Unit, Institute of Neurology, University College London, London, United Kingdom; ³MRC Prion Unit, Institute of Neurology, University College London, London, United Kingdom; ⁴Dementia Research Centre. Dept. of Neurodegenerative Diseases, Institute of Neurology, University College London, London, United Kingdom

Diffusion weighted imaging (DWI) is the most sensitive MRI sequence for diagnosis in human prion disease. High-b-value (b~3000s/mm²; b3k) DWI was shown to be more sensitive to pathology in sporadic Creutzfeldt-Jacob disease than standard DWI (b~1000s/mm²; b1k). Most previous prion disease studies used region of interest analyses. We employed operator-independent voxel-based morphometry and voxel-based analysis (VBA) of DWI (b1k and b3k) to characterise structural parenchymal changes in inherited prion disease (iPD) patients. In this cohort, DWI-VBA resulted more sensitive than VBM, potentially indicating microstructural changes occurring before grey matter atrophy becomes detectable; b1k acquisitions resulted relatively more sensitive vs b3k.

4480. Mapping the Distribution of Local Cross-Term Gradients Using DTI in Patients with Alzheimer’s Disease

Geon-Ho Jahng¹, Songfan Xu², Chang-Woo Ryu¹, Dal-Mo Yang¹, Dong-Wook Sung¹, Dong Ho Lee³, Seungjoon Park⁴

¹Radiology, East West Neo Medical Center, Kyung Hee University, Seoul, Korea, Republic of; ²Biomedical Science, Graduate School of Medicine, Kyung Hee University, Seoul, Korea, Republic of; ³Radiology, KHU Hospital, Kyung Hee University, Seoul, Korea, Republic of; ⁴Pharmacology and Biomedical Science, School of Medicine, Kyung Hee University, Seoul, Korea, Republic of

To map the strength of a local cross-term gradient among diffusion, imaging, and background gradients in groups of AD, MCI, and cognitive normal (CN), two DT-MRI sets with positive and negative polarities of diffusion-sensitizing gradients were obtained in 15 AD and 18 MCI patients and 16 CN controls with four b-values. The cross-term b-value (bc) maps for each subject group were calculated. The bc differs locally between AD patient and MCI or CN subjects, but not between MCI and controls and we may obtain the strength of a local background gradient using DTI data.

4481. Lateralisation of Perisylvian Pathways with Age in Asperger’s Syndrome – a Cross-Sectional DTI Study

Sanja Budisavljevic¹, Flavio Dell’Acqua, Stephanie Forkel, Michel Thiebaut de Schotten, Marco Catani

¹Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, King’s College, London, United Kingdom

Using DT-MRI tractography we investigated lateralisation of perisylvian pathways with age in Asperger’s Syndrome. We observed that the indirect pathway of the arcuate fasciculus shows abnormal development with age in people with Asperger’s syndrome compared to controls. This suggests that abnormalities in white matter development may be a key feature of autism spectrum disorders and may explain impairments in language and communication.

Thursday 13:30-15:30 Computer 86

13:30 4482. Longitudinal Changes of DTI Parameters During Acute and Sub-Acute Phase Following Mild Traumatic Brain Injury Using Tract-Based Spatial Statistics Analysis: The Preliminary Results

Tong Zhu¹, Jeffrey Bazarian², Jianhui Zhong¹

¹Imaging Sciences, University of Rochester, Rochester, NY, United States; ²Emergency Medicine, University of Rochester, Rochester, NY, United States

DTI studies of both human mTBI subjects and animal TBI models have shown different alteration patterns of tensor derived parameters, such as fractional anisotropy (FA), axial and radial diffusivity, with the accompanying neuroimaging alterations following initial concussions. In this study, we performed a prospective longitudinal study of mTBI patients with three DTI scans for each subject to characterize the acute (within 24 hrs), late acute (1 week) and sub-acute (1 month) phase following mTBI. The tract-based spatial statistics (TBSS) was performed to achieve voxelwise statistical comparisons of longitudinal changes of DTI parameters for quantification of white matter micro-structural alterations. In 13 mTBI patients and 21 healthy controls analyzed so far we observed decreased FA and increased radial diffusivity in several major white matter tracts such as the genu corpus callosum, the anterior corona radiata and the internal capsule, although our findings are only approaching significance (p<0.01) due to the small number of subjects and subtle DTI changes in acute mTBI. Different from increased radial diffusivity due to demyelination in the recovery phase (9-15 months) of TBI, increased radial diffusivity as well as consequently decreased FA in the acute phase of mTBI may reflect possible neurofilament misalignments which create projections of the principal diffusivity onto the transverse plane.
Deformable Registration and Tract-Based Spatial Analysis of Diffusion Tensor MR Images in Mild Traumatic Brain Injury of Military-Related Blast Injury
Ping-Hong Yeh1, Binquan Wang, Terrence R. Oakes,*, Louis M. French3, David F. Moore2, Gerard Riedy.1,2
1Henry Jackson Foundation for Military Medicine, Rockville, MD, United States; 2National Capital Neuroimaging Consortium, Walter Reed Army Medical Center, Washington DC; 3Defense and Veterans Brain Injury Center, Walter Reed Army Medical Center; *Department of Radiology and Radiological Sciences, Uniformed Services University

Evaluating the white matter disruption in mild traumatic brain injury (mTBI) is challenging. The study investigated mTBI in military-related blast injury using diffusion tensor imaging. High-dimensional spatial normalization of diffusion tensor images, atlas reconstruction and tract-based spatial analysis were applied to assess the physiological and geometric changes in mTBI, and their relationships with neuropsychopathic symptoms. The features of micro- and macro-structural changes varied within the mTBI group. Greater severity of neuropsychopathic symptoms was associated with the disconnection in fronto-(sub)cortical, fronto-limbic and inter-hemispheric circuitry. Optimizing spatial normalization method can help detect white matter disruption in mTBI using a low field clinical scanner.

Diffusional Kurtosis Imaging of Deep Gray Matter in Mild Traumatic Brain Injury
Elan J. Grossman1, Yulin Ge1, Jens H. Jensen1, James S. Babb1, Joseph Reaume1, Jonathan A. Silver1, Robert I. Grossman1, Matilde Inglese1
1Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, United States; 2Department of Psychiatry, NYU School of Medicine, New York, United States

While conventional imaging has been unsuccessful detecting cerebral damage in mild traumatic brain injury (MTBI), investigations using DTI report evidence of diffuse axonal injury. The purpose of the current study is to assess whether DKI, which measures non-Gaussian diffusion of water, can provide additional complimentary information about MTBI pathology. In addition to white matter regions we investigated thalamus and basal ganglia in patients with MTBI using DKI and DTI. Differences from controls were observed in thalamus and posterior internal capsule of acute and chronic MTBI patients. This suggests that DKI and DTI might be prognostic markers of persistent post-concussive syndrome.

Combined Quantitative Diffusion Tensor and 1H Magnetic Resonance Spectroscopic Imaging Findings in Patients with Persistent Neurocognitive Deficits Following a Mild Traumatic Brain Injury
Brenda Bartnik Olson1, Kimberly Conley2, Karen Tong1, Sarah Uffindell1, Valerie Wong1, Barbara Holshouser1
1Dept. of Radiology, Loma Linda University, Loma Linda, CA, United States; 2School of Medicine, Loma Linda University, Loma Linda, CA, United States; 3Dept. of Neurology, Loma Linda University, Loma Linda, CA, United States; 4Redlands Pediatric and Adult Medicine, Loma Linda University, Loma Linda, CA, United States

Neurocognitive deficits occur in approximately 50-80% of mild TBI patients, which may persist for several years after injury even though conventional imaging is normal. In this study we used diffusion tensor and 1H magnetic resonance spectroscopic imaging to evaluate if microstructural and/or metabolic abnormalities are present in mTBI subjects with persistent neurocognitive deficits. Our findings show that regions of neuronal loss or dysfunction are present in the left anterior internal capsule and left occipital white matter of mild TBI patients. In addition, increased fractional anisotropy in the left anterior internal capsule may be related to an increase in extracellular space adjacent to remaining axons after the loss of a subset of corticospinal tract fibers. Our findings suggest that both metabolic and ultrastructural changes persist following a mild TBI which may relate to continued neurocognitive deficits seen in these subjects.

Animal Models of Stroke & Ischemia

Hall B Monday 14:00-16:00

Serial MR Analysis of Permanent and Transient Cerebral Ischemia in a Rat Model: High and Low B Value Diffusion – Weighted Imaging and Diffusion Tensor Imaging
Ji-hoon Kim1, Kee-Hyun Chang, Chul Ho Sohn, Sung Hong Choi, Yoo Jung Yim, Chang Min Park, In Chan Song
1Radiology, Seoul National University Hospital, Seoul, Korea, Republic of

We tried to determine the serial changes in FA, ADC and DWI signal intensity at high and low b values during early cerebral ischemia and transient ischemia and investigated their relationships. With 30 male Sprague-Dawley rats of middle cerebral artery occlusion (MCAO) of the suture occlusion model, PWI, DTI, high and low b value DWI were performed for hyperacute (n=9) and acute (n=13) permanent ischemia groups and transient (n=8) ischemia group. Although time-ADC curve showed early initial decrease until 3 hour and then increasing tendency, Time – FA curve showed initial increase, transient plateau until 1 hour, and then sequential decrease in permanent ischemia group. In transient ischemia group, FA showed transient reversibility and secondary decay in transient ischemia group, correlating with ADC change. Although the lesion contrast ratio of DWI in early ischemic tissue was larger at high b value. But, the lesion contrast ratio of ADC map was smaller at high b value than low b value. These results might be related to the initial shift of water from extracellular to intracellular space and biexponential decay of cerebral water diffusion.
We measure the DT indices changes in stroke model from the hyperacute to chronic phase. Rats are subjected to focal cerebral ischemia for 90 minutes followed by reperfusion. DT imaging studies were performed with a 4.7 T scanner. Significant DT indices changes were related to the evolution of the transient MCAO. DTI indices may allow separate evaluation of the treatment response of white and gray matter to neuroprotective therapy. DTI analysis of directional diffusivities could provide additional information to FA and MD, and may reflect more specifically the histological changes of reduced myelination and axonal injury.

15:00 4488. Unique Pattern of Diffusion Metrics Sheds Light on Cellular Changes During Hypoxic-Ischemia

Ahmed Shereen1, Diana Lindquist3, Chia-Yi Kuan3
1Department of Physics, University of Cincinnati, Cincinnati, OH, United States; 2Imaging Research Center, Cincinnati Children's Hospital Medical Center, United States; 3Division of Neurology, Cincinnati Children's Hospital Medical Center

Using diffusion tensor imaging (DTI), we characterized an animal model of leukoaraiosis, a condition caused by chronic hypoxic-hypoperfusion which often leads to post-stroke dementia. We observed radial diffusivity decrease in white matter, contrary to previous findings of increases in radial diffusivity attributed to demyelination after hypoxic-ischemia. Further examination using electron microscopy revealed rapid separation of myelin sheaths and protrusion of myelin-coated vesicles which created multiple intercellular compartments to restrict radial and axial diffusion with minimum change in fractional anisotropy. These results suggest a biophysical mechanism behind leukoaraiosis which may be inferred from unique patterns in DTI metrics.

Progression of MRI Changes and Their Correspondence with Histological Changes in the Descending Corticospinal Tract Following Neonatal Hypoxic-Ischemic Infarction.

Ursula I. Tuor1, Sanju Lama2, Edwin Cheng3, Dave Kirk, Tadeusz Foniok4
1Institute for Biodiagnostics (West), National Research Council of Canada, Calgary, Alberta, Canada; 2Medical Science, University of Calgary; 3Experimental Imaging Centre, University of Calgary, Calgary, Alberta, Canada; 4Institute for Biodiagnostics (West), National Research Council of Canada, Calgary, Alberta, Canada

In the present study we investigate both the acute and chronic changes in T2 and diffusion weighted images containing the descending corticospinal tract following a unilateral cerebral hypoxic-ischemic insult in neonatal rats. Diffusion weighted and T2 increases along with ADC decreases occur at relatively acute times post hypoxia-ischemia whereas both T2 and ADC are increased more chronically. The corresponding axonal changes detected using immunohistochemistry for neurofilaments and silver staining provides corresponding evidence for Wallerian degeneration. These results should assist in the diagnosis and timing of MR imaging changes detected clinically in human neonates following stroke.

Tuesday 13:30-15:30  Computer 87

13:30 4490. Spatial-Temporal MRI Responses of Stroke Rats to Oxygen Challenge

Qiang Shen1,2, Shiliang Huang1, Fang Du1, Timothy Q. Duong1,2
1Research Imaging Institute, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States; 2Department of Ophthalmology/Radiology, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States

The identification of ischemic penumbra is of utmost importance for the initiation of treatment strategies. Although diffusion/perfusion MRI mismatch has been used to be an estimate of penumbra, it has been demonstrated overestimation of penumbra. Beside perfusion deficit, a marker of metabolism is essential to better define penumbra. In this study, the spatial and temporal responses of stroke rats to 100% oxygen challenge were investigated. DWI/PWI mismatch region showed significant higher signal increase during OC and spatially around the ischemic core could be a better estimation of penumbra.

14:00 4491. T2 Component “area Fractions”: A Possible Marker for Ischemic Penumbra

Jeff F. Dunn1,2, Thorarin A. Bjarnason3, Tonima Ali3, Ying Wu1,2, Cheryl R. McCreary1,2, Ross J. Mitchell1,2
1Hotchkiss Brain Institute, University of Calgary, Calgary, Alberta, Canada; 2Department of Radiology, University of Calgary, Calgary, Alberta, Canada; 3Biomedical Engineering, University of Calgary; 4Department of Clinical Neurosciences, University of Calgary, Calgary, Alberta, Canada

Quantitative T2 (qT2) has been used to identify a range of pathophysiology in brain including multiple sclerosis. We have extended the application of qT2 to that of assessing heterogeneity of stroke within an experimental infarct in a rat brain. We have applied a recently published voxel-based approach, which allows for assessment of heterogeneity of T2 components. It was determined that the proportion of the total T2 which relates to the 50-60ms range results in visualization of the periphery of the infarct. This type of approach may be useful in identification of the ischemic penumbra.
Characterization of Mild Hypoxic-Ischemic Injury in Multiple White Matter Tracts in a Neonatal Rat Model by Diffusion Tensor MR Imaging

Silun Wang1,2, ED X. WU3, Ho-fai Lau3, Jing Gu1, Jinyuan Zhou2, Pek-lan Khong1
1Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong; 2Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States; 3Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, Hong Kong

We evaluated hypoxic-ischemic (HI)-induced white matter (WM) injury in a mild HI neonatal rat model from Day 1 to 90 post-HI by DTI. Results showed that significantly decreased FA in multiple injured WM tracts, including external capsule (EC), fornix (F), cerebral peduncle (CP) and optical tracts (OT), at different time points, but no differences were demonstrated in anterior commissure (AC). Our results support the use of DTI as an imaging biomarker to non-invasively monitor the severity and longitudinal changes of mild HI-induced WM injury. Different severity and patterns of WM tract injury may reflect disturbances of cerebral blood supply in this ischemic animal model.

DTI of Adult Visual Pathways After Severe Neonatal Hypoxic-Ischemic Cerebral Injury

Kevin C. Chan1,2, Abby Y. Ding1,2, Ed X. Wu1,2
1Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong SAR, China; 2Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR, China

This study employs in vivo diffusion tensor imaging (DTI) to determine the long-term outcomes of microstructural integrity along the visual pathways after severe neonatal hypoxic-ischemic (HI) injury to the entire ipsilesional visual cortex in rats at postnatal day 7. Quantitative analyses showed that, compared to age-matched normal brains, a significantly lower FA but higher λ₂, λ₃ and diffusion trace value were observed in the ipsilesional posterior optic tract in the HI-injured brains at postnatal day 60, whereas significantly lower FA but mildly lower λ₂ and higher λ₁ and trace were observed in the ipsilesional prechiasmatic optic nerve and contralateral anterior and posterior optic tracts. The results of this study are potentially important in determining and improving the functional consequences of the brain lesion after most compensatory and reparative phases have been passed.

Comparison of MRI Measured Mean Micro-Vessel Segment Length and Micro-Vessel Radius and Laser Scan Confocal Microscopy After Embolic Stroke

Asamoah Bosomtwi1,2, Quan Jiang2,3, Li Zhang2, Zheng Gang Zhang2,3, Michael Chopp1,2
1Yerkes Imaging Center, Emory University, Atlanta, GA, United States; 2Neurology, Henry Ford Hospital, Detroit, MI, United States; 3Physics, Oakland University, Rochester, MI, United States

We investigated vascular remodeling after stroke using MRI mean segment length (MSL) and vessel size index (VSI) measurement and correlate the results with measurements using Laser Scanning Confocal Microscopy (LSCM). We demonstrate that MRI MSL and VSI can detect the microvascular status of brain tissue with different ischemic damage. The MSL and VSI measured by MRI were highly correlated with LSCM histological measurements. Our data demonstrate that these MRI measurements can quantitatively evaluate microvascular remodeling after stroke.

Cell-Based Treatment Induced White Matter Reorganization After Traumatic Brain Injury Measured by Gaussian, Q-Space DTI, and Histology

Quan Jiang1,2, Guang Liang Ding, Siamak Pourabdollah-Nejad1, Chang Sheng Qu3, Asim Mahmood1, Li Zhang1, Zheng Gang Zhang1, Jian Hu1, Nassan Bagher-Ebadian1, James R. Ewing1, Michael Chopp1,2
1Neurology, Henry Ford Health System, Detroit, MI, United States; 2Physics, Oakland University, Rochester, MI, United States; 3Neurosurgery, Henry Ford Health System, Detroit, MI, United States; 4MR Center, Wayne State University, Detroit, MI, United States

We investigated cell-based treatment induced white matter remodeling after traumatic brain injury (TBI) using Gaussian, q-ball, standard deviation (SD) DTI, and immuno-histochemistry staining. We demonstrate that in brain tissue with a preponderance of single oriented fibers, Gaussian DTI can correctly identify white matter reorganization and detect changes of axonal orientation in the boundary recovery region after TBI. However, SD and q-ball need to be employed to measure WM reorganization if substantial fiber crossing is present in the recovery tissue. Our data suggest that combination SD and FA data may provide information about the stage of white matter remodeling after TBI.
In a rat model of stroke, the effects of human mesenchymal stem cells (hMSC) on the microvascularisation were studied. Seven days after transient cerebral ischemia, rats received a 10µL intracerebral administration of either cell culture medium or 4×10^5 hMSC. Two groups of healthy control rats underwent the same treatment. Groups were followed by MRI during 21 days (ADC, cerebral blood volume (CBV), vessel size (VSI)). One day after IC administration, hMSC abolish the CBV increase commonly observed after transient cerebral ischemia. VSI estimates suggest that hMSC also delay the vasodilation secondary to cerebral ischemia.

We investigated vascular remodeling after stroke using MRI microvascular density (MVD) measurement and gold standard immunohistochemistry staining. We demonstrate that MRI MVD detect the microvascular status of brain tissue with different ischemic damage. The MVD measured by MRI was highly correlated with histological measures of MVD. Our data demonstrate that MRI MVD measurement can quantitatively evaluate microvascular remodeling after stroke.

The treatment of hemorrhagic lesion with neuronal stem cell procedure was studied by diffusion tensor imaging in a monkey model using a clinical 3T MRI system. The longitudinal changes of the fractional anisotropy indicate that the procedure at the dosage of 0.5-2.5 million cells is very effective and DTI is a useful tool to monitor the time course of the neuronal repair and fiber track regeneration process.

Spreading depression (SD) is a propagating wave of cellular depolarization, and implicated in pathophysiology of migraine and peri-infarct depolarization. In last decade, MRI started to be used for non-invasive imaging of SD, but not much is known about the neurovascular coupling in SD, especially for subcortical regions. We investigated CBV changes induced by SD in cortical and subcortical regions using intravenous contrast agent. We observed marked CBV increase (up to 20%) in cortex, striatum, and hippocampus, but not in thalamus. The CBV response gradually reached peak ~5 min after the neuronal depolarization, suggesting neurovascular coupling is largely modified in SD.

The quantification of tissue sodium concentration using 23Na-Magnetic Resonance Microscopy at 7 T: Probing the acute stroke phase.

Spreading depression (SD) is a propagating wave of cellular depolarization, and implicated in pathophysiology of migraine and peri-infarct depolarization. In last decade, MRI started to be used for non-invasive imaging of SD, but not much is known about the neurovascular coupling in SD, especially for subcortical regions. We investigated CBV changes induced by SD in cortical and subcortical regions using intravenous contrast agent. We observed marked CBV increase (up to 20%) in cortex, striatum, and hippocampus, but not in thalamus. The CBV response gradually reached peak ~5 min after the neuronal depolarization, suggesting neurovascular coupling is largely modified in SD.

The quantification of tissue sodium concentration using 23Na-Magnetic Resonance Microscopy at 7 T: Probing the acute stroke phase.
Scotland, United Kingdom; 3Bruker BioSpin GmbH, Ettlingen, Germany; 4Centre for Advanced Medical Imaging, St. James’s Hospital, Dublin, Ireland

The aim of this study was to accurately quantify subtle changes in Tissue Sodium Concentration (TSC) during the acute phase in a rodent stroke model. A double-tuned $^{23}$Na/$^1$H dual resonator system was developed and a 2D radial sequence optimized for qNa-MRM (voxel sizes of 1.2µl, TA = 10min). A quantification accuracy of <10mM was achieved, which enabled the evolution of the TSC changes to be followed in the acute phase of stroke. TSC maps were computed and analyzed for each of the investigated five stroke and two sham rats from 30mins up to 8h after MCAO.

15:00  4501.  7 T $^{87}$Rb MRI to Assess K+ Dynamics in Ischemic Rat Brain in Vivo

Victor E. Yushmanov1, Alexander Kharlamov1, Tamer S. Ibrahim2,3, Tiejun Zhao4, Fernando E. Boada2,3, Stephen C. Jones, 3,5
1Department of Anesthesiology, Allegheny-Singer Research Institute, Pittsburgh, PA, United States; 2Department of Bioengineering; 3Department of Radiology, University of Pittsburgh, Pittsburgh, PA, United States; 4Siemens Medical Solutions USA, Pittsburgh, PA, United States; 5Departments of Anesthesiology and Neurology, Allegheny-Singer Research Institute, Pittsburgh, PA, United States

To monitor K+ in the brain in vivo, $^{87}$Rb MRI in a rat model of focal ischemic stroke was performed. Rats pre-loaded with dietary Rb+ were subjected to MCAO, and $^{87}$Rb MRI was implemented using a dedicated built in-house RF coil and a spiral ultrashort-TE sequence (TR/TE of 3/0.07 ms). The data represent the world’s first successful $^{87}$Rb MRI in vivo co-registered with an anatomic image, and demonstrate the potential of $^{87}$Rb MRI at high fields (7 T) to quantitatively assess the dynamics of K+ efflux from the ischemic brain with 13-min temporal resolution in a single animal.

Applications of Manganese-Enhanced MRI/Animal Models of White Matter Disease

Hall B Monday 14:00-16:00  Computer 88

14:00  4502.  Limits of Mn Detection in Vivo: Spatial Segregation of Relaxation Behavior

Jessica A. M. Bastiaansen1,2, Xiaowei Zhang1, Russell E. Jacobs1
1Biological Imaging Center, California Institute of Technology, Pasadena, CA, United States; 2CIBM, EPFL, Lausanne, Switzerland

In MEMRI, quantitative analysis of signal intensity is used to monitor Mn transport and accumulation, translating signal intensity into concentration. However, several factors may affect the relaxation behavior of Mn and little is known about the cellular uptake and distribution as well as whether the detection limit of Mn changes in different brain regions. Here we investigated changes in Mn relaxation behavior in cortical and striatal areas of the mouse brain in vivo and show that relaxation behavior is brain region-specific. The above has implications on the quantification of axonal transport rates and Mn concentration.

14:30  4503.  High-Throughput Manganese Enhanced Magnetic Resonance Imaging in Newborn Rabbits for Olfactory Response to Nitric Oxide Stimulus

Yirong Yang1, Alexander Drobyshevsky1, Xinhai Ji1, Lei Yu1, Sidhartha Tan1
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Different nitric oxide (NO) level in olfactory nerves may affect the activity of neurons. Mn2+ will move along appropriate neuronal pathways in an anterograde direction. The function of olfactory neurons can be monitored in vivo by manganese enhanced magnetic resonance imaging (MEMRI). To observe manganese enhanced process, MRI experiments need several hours or even several days. Therefore, multi animal imaging strategy is needed to provide an efficient way to perform experiments and acquire data with enough statistical power. This abstract presents a high-throughput MEMRI method to determine whether nitric oxide can affect olfactory neuronal function in newborn rabbits.

15:00  4504.  MEMRI Study of Mice Cerebellar Activation After Voluntary Wheel Running

Iris Y. Zhou1,2, April Mei Kwan Chow1,2, Kevin C. Chan1,2, Condon Lau1,2, Ed X. Wu1,2
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In the present study, we use in vivo MEMRI to detect the cerebellar activation in mouse brain induced by voluntary wheel running. The preliminary result of our study shows that after voluntary wheel-running exercise, mouse cerebellum regions such as vermis, Crus I and II of ansiform lobe and caudal pontine reticular nucleus are significantly activated compared to the sedentary animals. This difference can be feasibly detected by MEMRI, suggesting the great potential of MEMRI as an in vivo probe for mapping neural activity.
15:30 4505. Manganese-Enhanced MRI Detection of Neural Compensatory Changes After Neonatal Monocular Enucleation

Iris Y. Zhou1,2, April M. Chow1,2, Shu Juan Fan1,2, Ed X. Wu1,2
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In this study, in vivo MEMRI was introduced to investigate cellular alteration and manganese-induced signal intensity changes after neonatal monocular enucleation. With MEMRI, impaired superior colliculi with high spatial resolution revealing the laminar structure and enhancement of monocular area of primary visual cortex can be observed after neonatal monocular enucleation noninvasively. Such MEMRI approach may be useful in investigation of neural plasticity and the adaptive and compensatory modifications within the brain following neonatal monocular enucleation.

Tuesday 13:30-15:30 Computer 88

13:30 4506. Manganese-Enhanced MRI of Perilesion Cortex in Subchronic Focal Brain Ischemia

Kevin C. Chan1,2, Ed X. Wu1,2
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In this study, MEMRI was employed to investigate into the late changes in Mn2+ enhancement in subchronic focal brain ischemia, with emphases on the temporal evolutions in different subregions of the perilesion cortex. The results of this study may provide a new tool for in vivo longitudinal monitoring of the of salvageable tissues and hence represent potential new therapeutic targets for improving the functional consequences after stroke.

14:00 4507. Bimodal FMRI for Exploring Brain Activity: A Striatal CBV Response Accompanied by Enhanced Nigrostriatal Activity Detected by MEMRI

Chiao-Chi V. Chen1,2, Yi-Hua Hsu2, Chen Chang2
1Functional and Micro-Magnetic Resonance Imaging Center, Institute of Biomedical Sciences, Academia Sinica, Taipei, Taiwan; 2Functional and Micro-Magnetic Resonance Imaging Center, Institute of Biomedical Sciences, Academia Sinica, Taipei, Taiwan

Brain activation can be evaluated by a bimodal fMRI protocol that utilizes hemodynamics based fMRI and manganese-enhanced MRI (MEMRI) in combination. The present study demonstrates a striatal CBV response accompanied by enhanced nigrostriatal activity detected by MEMRI following peripheral electrical stimulation.

14:30 4508. Regional Difference in Mn Uptake and Retention in Mouse Brain

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We compared the difference in Mn uptake and retention rates at various brain regions after systemic administration of MnCl2. By estimating Mn concentration with the change in T1 relaxation rate (ΔR1), it was observed that different brain regions have considerable difference in the time-to-peak and bioelimination rate of Mn. The ΔR1-time course was fitted to a gamma variate model which showed reasonable fit and provides estimation of time-to-peak, peak value and half-life. The olfactory bulb reached the peak earliest and highest, while regions like thalamus reached peak at day 2. Olfactory bulb had fastest clearance with a half-life of 6.6 days, and cerebellum had longer half-life of 11.5 days. This method can allow better estimate of the uptake and retention and can be used to maximize tissue contrasts or applied to studying of transporter mechanism in animal models.

15:00 4509. Detection of Brain Activity During Chronic Pain Using Activity-Induced Manganese-Enhanced MRI in the Rat

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Nerve injury occasionally induces neuropathic pain, which is a type of chronic pain. The cardinal symptom of neuropathic pain is spontaneous or touch-evoked pain. The purpose of this study is to detect brain activation during foot stimulation by using Activity-induced manganese-enhanced (AIM) MRI in a segmental spinal nerve ligation (SNL) model. Methods The right L5–L6 spinal nerves were ligated with 5–0 silk sutures. AIM MRI were acquired using a 4.7-T MRI system. Results Pain-induced brain activation was successfully visualized using AIM MRI. It suggested that the AIM MRI is useful for the depiction of the conducting pathway of pain.
Wednesday 13:30-15:30 Computer 88

13:30  **4510**. In Vivo DTI-Derived Axial Diffusivity Correlates with Neurological Assessments in EAE-Affected Mice

Joong Hee Kim1, Anne H. Cross2, Sheng-Kwei Song3

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Diffusion tensor imaging (DTI) was used to examine the spinal cords of mice with experimental autoimmune encephalomyelitis (EAE), an animal model of Multiple Sclerosis. Compared to age-matched controls, EAE-affected mice exhibited a statistically significant decrease in axial diffusivity in spinal cord white matter. The decrease of axial diffusivity was parallel to disease severity examined by clinical scoring of EAE mice. The axial diffusivity threshold analysis on EAE-affected mice enabled quantifying the extent of abnormal or damaged axons, which correlated with four independent neurological assessments.

14:00  **4511**. Contrasting Roles for CD4 and CD8 T Cells in a Murine Model of T1 Black Hole Formation

Istvan Pirko1, Jeremiah McDole2, Yi Chen2, Scott R. Dunn3, Diana M. Lindquist3, Aaron J. Johnson2

1Department of Neurology, Mayo Clinic, Rochester, MN, United States; 2Department of Neurology, University of Cincinnati, Cincinnati, OH, United States; 3Imaging Research Center, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States

TMEV infection of mice is an accepted model of multiple sclerosis. In C57B6/J mice, the formation of T1 black holes (T1BH) is detectable in this model. In this study we confirmed that CD8 T cells are the main contributors to T1BH formation, whereas CD4 T cells prevent T1BH formation. We also determined that the involved CD8 T cells are classic epitope specific cytotoxic T cells. T1BH formation is thought to represent neuronal/axonal damage in MS; therefore, it is plausible that CD8 T cells play an important effector role targeted at neurons and axons in MS-related neuroinflammatory diseases.

14:30  **4512**. Monitoring Demyelination in a Cuprizone Mouse Model with Longitudinal and Quantitative MRI Measurements

Jonathan D. Thiessen1, Yanbo Zhang2, Handi Zhang2, Lingyan Wang2, Richard Buist3, Jiming Kong4, Xin-Min Li2, Melanie Martin1,5

1Physics and Astronomy, University of Manitoba, Winnipeg, Manitoba, Canada; 2Psychiatry, University of Manitoba; 3Radiology, University of Manitoba; 4Human Anatomy and Cell Science, University of Manitoba; 5Physics, University of Winnipeg

Magnetic resonance imaging methods capable of quantifying changes due to demyelination can improve both the diagnosis and understanding of white matter diseases such as multiple sclerosis. T2-weighted and magnetization transfer images (MTI) were acquired weekly in control (n=4) and cuprizone-fed mice (n=4) from 2 to 6 weeks of treatment. Diffusion tensor imaging, quantitative MTI, high-resolution T2-weighted imaging, and histopathology were used to analyze ex vivo tissue. All in vivo methods showed significant differences longitudinally in the corpus callosum of the cuprizone-fed mouse. All in vivo and ex vivo methods showed significant differences in the corpus callosum between groups.

15:00  **4513**. Correlation of Fractional Anisotropy (FA) Changes in Demyelination Lesion with Its Surrounding Edema in an Experimental Model

Krithika Balasubramanian1, Senthil S. Kumaran1, Uma Sharma1, Naranamangalam R. Jagannathan1

1Department of NMR & MRI Facility, All India Institute of Medical Sciences, New Delhi, Delhi, India

Evaluation of sequential changes in fractional anisotropy (FA) in demyelination lesion and associated edema in an experimental rat model of demyelination was carried out at 4.7T. Results showed that both FA(lesion) and FA(edema) decreased during demyelination till day 11. Decreased FA(lesion) is attributed to the damage of myelin which progressed till day 11 while reduced FA(edema) is due to breakdown of blood-brain barrier (BBB). From day 15 remyelination set in along with repair of BBB, which led to increased FA(lesion) and FA(edema). Our study thus showed that DTI may aid in better understanding of the pathophysiology of de- and remyelination.

Thursday 13:30-15:30 Computer 88

13:30  **4514**. Study of the Pathophysiology of Demyelination in an Experimental Model: Correlation of Lesion Volume with T2, Apparent Diffusion Coefficient (ADC) and Fractional Anisotropy (FA)

Krithika Balasubramanian1, Uma Sharma1, Senthil S. Kumaran1, Naranamangalam R. Jagannathan1

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Evaluation of variation in T2, ADC and FA with the lesion volume at various stages of de- and re-myelination in a demyelinating rat model was carried out at 4.7 T. During demyelination lesion size, T2 and ADC increased while FA decreased indicating loss of myelin, while these values were reversed during remyelination. A strong positive correlation was observed between lesion volume and
T2 and between lesion volume and ADC, while FA showed strong negative correlation. Our data thus indicated the potential of parameters in characterizing the various stages of the de- and re-myelination thus providing useful information on its pathophysiology.

14:00  **4515. Cross-Relaxation Imaging of Age-Related Changes in Myelin Mutant Shaking Pup**

*Alexey A. Samsonov*, *Andrew L. Alexander*, *Julia V. Velikina*, *Ian D. Duncan*, *Aaron S. Field*

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We report results of studying of quantitative parameters of two-pool MT (cross-relaxation) model across ages in the shaking (sh) pup, a canine mutant with a profound paucity of myelin. All qMT measures were sensitive to changes between dysmyelinated and myelinated dogs. The bound pool fraction f provided the strongest discrimination between myelinated and dysmyelinated dogs confirming its high sensitivity to myelin content. The observed qMT measures may represent a result of mixing several potentially distinguishable bound pools including myelin protons. Including additional pool in a MT model may potentially help distinguishing myelin from other components of bound proton pool.

14:30  **4516. Multicomponent Relaxometry (McDESPOT) in the Shaking Pup Model of Dysmyelination**

*Samuel Anthony Hurley*, *Pouria Mossahebi*, *Alexey A. Samsonov*, *Andrew L. Alexander*, *Sean C.L. Deoni*, *Ron Fisher*, *Ian D. Duncan*, *Aaron S. Field*

1Medical Physics, University of Wisconsin, Madison, WI, United States; 2Biomedical Engineering, University of Wisconsin, Madison, WI, United States; 3Radiology, University of Wisconsin, Madison, WI, United States; 4Psychiatry, University of Wisconsin, Madison, WI, United States; 5Engineering, Brown University, Providence, RI, United States; 6Waisman Lab for Brain Imaging and Behavior, University of Wisconsin, Madison, WI, United States; 7Medical Sciences, University of Wisconsin, Madison, WI, United States

McDESPOT is a recently proposed technique which provides two-component relaxometry using steady-state imaging. The relative fraction of water in two microstructural compartments may be estimated via the myelin water fraction map. We report initial results of this technique on the shaking pup mutant. The shaking pup is a canine model which suffers from dysmyelination without the confounding effects of inflammation or edema, and is thus an excellent model for investigating the sensitivity and specificity of McDESPOT parameters to myelin content in the brain.

15:00  **4517. Myelin Visualization Using Q-Space MRI**

*Keigo Hikishima*, *Kanehiro Fujiyoshi*, *Masayuki Yamada*, *Yuji Komaki*, *Suketaka Momoshima*, *Kazuo Yagi*, *Norikazu Tamaoki*, *Masaya Nakamura*, *Hideyuki Okano*

1Central Institute for Experimental Animals, Kasawaki, Kanagawa, Japan; 2Department of Physiology, Keio University; 3Department of Orthopaedic Surgery, Keio University; 4School of Health Science, Fujita Health University; 5Department of Radiology, Keio University; 6Graduate School of Health Science, Tokyo Metropolitan University

One of the most recently developed DWI methodologies is q-space imaging (QSI) which has been used to detect the size of microstructure using higher b-values. We developed the myelin mapping protocol using QSI by focusing on the strong restriction of water diffusion in myelin architecture. We compared myelin mapping with histological findings in spinal cords using dysmyelination mutant mice and monkeys with spinal cord injury. In this study we demonstrated that myelin mapping depicts the presence of myelin in spinal cord.

**MRS of Animal Brain**

**Hall B Monday 14:00-16:00 ** Computer 89

14:00  **4518. In Vivo MRS Study of Adolescent Rhesus Monkeys with Early Life Stress**

*Yumei Yan*, *Xiaodong Zhang*, *Brittany Howell*, *Mar Sanchez*

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In vivo Magnetic Resonance Spectroscopy (MRS) was used to investigate the metabolic changes in basal ganglia (BG) and anterior cingulate cortex (ACC) of adolescent rhesus monkeys with Early Life Stress (ELS). The MRS findings suggest that ELS has an enduring impact on the brains of adolescent male monkeys, potentially reflecting neuropathological alterations or even neuronal loss in their BG (striatum). Males seem more vulnerable to these long-term alterations than females, supporting previous sex differences in vulnerability to ELS. The sex differences in Cho striatal concentrations could be due to differences in glial cell proliferation.
A proton magnetic resonance spectroscopy (1H-MRS) study was performed to examine the metabolite abnormalities in the Rhesus monkeys during the abstinence from a long history of methamphetamine (METH) self-administration. The 1H-MRS spectral data were acquired from the frontal lobe and striatum of Rhesus monkeys at 3T in 5 separate sessions (1-day, 1-week, 1-month, 3-month, and 6-month abstinence, respectively). Compared to the control group (n=5), the total choline (tCho) level in the striatum is significantly elevated during the early abstinence (up to 1 month) and continued to be elevated after 3 months of drug withdrawal in the METH-abstinence group (n=10).

The rhesus macaque brain is an advanced model system for the study of neurological diseases. To correct for unknown T1 weighting in MRS quantification, the B1 corrected T1s of NAA, Cho and Cr in gray and white matter structures of rhesus macaques were measured at 3T. Data was acquired with 3D multivoxel proton MRSI at 180μL resolution. The macaque’s NAA, Cr and Cho T1s are, in MRS quantification, the B1 corrected T1s of NAA, Cho and Cr in gray and white matter structures of rhesus macaques were measured at 3T. Data was acquired with 3D multivoxel proton MRSI at 180μL resolution. The macaques’ NAA, Cr and Cho T1s are, 1232, 1238 and 1107ms. These values are in agreement with human 3T in vivo results.

The absolute metabolic maps of 12 metabolites were obtained in rat brain at different plasma glucose (Glc) concentrations (6.4 – 19 mmol/L) using short-echo-time proton spectroscopic imaging. A satisfactory linear fit of brain Glc concentration versus plasma Glc concentration in cortex, hippocampus and thalamus was found. The slope of this fit was the same within experimental error in all measured brain structures. The linear fit of increased lactate concentrations at increased plasma Glc levels was poor, indicating that other factors such as stress or impaired metabolism during long-term anesthesia can affect the lactate concentration in brain.

Concentrations of myo-inositol, taurine, ascorbate, phosphoethanolamine, glutamine, GABA, N-acetylaspartate, total creatine, total choline and macromolecules were not substantially affected by acute hyperglycemia.

We tested the hypotheses that 1) the electroconvulsive shock (ECS) induced increase in the 1.28ppm neural stem cell biomarker could be tracked using LCModel software and 2) that ECS being an effective anti-depressant treatment would result in changes in glutamate detectable by LCModel software. Analysis of our 1HMRs data acquired from the rat dentate gyrus before and after ECS demonstrated that the 1.28ppm signal was too low to be tracked by LCModel software (CRLB<30%). Further we show that glutamate increases...
significantly in rats exposed to ECS suggesting a role for glutamate as an anti-depressant and/or as an important instigator of synaptic plasticity.

14:30 4524. In Vivo Studies on a Hyperpolarized Choline Contrast Agent: Design and Implementation of a New Biomarker
Hyla Allouche-Arnov1, Aaron K. Grant2, Elena Vinogradov2, Xiaoen Wang3, Robert E. Lenkinski4, Ayelet Gamliel1, Ruppen Nalbandian1, Lucio Frydman4, John Moshe Gomori1, Claudia Monica Barzilay1, Rachel Katz-Brull1,6
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Choline metabolism is known to be altered in neurodegeneration and malignancy. In order to enable the monitoring of choline metabolism in a direct and non-invasive manner in vivo, a stable-isotope labeled analog of choline namely, [1,1,2,2-D4,2-13C]-choline chloride, was designed and implemented for hyperpolarized magnetic resonance applications. The position enriched with 13C in this molecule presents with both a long T1 (35 sec) and a chemical shift that differentiates choline from its metabolites. Here we report on the first in vivo studies of carbon-13 hyperpolarized [1,1,2,2-D4,2-13C]-choline that suggest it is a promising new agent for metabolic imaging by MRI and MRSI.

15:00 4525. Metabolite Profiling of Mild Hypothermia by 1H-MRS
Kannie W. Y. Chan1,2, April M. Chow1,2, L. Xiao1,2, Ed X. Wu1,2
1Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; 2Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

Hypothermia has a profound effect on the protection of brain. However, its exact mechanisms remain to be elucidated. Hypothermia induces changes in brain metabolites. 1H-MRS can detect changes in metabolites and hence help us to have a better understanding of hypothermia. Our data shows changes in several metabolites in the cortex and thalamus. These metabolites are associated with cascade of events that lead to neuroprotection and thermoregulation, which are similar to ex vivo and microdialysis findings. This real time and site specific monitor of metabolites at 7T gives insight into how hypothermia protects the brain from various insults.

Wednesday 13:30-15:30 Computer 89

13:30 4526. Effects of Lactoferrin on Altered Brain Metabolism in Pup Rats After Prenatal Exposure to Dexamethasone
Yohan van de Looij1,2, Pierre Larvaron1, Emmanuel Somm1, Bing Wang5, Rolf Gruetter2,4, Stéphane V. Sizonenko1, Petra S. Hüppi1
1Division of Child Growth & Development, Department of Pediatrics, University of Geneva, Geneva, Switzerland; 2Laboratory for Functional and Metabolic Imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; 4Department of Nutrition and Health, Nestlé Research Center, Lausanne, Switzerland; 4Department of Radiology, University of Geneva and Lausanne, Geneva and Lausanne, Switzerland

Rat model of glucocorticoids exposure during gestation has shown reduction in brain weight. At P7, alterations of cerebral metabolism in the cortex and the hippocampus have been observed by in vivo 1H-MRS. Lactoferrin (Lf) is an iron-binding glycoprotein secreted in milk which has an antioxidant activity. The aim of this work was to evaluate the neuroprotective effect of Lf following prenatal exposure to glucocorticoids by high field localized 1H-MRS. Neurochemical profiles of the pup rat brains confirmed the altered brain development after Dex exposure and revealed the potential protective effect of Lf given to gestational and lactating dams.

14:00 4527. Proton MRS in the Late Stage of Neonatal Hypoxic-Ischemic Cerebral Injury
April M. Chow1,2, Iris Y. Zhou1,2, Shu Juan Fan1,2, Kannie W.Y. Chan1,2, Kevin C. Chan1,2, Ed X. Wu1,2
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Neonatal hypoxic-ischemic (HI) cerebral injury is major cause of permanent damage to neuronal cells. The neonatal brain undergoes regenerative processes late after HI injury. While 1H MRS has been employed to investigate metabolic changes during acute-phase of HI injury, roles of major neurochemicals as markers for neurodegeneration and neuroprotection at late stage are also important for studying the neurophysiological changes. In this study, we showed that alteration in the metabolism at late stage in cortical and subcortical structures is associated with neonatal HI cerebral injury. This may provide insights into the plastic changes and adaptive modifications within brain following injury.
14:30  **4528. Localized In Vivo 1H NMR Spectroscopy of the Rat Brain at 16.4T**

Sung-Tak Hong1, Dávid Zsolt Balla1, Gunamony Shajan1, Changho Choi2, Kamil Uğurbil3, Rolf Pohmann1

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In vivo 1H NMR spectroscopy has several problems including narrow spectral dispersion and low SNR. Increasing a static field strength could alleviate these problems, providing feasibilities of quantifying metabolites not observable at lower field strength. The acquisition of an enhanced neurochemical profile was obtained by minimizing TE up to 1.7 ms in a STEAM sequence at 16.4T. The technique demonstrated possibilities of quantification of additional metabolites, acetate and ethanolamine, in the rat brain in vivo.

15:00  **4529. A Multinuclear NMR Study of Glucose Metabolism in Thiamine-Deficient Cerebellar Granule Cells: New Mechanistic Insights**

Abolghasem Mohammadi1, Claudia Zwingmann1

1Département de médecine, Université de Montréal, Montreal, Quebec, Canada

Wernicke's encephalopathy is a neurological disorder which is characterized by disturbances in consciousness and region-selective brain lesions. Brain damage is associated with a deficiency in thiamine, an essential vitamin in carbohydrate metabolism. Multinuclear NMR spectroscopy was used to assess carbon fluxes and cellular energy state of thiamine-deficient cultured rat cerebellar granule neurons. The data show that neuronal energy failure and death likely result from a primary impairment of neuronal a-KGDH causing impaired carbon flux from glucose/pyruvate through PDH, decreased catabolism of glutamine, and lactate accumulation. Under hyperglycemic conditions, however, alternative explanations to the lactic acidosis hypothesis have to be considered.

Thursday 13:30-15:30  Computer 89

13:30  **4530. Taurine Change in Visual Cortex of Neonatal Monocular Enucleated Rat: A Proton MRS Study**

April M. Chow1,2, Iris Y. Zhou1,2, Shu Juan Fan1,2, Kannie W.Y. Chan1,2, Kevin C. Chan1,2, Ed X. Wu1,2

1Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; 2Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

Neonatal monocular enucleation has been used to study developmental mechanisms underlying visual perception and the cross-modal changes in the central nervous system caused by early loss of the visual input. In this study, we demonstrated that alteration in the metabolism of taurine in visual cortex accompanied with neonatal monocular enucleation could be monitored using 1H MRS at 7 T. The change in taurine signal with respect to creatine signal may possibly due to the increased taurine signal in the right control visual cortex, likely caused by the plasticity resulted from recruitment of resources to the remaining left eye for adaptation.

14:00  **4531. Simultaneously Measuring Glucose Transport Constants and Cerebral Metabolic Rate of Glucose by in Vivo 1H MRS in the Rat Brain**

Fei Du1,2, Yi Zhang1, Xiao-Hong Zhu1, Wei Chen1

1Radiology, Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States; 2Psychiatry, McLean Hospital, Harvard University, Belmont, MA, United States

The basal brain activity and function depends upon a constant supply of glucose through the specific glucose transport mechanism mediated by transporter molecules, referred to as the blood-brain barrier (BBB). Therein the noninvasive method to reliably measure glucose cerebral metabolic rate and transport constants are of importance for understanding underlying glucose transport mechanism and energy consumption in the various physiological or pathological conditions. For instance, in our previous studies, we observed that compared to the light anesthesia (2% v-v isoflurane), brain glucose concentration significantly decreased although cerebral metabolic rate of glucose (CMRglc) decreased 37% at the iso-electric condition. This observation of glucose reduction seemingly contradicted with other studies showing a decreased brain glucose concentration accompanied by the increased CMRglc due to the elevated stimulations. This apparent discrepancy can be explained by the changes of blood plasma glucose concentrations, which were found to be substantially decreased under the iso-electric conditions. Another possible reason is alterations of glucose transport constants (Kt and Tmax). It was reported that pentobarbital reduced blood-brain glucose transfer in the rat brain and the glucose transport constants decreased compared to the awake condition. Therefore, the aim of the current study is to build-up a noninvasive method to reliably and simultaneously measure CMRglc and transport constants for fully understanding brain glucose concentration changes with alterations of anesthesia depth. The method was introduced and implemented by simultaneously measuring plasma and brain tissue glucose concentration time courses after stopping glucose infusion.
14:30  **4532. 1H MRS of Cortical and Subcortical Structures in Mild and Severe Neonatal Hypoxic-Ischemic Cerebral Injuries**

Kevin C. Chan1,2, Ed X. Wu1,2

1Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong SAR, China; 2Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR, China

This study employed in vivo 1H MRS to understand the metabolic alterations in cortical and subcortical structures during the recovery period upon mild and severe hypoxic-ischemic (HI) injuries to the neonatal rat brains. Relative to the Cr peak, results showed a further increase in Cho, Glu and Lac in the left cortex of severe HI group than mild HI group at 3 days after HI injury at postnatal day 7. These values then decreased slightly at 7 days after surgery in both HI groups. Tau also increased on both sides of the cortex at Day 3 and then drop at Day 7 for both HI groups. In the left thalamus of the severe HI group, NAA appeared to decrease transiently at Day 3 and normalize at Day 7, whereas Cho, Glu, Lac and Tau levels apparently peaked at Day 3. The results of this study may help to investigate potential therapies and the recovery mechanisms upon different severity of neonatal HI insults.

15:00  **4533. Early Metabolic Changes Following Focal Traumatic Brain Injury in Rats**

Su Xu1,2, Steve Roys,23, Jennifer Racz4, Da Shi1,2, Jiachen Zhuo1,2, Rao Gullapalli,23, Gary Fiskum1,4

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Traumatic brain injury is characterized by acute physiological changes that may play a significant role in the final outcome resulting from the injury. Experimental models of TBI provide a useful tool for understanding the early cerebral metabolic changes induced by the damage. In this study, we investigate the early post-traumatic changes in neuro-metabolites in the rat brain following controlled cortical impact injury using in vivo 1H MRS at 7 Tesla. Significant changes in N-acetylaspartate, glutamate and choline were observed within the first 3 hours after injury in the pericontusional area suggesting a possible temporal window for therapeutic intervention.