RPS 1013-9 12:13

Orientation-resolved means of diffusivities and transverse relaxation times in heterogeneous brain tissue

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Purpose: In white matter, the millimetre-scale resolution of diffusion MRI may encompass myelinated axons and unknown fractions of grey matter, cerebrospinal fluid, or pathological tissue. To tackle this heterogeneity, conventional approaches rely on assumptions regarding tissue properties. This work combines novel MRI acquisition and processing methods to extract voxel-scale nonparametric 5D distributions of diffusion tensors (microstructure) and T_2 (chemical composition) without the use of limiting assumptions. Orientation-resolved (fiber-specific) means of diffusivities and T_2 are then defined via orientation clustering within the 5D distributions.
Methods and materials: A healthy volunteer was scanned on a 3T Siemens MAGNETOM Prisma using an EPI sequence customised for tensor-valued diffusion encoding and variable echo times. A nonparametric 5D distribution of diffusion tensors and T_2 is estimated in each voxel via a Monte-Carlo inversion algorithm. This algorithm also provides uncertainty on the estimated distribution and orientation distribution functions (ODFs) of anisotropic components. Finally, orientation-resolved means of isotropic diffusivity ("size"), normalised anisotropy ("shape") and T_2 are computed using an in-house orientation-clustering algorithm.
Results: ODFs present orientations that are consistent with the known anatomy, and are estimated in all areas of the brain, including heterogeneous voxels that comprise white matter, cerebrospinal fluid and/or grey matter. In parallel, our clustering procedure yields the median and interquartile range (uncertainty) of the orientation-resolved means of sizes, shapes and T_2.
Conclusion: We tease apart intra-voxel fibres and separately characterise their respective microstructure and chemical composition. This work shows potential in the understanding and longitudinal tracking of brain development and neurodegenerative diseases.
Limitations: Pilot study limited by the low number of investigated subjects.
Ethics committee approval: Approved by the IRB of Cardiff University School of Medicine.
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A. Reymbaut: Employee at Random Walk Imaging AB
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Natural abundance C13 magnetic resonance spectroscopy quantification of mono-and polyunsaturated fatty acids: influence of diet

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Purpose: Lipid composition of body fat can be a key indicator of nutritional status and other related human disorders. In vivo C13 magnetic resonance spectroscopy (MRS) enables the non-invasive study of fatty acids, notably two key unsaturated fatty acids: monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA). The purpose of this work is to utilise C13-MRS to quantify MUFA and PUFA in a cohort of healthy volunteers with well-established diets.
Methods and materials: A total of 13 carnivores (6 males, 7 females; mean age 49 ± 17 years) and 14 vegetarian (9 males, 5 females; mean age 43 ± 19 years) subjects were scanned on a clinical 3.0T GE Signa-HD scanner using a dual-tuned C13-H1 coil. The MRS acquisition consisted of a natural abundance non-decoupled C13 pulse sequence. MUFA and PUFA peaks were quantified in the frequency domain using a Marquardt fitting algorithm. Between-group differences in the PUFA/MUFA ratio were compared using a paired t-test.
Results: A non-decoupled, natural abundance C13-MRS spectrum from the calf muscle of a vegetarian subject in the region of mono and polyunsaturated lipid resonances was observed. Compared to carnivores, vegetarian subjects showed a lower PUFA/MUFA ratio (using 2-sided student t-test, p = 0.06).
Conclusion: This study demonstrated the feasibility to perform and quantify in-vivo non-decoupled natural abundance C13-MRS in the mono and polyunsaturated lipid region. PUFA/MUFA ratio differences between recruited carnivores and vegetarians were found to be non-statistically significant (p=0.06). Future work aims to increase statistical power by increasing the number of subjects. In general, this method can be used to monitor changes in lipid composition with diet.
Limitations: n/a
Ethics committee approval: All subject gave their informed consent.
Funding: No-funding was received for this work.
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Multimodal multi-parametric phantom of the fatty liver disease

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Purpose: Fatty liver disease (FLD) inevitably leads to steatohepatitis, fibrosis, and cirrhosis. The main trend of FLD diagnosis by ultrasound is a multi-parametric approach (mp-US) with the simultaneous application of 4 techniques: B-mode, shear wave elastography (SWE) for fibrosis, SW dispersion for inflammatory activity (SWD), attenuation coefficient (AC) for steatosis. Proton density fat fraction (PDFF) MRI recognised as a reference method. The aim was to create multimodal training phantom for mp-US and correlation of the steatosis degree between AC and PDFF.
Methods and materials: We propose a phantom container of non-magnetic material with a filler. We used milk fat based phantoms with different fat concentration, as far as milk composed of spherical drops of triglycerides comparable to fat vacuoles in hepatocytes. 35 phantoms with different fat concentrations were studied: milk 2.5%, 3.2% and cream 5%, 10%, 12%, 15%, 20%. We simultaneously used SWE, SWD and AC by US equipment Aplio i-800 (Canon Medical) with a PVI-475BX convex probe. PDFF was performed using Titan 1.5T MRI (Canon Medical). Mass fraction of fat filler was also biochemically evaluated. Spearman's rank correlation coefficient was applied.
Results: Close correlation was obtained of the filler fat concentration between the AC (dB/cm/MHz), chemicaly mass fraction of fat (%) - 0.700 and PDFF (average value - 0.782, minimum - 0.747, maximum - 0.782), respectively.
Conclusion: A training phantom was created for the simultaneously used the mp-US technologies: SWE, SWD and AC. A high degree of correlation between the values of AC and MR-PPDF is determined our phantom as multimodal for steatomery.
Limitations: An additional variety of fat concentration might increase the accuracy of correlation.
Ethics committee approval: No patients or animals were tested in study.
Funding: No external fundings were used for the conduction of the study.
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11:15 - 12:30 **Coffee & Talk 2**

Paediatric

RPS 1012a

Paediatric musculoskeletal imaging: what's new?

Moderators:
I. Barber Martinez; Esplugues De Llobregat/ES
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RPS 1012a-1 11:15

Bone marrow signal on whole-body MRI in healthy asymptomatic children: a prospective observational study establishing novel reference standards

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Purpose: WBMRI enables the depiction and characterisation of diseases at an early stage and is embraced for use in children by many centres, although no studies addressing its precision, accuracy, and clinical validity are published. The signal in the bone marrow that may be interpreted as pathology is shown to be present in healthy children. We set out to examine healthy, asymptomatic children with WBMRI to establish normal reference standards for the skeleton in children.