Fast Field-Cycling MRI identifies ischaemic stroke at ultra-low magnetic field strength.

1 M.J. Macleod, 2 L.M. Broche, 2 P.J. Ross, 1 G. Guzman-Guttierez, 2 A.D. Murray, 2 D.J. Lurie

1Acute Stroke Unit, Aberdeen Royal Infirmary 2Aberdeen Biomedical Imaging Centre, School of Medicine, Medical Sciences & Nutrition, University of Aberdeen, Aberdeen AB25 2ZD

Introduction: Fast Field-Cycling MRI (FFC-MRI) is a novel MRI technique in which the external magnetic field is switched during the imaging experiment. By doing this, FFC-MRI gains access to information which is invisible to conventional MRI scanners, including the variation of $T_1$ with magnetic field which is known as $T_1$ dispersion. In this work we aimed to assess whether we can identify recent cerebral infarcts at ultra-low field strength, when compared with conventional imaging.

Methods: After informed consent, a group of patients (n=9) with ischemic stroke were scanned within 24-96h of presentation. The FFC-MRI examination took 45 minutes, and included FFC images at five evolution fields (0.2mT to 0.2T). Patients also had CT and/or 3T MRI images available. In 4 patients the FFC-MRI single slice missed a small cortical or lacunar infarct, thus images were available for five patients.

Results: In patients with sub-acute ischaemic stroke, $T_1$-weighted FFC-MRI images exhibited hyper-intense regions, with contrast increasing markedly as the evolution magnetic strength field decreased, to a maximum at the lowest field used (0.2 mT). The infarct region measured by FFC-MRI correlated well with the abnormality in CT and/or DWI images (Examples in Fig 1,2).

Discussion: This is the first-ever clinical application of this new modality, proving that FFC-MRI can generate diagnostic-quality images of ischaemic stroke at ultra-low magnetic fields (e.g. 0.2 mT), with significantly enhanced endogenous $T_1$-contrast compared to conventional MRI. These exciting findings have implications for future development of a new and safe imaging modality not only for stroke but many other clinical conditions.

Acknowledgements: This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 668119 (project “IDentIFY”).