

Title

Characterisation of human glioma resections by Fast Field-Cycling NMR

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Purpose:

Fast field-cycling NMR (FFC-NMR) is a technique that varies the magnetic field strength to measure T_1 dispersion, which relates quantitatively to molecular dynamics providing valuable structural information at nanometer scale. It also shows Quadrupolar Peaks (QP) due to proton-nitrogen coupling that are invisible to conventional NMR. Several works demonstrated the usefulness of the T_1 dispersion profiles to characterise biological tissues^{1,2} and diseases^{3,4} by exploiting either the T_1 dispersion profiles or the QP. Here we report the first results of FFC-NMR measurements of non-fixed human brain tissues obtained from glioma surgery.

Subjects and Methods:

5 samples of human brain glioma and 3 reference samples of human epileptic brain were obtained frozen from a tissue bank (Grenoble centre for biological resources). Histological analyses were performed to target homogeneous regions. The target regions were sliced by microtome and homogenised. FFC-NMR acquisitions were performed at 37°C using a SpinMaster relaxometer (Stelar, s.r.l., Italy) using an inversion recovery CPMG sequence. The T_1 dispersion profiles were acquired from 10 mT to 1T and fitted using standard models obtained from the literature^{5,6}. Mass spectroscopy (MALDI-MS) was also acquired to define the range of tumour protein mass.

Results:

The tumour dispersion curves showed power-law shapes, indicating relaxation by protein matrix. The low-frequency region showed large differences between glioma and epileptic tissues, correlating with the mass distribution provided by MALDI-MS, possibly indicating variations in protein interactions. Altered tissues microstructures showed large QPs and distinct shape with higher overall relaxation rate (Figure 1).

Discussion/ Conclusions:

Contrast between tumour grades seemed more pronounced at low magnetic field and QP appeared as a potential biomarker of tissue remodelling. This work also showed significant differences between epileptic tissues and glioma that can be exploited for tissue structure characterisation. This pilot work will be extended to better understand the correlations between tissue structures and the T_1 dispersion curve and highlights the potential of FFC-NMR to provide novel relevant contrasts.

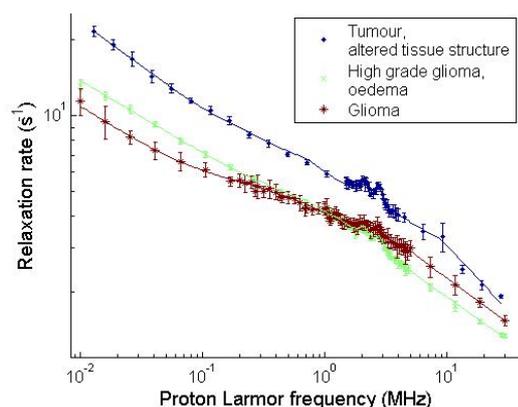


Figure 1: T_1 dispersion curves of homogenised gliomas

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