Quantitative Cervical Proton Magnetic Resonance Spectroscopy of Multiple Sclerosis

A. F. Marliani[1], V. Clementi[2], L. Albini Riccioli[1], R. Agati[1], and M. Leonardi[1]

[1]Neuroradiology Department, Bellaria Hospital, Bologna, Italy, Italy, [2]GE Healthcare, Bologna, Italy, Italy

Introduction

Since some years brain proton MR spectroscopy (^{1}H-MRS) was considered a useful technique for evaluating neuronal/axonal damage and demyelination in multiple sclerosis (MS) (1). Despite frequently disability in MS is related to spinal cord lesions there are few published works on spectroscopy study of cervical diseases because of the technical difficulties limiting the quality of spectroscopy data (2,3). 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 (4). On this study we applied the same acquisition and post-processing protocol to quantify the main CNS metabolites on the cervical spinal cord plaques of a group of 8 MS patients and compared them with the healthy metabolite content.

Methods

A rectangular ^{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 a plaque hyperintense on T2 weighted images, in a group of 8 MS patients (mean age 43±20 years, 7 female), using a 3T whole-body system (General Electric Company) equipped with a standard 8 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 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 (5). Relative concentrations expressed by the absolute concentration ratios of total NAA (tNAA), choline (Cho), myo-inositol (mI) and creatine plus phosphocreatine (Cr) were calculated. Mean, standard deviation (SD) and coefficient of variation (CV) of the main metabolite ratios were calculated. The Student's t-test were used to evaluate the difference with the healthy metabolite 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 all subjects provided informed written consent.

Results

Figure 1 shows a typical LCModel analysis result of a spectrum from the normal cervical cord. Table 1 lists the mean, SD and CV of the main metabolite ratios obtained from the SM patients compared with the healthy values. Student's t-test values for the statistical difference between the two groups are reported in the last row.

Discussion

Despite the little group of patients (and the lake of subgroup evaluation) the statistical analysis show a significant decrease of tNAA/Cho and an increase of Cho/Cr contents on MS plaques respect to healthy cervical spine tissue. This trend is in accord with the metabolic abnormality already interpreted on the brain MS plaques as neuronal dysfunction and demyelination (1). This preliminary result shows that the quantification cervical spectroscopy protocol optimized on healthy volunteers is reliable also for patients clinical studies. This technique offers a metabolic evaluation on the cervical cord diseases studies and in the clinical routine, as it happens in the brain. It will be interesting to apply this quantification protocol in a greater patients group.

References

1)Narayana PA et al. J Neuroimaging;15:46S-56S,2005. 2) Dydak U et al. Proc Intl Soc Magn Reson Med:813,2005. 3) Kendi ATK ae al. Neuroradiology;46:764-769,2004. 4)Marliani AF et al. MRM in press. 5) Provencher SW.MRM;30:672-679,1993.

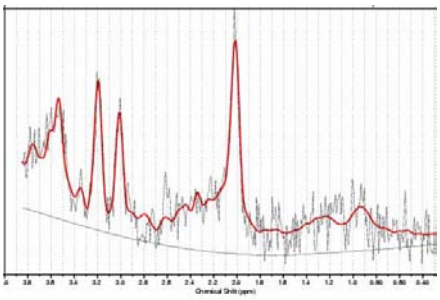

Figure 1

	tNAA / Cr	tNAA / Cho	Cho / Cr	mI / Cr
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
MS cervical spinal cord				
mean ± SD	1.0 ± 0.2	1.8 ± 0.4	0.6 ± 0.1	2.0 ± 0.4
CV (%)	17	24	19	22
p	0.2	0.008	0.005	0.1

Table 1