Quantitative Cervical Proton Magnetic Resonance Spectroscopy of Relapsing-Remitting Multiple Sclerosis

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Introduction

Nowadays proton MR spectroscopy (^{1}H-MRS) is considered a useful technique for evaluating axonal damage and demyelination in multiple sclerosis (MS) on the brain (1). But only one spectroscopic cervical MS study was published, because of the technical difficulties (2). Recently we presented a protocol for quantitative cervical spinal cord single voxel MRS with the first mean relative concentrations ratios for NAA, Cr, Cho and mI in a group of ten healthy volunteers using a clinical 3T system (3). On this study we applied the same acquisition and post-processing protocol to study the metabolites changes on the cervical spinal cord plaques of a patient affected by a relapsing-remitting multiple sclerosis (RRMS) for two months starting from the onset of a relapse phase.

Methods

Patient: RRMS patients (age 74 years, female). After the relapse onset the patients follow a cortisone therapy (1 gramme a day, for 5 days). MR exams: A cervical spine MR exam was repeated 5 times on the following days starting from the onset time: 2, 9,16,23,58 days. MR included sagittal and coronal T_2-weighted images, axial T_2*-weighted images and sagittal and axial T1 weighted pre and post contrast images. ^{1}H-MRS VOI (approximately 7 x 9 x 35 mm) was prescribed along the main axis of the cord between the C2-C3 levels, on the cervical plaque hyperintense on T2 weighted images, using a 3T whole-body system (General Electric Company), equipped with a standard eight channel phased array spinal coil. A PRESS (TR 2000 ms and TE 35 ms) and CHESS (to provide water suppression) sequences were used with six saturation bands contiguously to the VOI to minimize fat contamination. 400 repetitions and 16 additional acquisitions with unsuppressed water were collected, obtaining a total spectrum acquisition time of approximately 14 minutes. MRS data were analysed by the user-independent fitting routine LCModel (4). Relative concentrations expressed by the absolute concentration ratios of total NAA (tNAA), choline (Cho), myo-inositol (mI) and creatine plus phosphocreatine (Cr) were calculated. The main metabolites ratios were compared with the healthy metabolites content previously published (same protocol, 10 healthy volunteers, mean age 35±12 years, 6 female). The study was approved by the local ethical committee and the patient provided informed written consent.

Results

All the 5 exam sessions showed a plaque at C2-C3 level, hyperintense on T2 and T2* weighted images. The plaque revealed a slight different contrast enhancement on the 5 MR sessions. Table 1 lists main metabolite ratios obtained from the patient on each exam session. Mean, SD and CV of the healthy values recently published are reported too.

Discussion

The quantification results, respect to the healthy metabolites ratios, show an initial phase where there is an increase of Cho suggestive of a demyelination and inflammatory process. The Cho will return on the normal range only on the last examination, 58 days after the onset. At 16 days from the offset mI increases. These changes are followed by a transient decrease of the tNAA, suggesting of secondary axonal/neuronal disfunction. 58 days after the onset all the metabolic ratios follow inside the healthy range. In our knowledge this is the first study in a cervical SM plaque of the temporal metabolic changes. The evolution of the observed plaque can be compared with similar trends on MS brain plaques (5,6). This single case shows that the quantitative cervical spectroscopy is a reliable tool and it can offer an important contribution of the metabolic information as already used on the brain to evaluate the severity, progression and pathogenesis of the MS.

References

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day from onset	tNAA / Cr	tNAA / Cho	Cho / Cr	mI / Cr
2	1.6	1.7	0.9	1.6
9	1.1	1.3	0.9	1.7
16	1.1	1.4	0.7	2.0
23	0.6	0.8	0.8	2.1
58	1.3	2.3	0.6	1.9
		healthy cervical spinal cord		
mean ± SD	1.4 ± 0.3	3.1 ± 0.8	0.5 ± 0.1	1.7 ± 0.2
CV (%)	23	26	10	13