The first "in vivo" $1/T_1$ FFC-NMRD profile of tumour tissue

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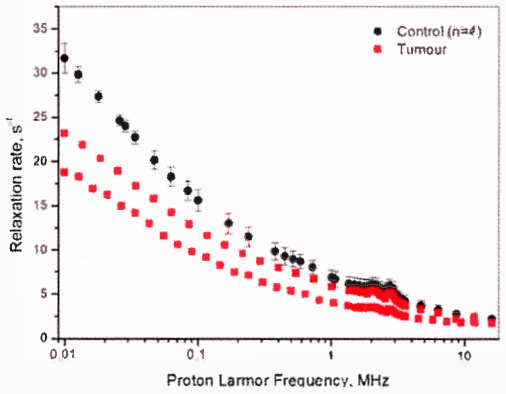

Introduction. Many diseases are inadequately diagnosed, or not diagnosed early enough by current imaging methods. Examples of unmet clinical needs arise in thromboembolic disease, osteoarthritis, cancer, sarcopenia, and many more areas. As shown by clinical pilot studies [1,2] "In vivo" Fast Field-Cycling (FFC) can provide completely new diagnostic information currently inaccessible to standard MRI operating at relatively high field. Indeed, FFC-NMR introduces an entirely new dimension into MRI, namely the dependence of T_1 on the strength of the applied magnetic field. Methods. In this study, a dedicated surface coil and a suitable FFC NMR equipment has been developed for the acquisition of "in vivo" NMRD profiles on animal models. Cancer cells (parental mammary adenocarcinoma, TSA) have been injected in the leg muscle 7 days before the acquisition. At that time a tumour mass covering 70-80% of the leg was observed by MRI.

Results. We observed that TSA tumors T_1 are significantly longer than control at lower field. T_1 differences are inversely proportional to the magnetic field strength (from 40 to 10%) in the range 0.01-10MHz. The quadrupolar peaks (QPs) arising from protein amidic groups can be seen very clearly, centred at proton NMR frequencies of 0.65, 2.10 and 2.75 MHz.

Conclusions. Longer T_1 in tumours are mainly the consequence of higher water mobility. The QPs are invisible to conventional (fixed-field) MRI but fully exploitable by FFC-NMR. They reflect the tissue remodeling associated with the tumor development. Acquiring "In vivo" NMRD profiles on animal models is a fundamental step forward in validating the clinical effectiveness of FFC-MRI with the final goal of finding new biomarkers characterizing different diseases for an earlier diagnosis with lower costs and new protocols responsive to changes in water mobility following therapeutic treatment.

References

[1] Broche, LM., Ashcroft, GP. & Lurie, DJ. (2012). 'Detection of osteoarthritis in knee and hip joints by fast field-cycling NMR'. *Magnetic Resonance in Medicine*, vol **68**, no. 2, pp. 358-362

[2] Broche, LM., Kennedy, BW., MacEachern, C., Ashcroft, GP. & Lurie, DJ. (2014). 'Fast field-cycling NMR of cartilage: a way toward molecular imaging'. *Osteoarthritis and Cartilage*, vol **22**, no. Supplement, pp. S66-S67.