Evidence for the role of intracellular water lifetime as a tumour biomarker by
in vivo Field-Cycling relaxometry

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Magnetic resonance imaging (MRI) has had a key role in the field of oncology over the last few
decades. The prominent role of MRI relies on its superb spatial and temporal resolution and
its diagnostic power arises basically from the differences in the longitudinal (T1) and transverse
(T2) proton relaxation times between healthy and pathological tissues. However, at the
magnetic field strength of the currently available MRI scanners, changes in T1 do not appear
sensitive enough to report on the particular aspects of the tumour stage1. However, there is
widespread opinion that, at low magnetic field strength, the marked increase of R1 (=1/T1)
observed in biological tissues might be beneficial towards improving the diagnostic potential
of MRI in tumour phenotyping2-4.

Herein it is shown that the in vivo acquisition of 1/T1 Nuclear Magnetic Resonance Dispersion
(NMRD) profiles (from 0.2 to 200mT) fully supports this expectation as the observed R1s at low
magnetic fields (< 0.2 T) allow a clear discrimination between tumours characterised by
different metastatic potential.
The T1-lengthening is associated with an enhanced water exchange rate across the
transcytolemmal membrane through an overexpression/upregulation of GLUT1 and
Na+/K+/ATP-ase transporters. It follows that the intracellular water lifetime represents a
hallmark of tumour cells that can be easily monitored by measuring T1 at different magnetic
field strengths ranging from 0.2 to 200mT.

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