# Proton MR Spectroscopy Reveals Elevated Myo-Inositol and Glutamine in the Contralateral Cerebral Hemisphere of Patients with Untreated Glioblastoma Multiforme

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## Objective

Glioblastoma multiforme (GBM) is the most common primary brain tumor, highly malignant, with invasive growth and mainly of astrocytic origin. MRI techniques are increasingly important for diagnosis, therapy planning and follow up. Previous studies of GBM patients identified tumor cells in macroscopically normal brain parenchyma [1,2]. The purpose of this study was to assess alterations of cerebral metabolite levels within the contralateral hemisphere of GBM patients as potential markers of GBM cells.

## Methods

Single-voxel proton MRS (STEAM; TR/TE/TM=6000/20/10 ms; 64 accumulations) at 3 Tesla (Siemens Magnetom Trio) using the standard 8-channel phased array head coil was performed in patients with newly diagnosed and untreated GBM (n = 22). The volume-of-interest (4.1 ml) was placed in the normal-appearing white matter (NAWM) in the hemisphere contralateral to the tumor. Absolute metabolite concentrations as quantified by LCModel [3] were compared to values from patients with low-grade gliomas (LGG, n = 5) and a group of age-matched controls (control, n = 14).

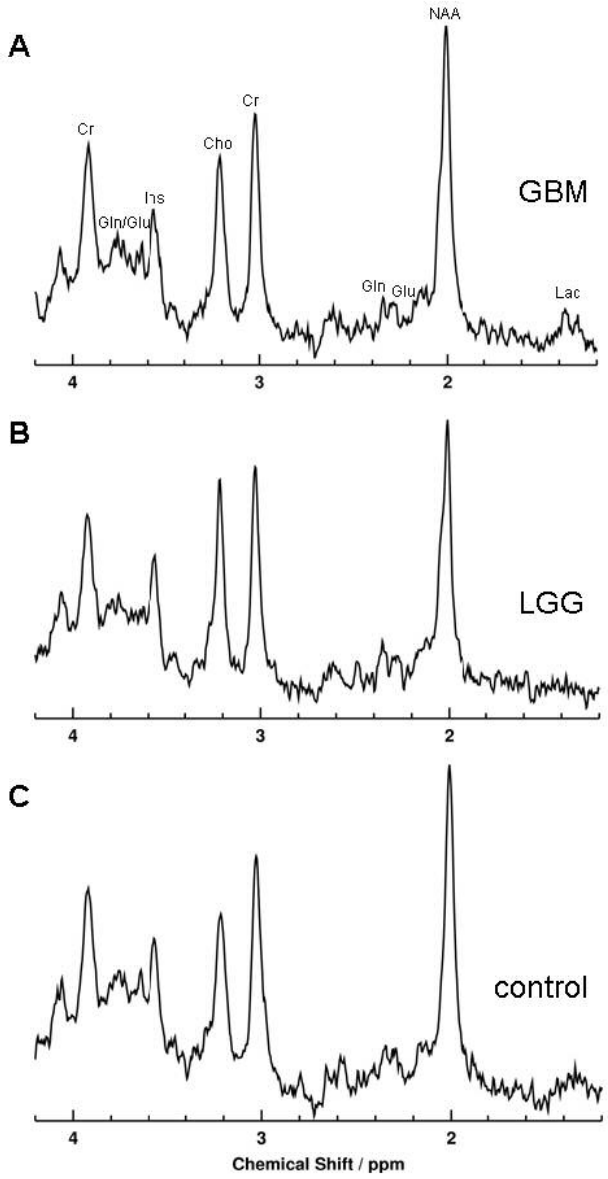
## Results

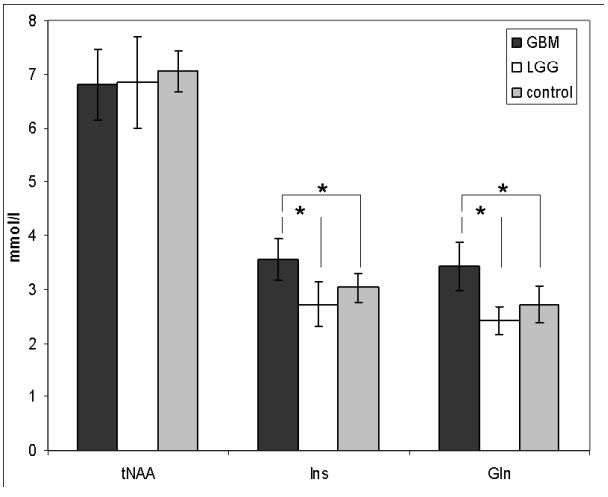
Representative spectra of a GBM patient, a LGG patient, and a control subject are shown in **Figure 1** (top). **Figure 2** (bottom) depicts the mean concentrations of tNAA, Ins, and Gln averaged across subjects for the three groups. The mean concentrations of tNAA, tCr, Cho, and Glu in contralateral NAWM were not significantly different between the three groups.

On the other hand, the mean Ins and Gln concentrations of NAWM in GBM patients were significantly higher than in both the LGG patients and the control subjects. Specifically, the Ins levels for GBM (3.6 ± 0.8 mmol/l), LGG (2.7 ± 0.7 mmol/l; $p < 0.05$), and control (3.0 ± 0.5 mmol/l; $p < 0.05$) as well as Gln levels for GBM (3.4 ± 0.9 mmol/l), LGG (2.4 ± 0.5 mmol/l; $p < 0.05$), and control (2.7 ± 0.7 mmol/l; $p < 0.05$) were significantly different. Furthermore, lactate concentrations were eventually elevated above background (> 1 mmol/l) in 9 GBM patients, but neither in the LGG group nor in the control group.

## Conclusion

Elevated concentrations of Ins and Gln in the NAWM of GBM patients most likely refer to a mild astrocytosis indicating early neoplastic changes in line with reports of glioma cells in otherwise inconspicuous brain parenchyma.

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