PROTON MR SPECTROSCOPY FOR NON-INVASIVE GRADING OF ADULT CEREBRAL GLIOMAS AT 3 T

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PURPOSE
Proton magnetic resonance spectroscopy provides useful information in the diagnosis of brain tumours. While spatially limited, single voxel spectroscopy (SVS) is the preferred method as it yields reliable results in clinically acceptable examination times. The number of detectable metabolites increases with increasing field strengths, but it is still unclear whether this translates in clinically relevant added value. Here, we assess the diagnostic value of 1H-MRS at 3 T for grading of cerebral gliomas and especially whether the presence of necrosis-associated mobile lipids allows separation of grade III from grade IV gliomas.

METHODS
This was a retrospective study as part of an audit for which consent was waived. 69 patients (54% male, age range 22-83; 42% female age, range 20-83) with histologically confirmed cerebral glioma who had undergone proton MRS at 3 T (Philips Achieva) were included. A standard 8 channel head coil and point-resolved single-voxel spectroscopy (PRESS) with echo time of 35 ms, repetition time of 2000 ms, 128 averages was used. Acquisition of 16 averages of unsuppressed water spectrum has been performed. SVS region of interest was placed in the solid component of the tumour. LCModel software was used for metabolite quantification expressed in arbitrary units. The basis set consisted of spectra simulated by using spinevolution software. Tumours were classed according to histological grading into WHO Grade II (n = 26), III (n = 10) and IV (n = 33). The following quality criteria were applied: 1) full width at half maximum of less than 0.1 ppm 2) Cramer-Rao lower bounds <20% except for Glycine, lipids and macromolecules <50% and 3) visual inspection of voxel placement and artifacts.

Mean comparison between the metabolites, lipids and macromolecules to tumour grading were obtained using Kruskal-Wallis test. Diagnostic accuracy for separating grade III from Grade IV was performed using ROC.

RESULTS
Mean concentrations of Lip13a, Lip13b, Lip9, MM 14, Lip13a + Lip13b, MM14 + Lip13a + L, and MM09 + Lip09 differed significantly between grades (p < 0.05) with an increasing trend with tumour grades. The other biochemical with statistically significant difference were; Gin, Lac, GPC, GPC-Chol, Cr & PCR that showed increasing trend from grade II to III, but later fell off from grade III to IV. Highly significant metabolite differences (p < 0.001) were also found between Grade III and Grade IV gliomas for GPC (3.0 ± 0.6 vs 1.89 ± 1.0) and MM14 + Lip13a + Lip13b + Lac (16.0 ± 10.5 vs 59.1 ± 48.3). Using receiver operating characteristic (ROC) curve; concentration of GPC below 2.2 has a 84% specificity and 100% sensitivity; while MM14 + Lip13a + Lip13b + Lac concentration above 19 has sensitivity of 88% and specificity of 80% in differentiating Grade IV from Grade III.

CONCLUSIONS
This study help to narrow down the best biochemical denominators for grading of adult cerebral gliomas. In particular reduction of GPC and elevation of macromolecule 14+Lip13a-b-lactate may improve the differentiation of high grade gliomas into grade III and grade IV. This may assist the correct targeting of the most aggressive therapy for those patients at highest risk.

IMPORATANCE OF EARLY SPECTRAL VARIATIONS DURING 6 YEAR LONGITUDINAL MRI AND 1H MRS IN 24 PATIENTS WITH OLIGODENDROGLIAL TUMORS OR GLIOMATOSIS TREATED WITH TEMODAL

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PURPOSE
To better understand glial tumor metabolism and post chemotherapy, radiotherapy and antiangiogenic variations. To determine those variations in MRS areas, amplitudes, and ratios of metabolites and spectral profiles during a 6 year longitudinal follow-up in 24 patients with oligodendroglial tumors (10) or gliomatosis (14) without hyperperfusion initially and treated with temodal.

METHODS
MRI: Sagittal T1, axial proton density, T2, FLAIR, diffusion, 3D T1 3 planes after gadolinium. MRS : 1H, single voxel (6 to 12 cm3), PRESS with multiple TE's on a 1.5 T (GEMS). Over 24 patients, 13 underwent radiotherapy and 5 antiangiogenic therapy. Data processing : SAGE software and home-written automatic processing yielding amplitudes, areas, ratios, and relative concentrations. Statistical analysis of longitudinal spectroscopic data (every 3 months over 78).

RESULTS
Quantitative studies in MRS with multi-spectral segmentation and volumetry. Without chemotheraphy spectroscopic profiles worsen with increases in Choline/N-Acetyl-Aspartate (Cho/NAA), Cho/Cr and Myo-inositol/Creatine (mI/Cr) ratios, decreases in NAA/Cr. After chemotherapy treated tumoral volumes, in MRI, change little between two exams while spectroscopic profiles and ratios do change. MRS could be more sensitive than MRS Spectoscopic and metabolic changes often come well before clinical deterioration and sometimes before improvement. Therefore, MRS could be more sensitive and could detect changes earlier than MRI and sometimes is predictive. Later in the evolution for 5 patients with hyperperfusion this one disappears but proliferation stayed very important.

CONCLUSIONS
MRS remained often stable. MRS showed variable ratio of mI/Cr, Cho/Cr and NAA/Cr at baseline. We observed a decrease in Cho/Cr ratio and an increase in NAA/Cr ratio for patients whose clinical condition improved and inverse results for those whose conditions deteriorated. These spectroscopic and metabolic changes occurred well before clinical deterioration. MRS allows non-invasive follow-up of treated cerebral tumors with a large variability, but repition and modellisation of spectroscopic measurements during longitudinal follow-up could allow us to diminish it and to improve prognostic evaluation especially under antiangiogenic therapy. Studying the relationship between MRS measures, methionine PET, segmentation and perfusion parameters could lead to better understanding of therapeutic response, especially with regard to chemotherapy, radiotherapy and antiangiogenic molecules.

ROLE OF FRACTIONAL ANISOTROPHY AND RCBV IN DIFFERENTIAL DIAGNOSIS BETWEEN LOW GRADE OLIGODENDROGLIOMAS AND ANAPLASTIC ASTROCYTOMAS

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