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Neuroimaging 1
Direct assessment of wall shear stress by signal intensity gradient from time-of-flight magnetic resonance angiography

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Arterial wall shear stress (WSS), the stress tangential to the arterial wall, is known to have pathophysiologic roles in endothelial function and arterial thromboembolism. Time-of-flight magnetic resonance angiography (TOF-MRA) is based on a flow enhancement, and its technique to control intraluminal saturation has been evolved and now universally applied to every subject. It means that intraluminal saturation might be variable because of individual characteristics of arterial geometry and flow velocity.
Objective: To assess patient-specific WSS directly from TOF-MRA, calculating signal intensity gradient near the arterial wall (TOF-MRA SIG).
Methods: We developed a new method to calculate the TOF-MRA SIG, and performed validation studies. A phantom study for the TOF-MRA SIG as a function of flow rate was performed. A comparison between the TOF-MRA SIG and WSS from computational fluid dynamics (CFD) was made using 3D TOF-MRA of extracranial carotid artery in 5 healthy volunteers.
Results: The phantom study showed that the TOF-MRA SIG values were significantly higher in the tube with high flow rate than with low flow rate ($p < 0.001$). The TOF-MRA SIG values were highly correlated with the various flow rates ($\beta = 0.96$, $p < 0.001$). The comparison study showed that the correlation efficient between the CFD WSS and the TOF-MRA SIG at the carotid artery was more than 0.8 in every section (all p values < 0.001).
Conclusion: The TOF-MRA SIG was dependent on flow rate, and showed highly significant correlations with the CFD WSS. The TOF-MRA SIG might provide a convenient and efficient screening measurement to assess patient-specific WSS for the risk of vascular disease.

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Neuroimaging 1
Iron in typical and atypical parkinsonism — MRI and Mössbauer spectroscopy study

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Background: Iron may play an important role in typical Parkinson's disease (PD) and progressive supranuclear palsy (PSP). In both the destruction involves substantia nigra (SN). Attempts to use magnetic resonance imaging (MRI) to assess iron in living subjects remain controversial. Objective: to compare the results of measurements of the relaxation times T1 and T2 obtained from patients with PD, PSP and controls with the concentrations of iron measured with Mössbauer spectroscopy (MS).
Material and methods: MS was performed on of 29 control 17 PD and 10 PSP SN samples. The measurements of T1 and T2 from SN were performed with the use of 1,5 T MRI with Inversion Recovery pulse sequence to measure T1 and Fast Spin Echo pulse sequence to measure T2. 46 PD, 10 PSP and 18 control patients were studied.
Results: iron concentration (ng/mg wet tissue) in SN was 177 ± 14 for controls, 177 ± 18 in PD and 301 ± 26 in PSP. T1 (ms) was 708 ± 22 for controls, 730 ± 12 for PD and 589 ± 5 for PSP. T2 (ms) was 52 ± 1 for control, 47 ± 1 for PD and 55 ± 2 for PSP.
Conclusions: T1 shortening in PSP correlates with higher concentration of iron compared to PD and control, while there is no change in T2 within limits of experimental errors. Therefore T2 must be related not only to the concentration of iron. The differences between PD and PSP results suggest that the mechanism of the neurodegeneration in the two diseases may be different.

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Neuroimaging 1
Amide-proton-transfer MRI signal as biomarker of glioma as assessed by image-guided needle biopsy

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Background: Existing clinical MRI sequences are not tissue specific. Amide-proton-transfer (APT) imaging is a novel molecular technique that gives contrast via endogenous cellular proteins.

0022-510X/$ – see front matter.

Objective: We validate the diagnostic accuracy of applying APT imaging to glioma with neuropathology through targeted tissue sampling of APT imaging defined regions of interest (ROI).
Materials and methods: 25 patients (14 untreated cases and 11 treated cases, mean age: 43.9 ± 7.1 years) with glioma were recruited and scanned, using a fast 3D APT imaging sequence. APT-weighted (APTw) signals were calculated using a magnetization-transfer-ratio-asymmetry analysis at ±3.5 ppm. Two to four feasible and meaningful ROI for each patient were sampled through the BrainLab neuro-navigation system.
Results: In 9 untreated (without surgical intervention, radiotherapy or chemotherapy) patients with APTw hyperintensity within the lesions (2 cases did not show gadolinium enhancement), pathology showed that all lesions were high-grade gliomas (HGGs). In the remaining 5 untreated patients with APTw iso-intensity or mild punctate hyperintensity (one case with gadolinium enhancement), were found to be low-grade glioma (LGG). For 11 patients with questionable active tumor versus treatment effects, radiographic – pathologic correlation data showed that APTw hyperintensity was associated with tumor recurrence (9 cases), while APTw isointensity to mild hyperintensity indicated treatment effects (2 cases).
Conclusions: APTw hyperintensity is a typical feature of HGG, which is independent of gadolinium enhancement. The APTw signal, as a surrogate biomarker of active glioma, has the potential to enhance the noninvasive diagnosis of grade of glioma, as well as active brain tumor vs. treatment effects.

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Neuroimaging 1
Magnetic resonance imaging (MRI) in patients with and without central (CNS) or peripheral (PNS) neuropathic pain. A comparative study

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Background: There is little information on the contribution of MRI to the management of central and peripheral neuropathic pain (NP).
Objectives: To compare the contribution of MRI to the management of patients with and without NP.
Methods: Mean age 57.5 ± 11.5 years (range 21–83). Patients were classified as polyneuropathies with sensory involvement (PNP, n = 39), other peripheral nerve conditions (OPNS, n = 8) and CNS disease (CNS, n = 25), each subdivided in painful (+) and painless (−). MRI Siemens Symphony 1.5 T. Sequences were T1, T2, DP, FLAIR, Diffusion and T2GRE for brain and T1, T2, T2STIR, and T2CISS for spine, with and without gadolinium. MRIs were classified as concordant when diagnostic or consistent with the clinical diagnosis, and discordant either when the findings were not of significant pathological nature or unexpectedly normal, or when significant pathology was found but unrelated to the neurological diagnosis. Patient consent and institutional approval was obtained.
Results: Concordant: PNP(+) = 22 patients, PNP(−) = 10; OPNS(+) = 5; CNS(+) = 13, CNS(−) = 7. Discordant: PNP(+) = 4, PNP(−) = 3; OPNS(+) = 3; CNS(+) = 2, CNS(−) = 3;. The proportions of discordant MRIs were not significantly different (Fisher's exact test) in patients with (18%) versus without (26%), and in central (15%) versus peripheral (25%), NP. Seven with, and 3 without, pain of 15 discordant MRIs showed significant unsuspected pathology. MRI established the anatomic pathology of 38% with (13 CNS, 6 PNS), and 30% without (7 CNS), NP, and a second pathology in 3 with (2 CNS and 1 PNS), and 4 without, NP.
Conclusion: MRI helped establish pathology causing NP in 38% and to diagnose 14.3% of patients with unsuspected significant or contributory pathology, which was similar to patients without NP.

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Neuroimaging 1
Acute neurological decline with bilateral T2 imaging changes: A remedial cause not to miss

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Background: Intracranial arteriovenous shunts (AVS) may present with neuroimaging mimicking inflammatory, infectious or metabolic processes, presenting diagnostic challenges.
Methods: We describe the presentation, imaging and management of two patients who presented to Massachusetts General Hospital with acute neurological decline.
Results: A 64 year-old hypertensive, alcoholic male presented with confusion, confabulation and ataxia. MRI demonstrated T2 hyperintensity in bilateral thalami, mammillary bodies, tectum and periaqueductal grey. Thiamine was administered for presumed Wernicke's encephalopathy. Vascular imaging revealed a high-grade left petrosal sinus dural arteriovenous fistula. A 41 year-old male on Tacrolimus post-renal transplant presented with seizures and brainstem T2 hyperintensities on MRI. He was treated for presumed atypical PRES, but the imaging findings progressed over a month. Vascular imaging revealed a pial arteriovenous malformation fed by the superior cerebellar artery and draining into brainstem veins. Both patients underwent successful endovascular embolization with resolution of symptoms.
Conclusion: AVS may produce symptoms through a variety of mechanisms, including hemorrhage, venous congestion, vascular steal, mass effect and irritation of cortical tissue, and therefore can lead to a broad spectrum of clinical manifestations. We present two unusual cases of AVS and highlight that T2 hyperintensities resulting from venous congestion and venous territory infarction can be mimics for a variety of other pathologies. Suspicion for vascular pathology should be maintained for any patient with bilateral imaging changes, and investigation with catheter angiography pursued if suspicion is high. Prompt endovascular treatment can prevent further neurological injury, and permit complete recovery.

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Neuroimaging 1
Correlations of brain volumes with clinical data in neuropsychiatric lupus patients

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Background: Neuropsychiatric systemic lupus erythematosus (NP-SLE) include anxiety, depression or cognitive affection.
Patients and methods: We examined 3 groups of SLE patients and controls. Group I: 31 NP-SLE patients with epilepsy (NP-SLE epi), group II: 23 patients with SLE without NP-SLE (SLE) and group III: 32 patients with NP-SLE without epilepsy (NP-SLE). MR investigation was made on 1.5-T Philips. The volumes of the brain, amygdalae and cerebral lesions and the brain parenchyma fraction (BPF) were correlated with clinical and laboratory data.
Evaluated hypothesis: amygdalar volumes in NP-SLE correlate with the mood, depression and cognitive disorders occurrence. The mood disorder correlates with the lesions volume, SLE duration and negatively correlates with BPF in NP-SLE groups.
Results: Lesions volumes in NP-SLE epi: 0.46 to 8.14 cm^3; in NP-SLE: 0.08 to 21.68 cm^3. Brain volumes in NP-SLE epi: 1063.8 to 1433.60 cm^3. Brain volumes in NP-SLE: 912.69 to 11295.20 cm^3. NP-SLE and NP-SLE epi groups did neither differ statistically significantly nor in the volume of cerebral lesions ($p = 0.834$) or BPF ($p = 0.324$). The volumes of amygdalae in all groups significantly differed (significance level of 0.001), right amygdala was always greater and were not dependent on the occurrence of mood disorders, depression and cognitive disorders.
Conclusion: We failed to demonstrate correlation of volumetric values in NP-SLE patients with/without epilepsy with clinical data or psychiatric symptomatology. Amygdalar asymmetry was enhanced in NP-SLE patients as compared to controls.

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Neuroimaging 1
Improved quantitative accuracy of PET/CT imaging of plaque deposition in transgenic mice with F-18 quinoline for early diagnosis of AD

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Background: We have developed F-18 quinoline (FHOQ) for early detection of plaques in transgenic mice. Micro PET/CT devices have limitations in detecting small disease foci and assessing plaque burden quantitatively. 3D reconstruction time is too long (few hours). We have developed new software for faster image processing to enhance the quantitative ability.
Materials and methods: Control and double transgenic (tg) mice (APP/PS1) ages 6, 12 and 15 months were imaged in Siemens Inveon® PET/CT device. Dynamic PET scans were obtained immediately following administration of FHOQ and continued for 30 min. A rapidly converging iterative deconvolution algorithm with a novel subset based approach (RSMED) to de-noise and improve the quality of PET images is used. Pre-clinical imaging software (*invi*CRO) was used for fitting the reconstructed PET images to mouse brain atlas.
Results: Tg mice brains had slower washout of the tracer compared to controls. Tg mice, as early as 6 months, had increased but diffuse uptake in the cortex whereas older mice had discrete and higher uptake at 5 min post administration of the tracer. Enhanced tracer uptake in cortex and hippocampus could be seen in processed images. Only 5–10 iterations (0.5 min/iteration) were sufficient enough to obtain high quality images for quantitative analysis.
Conclusion: PET imaging with FHOQ had positive scan in tg mice at an early age (6 mo). Our new approach significantly reduced reconstruction time (few hours to minutes) to enhance image quality. This approach may be suitable for quantitative studies of measuring changes in Alzheimer's pathology.

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Neuroimaging 1
Hippocampal subfield volumes in physiological déjà versus mesial temporal lobe epilepsy and schizophrenia

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Using source-based morphometry a significantly less gray matter was recently revealed within a set of cortical (predominantly both-sided hippocampi) and subcortical regions in healthy subjects experiencing déjà vu (DV) when compared to déjà vu non-declarers (Brázdil et al., 2012). Importantly in these regions gray matter (GM) volume was inversely correlated with the frequency of déjà vu. Despite observed GM volume differences mirrored the distribution of GM volume reduction in subjects suffering from mesial temporal lobe epilepsy (MTLE), the pattern of GM differences within hippocampi were distinctive between MTLE and DV (Brázdil et al., 2013). Schizophrenia (SCH) represents another condition in which hippocampal GM volume was found to be significantly decreased (Haukvik et al., 2014). In this study we compared differences in GM volume within distinctive hippocampal subfields (CA1; CA2 + 3; CA4 + DG; subiculum; presubiculum) among healthy DV non-declarers ($N = 26$) and healthy DV declarers ($N = 85$), MTLE ($N = 47$) and schizophrenia ($N = 46$) patients alternatively. The images were automatically segmented and registered using SPM8 and its toolbox DARTEL. Local GM volume was corrected with respect to age, gender and total intracranial volume. The decrease of local GM volume across voxels (relatively to the non-DV group) was correlated between DV and MTLE and between DV and SCH. The results revealed significant correlations between GM volume reduction in DV and SCH as well as DV versus MTLE in the majority of analyzed hippocampal subfields. Importantly GM volume correlations were significantly higher for SCH (than MTLE) within left CA4 + DG, left and right CA2 + 3, and left presubiculum. The only significantly higher correlation for MTLE was observed within right subiculum. Our findings reveal common structural features of hippocampal involvement in physiological déjà and both investigated SCH and MTLE.

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