Functional connectivity modulation induced by transcranial direct current stimulation of the motor network investigated by resting state fMRI

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therefore, their potential in rehabilitation treatments should be further investigated.

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E.436
ARTERIAL SPIN LABELING (ASL) TECHNIQUE COULD BE USED AS STANDARD CLINICAL TOOL?

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Introduction: The two most common methods for measuring perfusion using MRI are the Dynamic Susceptibility Contrast (DSC) approach, which identifies the passage of an intravascular contrast agent, and the Arterial Spin Labeling (ASL), which uses magnetically labeled arterial blood water as a diffusible flow tracer. DSC perfusion is still the more widely applied clinical technique but recent technical advances have improved the sensitivity of ASL perfusion. It has been argued that ASL perfusion images are not clinically reliable due to the low SNR. The objective of the current study was to evaluate the regional correlation between ASL perfusion measurement of CBF in healthy subjects and patients with brain tumors in different brain areas.
Materials and Methods: 35 subjects were enrolled: 27 healthy subjects (19 m/17 f, 44.6 y) and 8 patients (4 m/3 f, 57 y) with different brain lesions. The study was performed using a 1.5 T MR scanner. Each subject received an ASL scan and all the routine clinical MRI scans; a DSC scan was also acquired only for patients. For all subjects, a series of ROIs in correspondence to the white matter (WM) and gray matter (GM) have been drawn on the ASL-CBF map; the same ROIs were also positioned on DSC-CBF map for all patients. The perfusion ASL values from different regions were analyzed using non parametric t-test. For patients, the ASL and DSC data have also been compared.
Results and Conclusions: From the comparison between the ASL values it was found that the values of the CBF were statistically higher in the GM (33.5 ± 5.8 ml/100g/min) with respect to the WM (17.1 ± 5.7 mL/100g/min) as expected. From patient data analysis, it was evident that ASL and DSC values are in agreement with the type of lesions, WM, GM. Our study confirmed that the ASL technique represents a valid alternative to conventional DSC. In our experience the ASL was able to highlight the topographical distribution of CBF and to locate in patients ischemic and glial lesions.

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E.437
TRANS-CRANIAL MRI-GUIDED FOCUSED ULTRASOUND SURGERY (TCMRGFUS): ITALIAN AND WORLD-FIRST EXPERIENCE AT 1.5 TESLA

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Introduction: Transcranial magnetic resonance-guided focused ultrasound surgery (tcMRgFUS) is a promising new technology for the non-invasive treatment of various brain disorders. Here, we present our preliminary results achieved with the first Italian installation of a transcranial MRI-guided focused ultrasound surgery (tcMRgFUS) certified system for functional neurosurgery. Technical issues faced to achieve a safe and effective treatment will be discussed focusing on MR high-resolution live imaging and thermometry sequences optimization.
Materials and Methods: Patient enrollment was based on indication for functional neurosurgery and evidence of medication-refractory disease; a detailed medical history has been collected together with a complete clinical examination and a neurophysiological assessment. Eligible patients have been screened by MDCT and MRI.
Results: Although this is a preliminary experience, the clinical success of our first treatments proves that this promising new technology for non-invasive treatment of various brain disorders can be safely and effectively performed also with the most popular MRI units operating at 1.5 T.
Conclusion: TcMRgFUS treatments are currently performed in a very few centers in the world and only using 3 T MRI units. This is the world-first experience of functional neurosurgery successfully performed with a tcMRgFUS installed on the most popular and affordable 1.5 T MR units. Thanks to the use of a radiation-free technique like the MRI as a guide and to the possibility of verifying the clinical effectiveness of such an innovative treatment before a permanent lesion is made in the targeted area of the brain, this technique allows for a huge step forward for both interventional neuroradiology and functional neurosurgery.

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E.438
COMPARATIVE EVALUATION OF DATA PREPROCESSING SOFTWARE TOOLS TO INCREASE EFFICIENCY AND ACCURACY IN DIFFUSION KURTOSIS IMAGING

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Introduction: Diffusion tensor imaging (DTI) is the most commonly used technique to extract microstructural features from a set of diffusion weighted images. In addition to the metrics obtained with DTI, diffusion kurtosis imaging (DKI) can provide non-Gaussian diffusion measures by means of the kurtosis tensor.
DKI has shown to be more sensitive to tissue microstructural changes in both normal and pathological neural tissue.
In a clinical setting, however, these benefits are often nullified by numerous acquisition artifacts. The aim of this study was compare two preprocessing software for DTI apply to DKI. Also, the major preprocessing, processing and post-processing procedures applied to DKI data are discussed.
Materials and Methods: The reproducibility typical to DKI parameters obtained from the same dataset using two DTI analysis software tools was evaluated by the image quality measurements in regions of interest on 10 DKI datasets. The data were corrected for motion and eddy current artifacts using two different softwares: ExploreDTI (http://www.exploredti.com) and TORTOISE DIFF_PREP (https://science.nichd.nih.gov/confluence/display/nihpd/TORTOISE).
The data analysis was performed using in-house developed software implemented in Python.
Results: The performances of these approaches were compared with Monte Carlo simulations. A quantitative analysis of differences of typical DKI maps obtained from data preprocessed with these two packages was performed and the advantages and disadvantages of each tool are highlighted.
Conclusion: This work is aimed at providing useful indications for application of DKI in clinical settings where artifacts in diffusion weighted images are common and may affect DKI measurements and the lack of standard procedures for post-processing might become a significant issue for the use of DKI in clinical routine.

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E.439
RESTING STATE FMRI: A TOOL TO INVESTIGATE FUNCTIONAL CONNECTIVITY MODULATION INDUCED BY TRANSCRANIAL DIRECT CURRENT STIMULATION OF THE MOTOR NETWORK

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Introduction: Resting-state functional connectivity (fcMRI) represents a novel fMRI approach that allows detection of temporal correlations in spontaneous BOLD signal oscillations while subjects rest quietly in the scanner. Under resting conditions the brain is engaged in spontaneous activity that causes a low frequencies (<0.1 Hz) BOLD signal fluctuations. Functional connectivity (FC) can be defined as the synchrony of neural activity among spatially distant regions.
Transcranial direct current stimulation (tDCS) is a non-invasive brain stimulation technique that is known to modulate cortical activity and FC among brain regions, as measured by functional magnetic resonance imaging.
This study is aimed at measuring the variation of functional connectivity between cortical brain regions after tDCS along time.
Materials and Methods: For this purpose we enrolled 20 healthy right-handed subjects. All subjects underwent 4 sessions RS-fMRI (10' each, TR 2'', 300 volumes, 1.5 T scanner): 2 immediately before and 2 after 20' tDCS over left M1. 10 of them received real (anodal) tDCS, 10 received sham stimulation. We analyzed FC between left and right M1 with two different statistical analyses: Seed-based correlation analysis (SCA) and the temporal concatenation group ICA (TC-GICA).
Results: Seed-based correlation analysis showed a significant decrease of FC during the first fMRI acquisition immediately after anodal tDCS stimulation ($p = 0.005$) that reaches back to baseline during the last fMRI session. This behavior was not found in subjects who underwent sham stimulation ($p = 0.12$).
The temporal concatenation group ICA showed that immediately after anodal stimulation the average value of voxels decreases significantly ($p < 0.05$) whereas there is no significant decrease in the case of sham tDCS stimulation.
Conclusions: Our results show that anodal tDCS is able to induce connectivity changes within motor network, that is, reversible in a period lasting between 10' and 20' after stimulation.

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E.440
LONG TERM SIGNAL TO NOISE RATIO ANALYSIS OF MAGNETIC RESONANCE IMAGES FROM MULTICOIL ARRAY

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Introduction: Image signal to noise ratio (SNR) is one of the most sensitive parameters in MR, however the use of standard evaluation protocols developed for single channel coils can be misleading for multicoil arrays. Moreover, when performing an acceptance test, a statistical approach is needed in order to define normalization ranges for routine evaluations. This study presents the results of SNR evaluations, repeated for 6 months with a variable time scheme, on head coil images, both for single coil and final reconstructed images, in order to define normality ranges for system performance.
Materials and Methods: A homogeneous spherical phantom was scanned on a 1.5 T system with a 20 channel head coil, using a SE standard acquisition protocol and a SOS reconstruction. 10 images were acquired each time in order to evaluate short term reproducibility. Daily measurements were performed for the first two weeks, then acquisitions were gradually reduced up to a fortnightly measure after 6 months. Image analysis was performed with NEMA SNR evaluation protocols.
Results: Single measure reproducibility in the combined images was good in many cases, with the worse results for axial scanning direction (CV 0.10% to 20%), while SNR had higher fluctuations for single coil images (7.8%–23.7%). Long term analysis showed no significant trend of the parameter except for one coil that had a continuous decrease of SNR (from 250 to less than 50) after 3 months, due to a signal drop off, that was not identified with the SNR evaluation of the final reconstructed images. For all the analyzed case, an acceptability range was calculated on a 2σ basis.
Conclusion: Our analysis aimed to define acceptability ranges for SNR of single coil elements and combined images, by means of short and long term repeated measurements. Other than the definition of ranges of normal performance, our results showed that reconstructed images are less sensitive to system failure compared to single coil images.

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E.441
MAPPING OF THE RESPONSE OF A 16 ELEMENT PHASED-ARRAY COIL USED FOR BREAST MRS

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Introduction: In MR spectroscopy, it is crucial to recognize the reasons of inconsistent quantification of metabolite concentration due to inhomogeneities in the vicinity of the volume of interest (VOI) or to suboptimal coil geometry. The purpose of this work was to assess the relative response of a breast coil as a function of the position within the coil volume.
Materials and methods: On a 3 T MRI scanner equipped with a dedicated 16 element phased-array coil and a couch to accommodate the patient in prone position, a series of acquisitions was performed changing the VOI position within a phantom consisting of a plastic bag (vol. = 1 l) containing a solution of choline chloride (1 mmol/l).
The characteristics of the acquisition sequence were the following: VOI selection = PRESS; Samples = 1024; BW = 2000 Hz, TE = 135ms, TR = 3000ms, VOI 10 mm3.
The comparison was assessed through the following figures of merit: peak areas of choline (tCho) and non-suppressed water (H2O); ratio of peak areas (tCho/H2O). The VOI position inside the phantom was described by the coordinates of the machine reference frame: patient prone, feet first; coordinates (AP, RL, FH) in mm (magnet center: 0, 0, 0); positive coordinates increasing towards posterior (P), left (L) and superior (H) directions.
Results: For each figure of merit, results were normalized to 100 at the center (–55, 95, 0) of the left coil housing: the tCho/H2O ratio measured at all positions had a substantially constant trend (mean = 104, sd = 7%). tCho (107, 27%) and H2O (101, 24%) showed a more accentuated variation. In particular, tCho assumed the value 55 for the most posterior position we tested in the left housing of the coil (–10, 95, 0) and 67 in medial position (-55, 55, 0), while H2O measure 61 in both locations.
Conclusions: As the tCho absolute values result to be four orders of magnitude lower than H2O, it might be difficult to detect tCho at positions where the variation is greater with respect to the coil center.

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E.442
DIFFUSION KURTOSIS IMAGING IN HEAD AND NECK AND BRAIN TUMOR: A FEASIBILITY STUDY

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Introduction: The aim of this work was to investigate the feasibility of DKI (diffusion kurtosis imaging) in patients affected by brain or head and neck (HN) cancer. The DKI technique allows quantifying the non-Gaussian behavior of water diffusion in biological tissues, as a consequence of the interaction of water molecules with underlying micro-structures (cell membranes).
Materials and Methods: Eleven patients affected by HN tumor (5 pts) or brain tumor (6 pts) underwent a MR examination at 3 T, including DKI at ultrahigh b-values up to 2500 s/mm2. The two parameters Dk (diffusion coefficient) and K (diffusional kurtosis) of the DKI model were derived using a home-made code. Conventional ADC (apparent diffusion coefficient) and D (pure diffusion coefficient) were also derived using the same DKI data set. Parametric maps of Dk, K, ADC and D were generated. The value of the residual sum of squares (RSS) of the best solution was calculated and used to assess the quality of the fit at the voxel level. The lesion was manually contoured by an expert radiologist to define a region of