Translational studies with fast field-cycling MRI

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- Aims and objectives

Our research aims to explore potential biomarkers of clinical relevance using a novel imaging platform called Fast Field-Cycling MRI (FFC -MRI). FFC-MRI differs radically from conventional MRI since it presents the added ability to change the main magnetic field during a scan. This allows measuring the parameter T1 in tissues at various magnetic fields, thereby providing a field-dependant T1-variation curve called the T1 dispersion curve. This curve is known to provide molecular information otherwise not accessible by MRI or any other technique.

- Methods and materials

So far we have explored the T1 dispersion curves of muscle, cartilage, breast and brain tissues in the context of muscle damage, osteoarthritis and cancer. To do this we make use of a T1 relaxometer device (SMARTracer, Stelar, Italy) and a whole-body FFC-MRI scanner previously build by our team. Access to samples are controlled by ethics (North of Scotland research ethics committee and CERB) and provided by various clinical units at the Aberdeen Royal Infirmary, UK.

- Results

The T1 dispersion curve provides two sorts of information: structural information at the mesoscopic scale (0.1 – 100 micrometres) and molecular information via a cross-relaxation phenomenon with protein ^{14}N, also termed the quadrupolar signal. These were found to provide valuable markers in the context of osteoarthritis, muscle damage and cancer. In particular, the quadrupolar signal correlates linearly with protein concentration and was found in several tissues without injection of contrast agent.

- Conclusion

FFC-MRI shows promising abilities in molecular imaging. This technique is very novel in the imaging world but has a wide background in theoretical physics and chemistry which makes it an attractive platform for translational studies.

Full e-poster available at: http://dx.doi.org/10.1594/ecr2014/C-1067