Comparison of spectroscopic imaging vs. localized spectroscopy to characterize clinical forms of Multiple

M. Bagory[1], F. Durand-dubief[2], D. Ibarrola[3], J-C. Comte[3], C. Confavreux[2], and D. Sappey-Marinier[1,3]

[1]CREATIS-LRMN UMR5220 CNRS & U630 INSERM, Université de Lyon, Lyon, France, [2]Service de neurologie A, Hopital Neurologique de Lyon, Bron, France, [3]Dpt. IRM, CERMEP - Imagerie du vivant, Bron, France

Introduction

Multiple sclerosis (MS) is a disease of the central nervous system including both inflammation and neurodegenerative processes, ultimately leading to irreversible neurologic impairment and clinical deficits. Magnetic resonance spectroscopy (MRS) was used in a 3 years follow-up research program, including 100 MS patients of different clinical forms, with the objective to identify new markers of inflammation and/or neurodegenerative processes and better understand the clinical progression in MS. The MR protocol consisted in two MRS approaches: 1. Single Volume Spectroscopy (SVS) to measure an easy and global metabolic index 2. Chemical Shift Imaging (CSI) to obtain both metabolic and spatial (tissue/lesion) informations, . Therefore, the goal of this study was 1) to compare these two methodological approaches, CSI and SVS, in order 2) to better characterize and distinguish MS clinical forms.

Methods

Cohort included 28 MS patients (11 relapsing-remitting (RR, age= 34.2 ± 7.2 y), 7 secondary-progressive (SP, age = 42.4 ± 6.7 y) and 10 primary-progressive (PP, age = 44.8 ± 3.3 y) and 10 controls (age = 34.2 ± 12.9 y). A large SVS (75x75x30 mm) and a 32x32 CSI slice of 15 mm thickness were positioned along the AC-PC axis above ventricles (fig. 1) and acquired using a PRESS sequence (TR = 1500 ms, TE = 135 ms). CSI voxels comprised in the SVS volume were selected by a homemade co-registration Matlab code. Metabolites signals were quantified using jMRUI tool [1], a time-domain processing software, based on QUEST method [2] and NMRScope simulated basis set [3]. Processing procedure included water signal suppression by HSLVD filter, 1.4 Hz lorentzian apodization, baseline handling by subtraction method, and automatic zero order phase correction. CSI spectra were first individually tuned and phased; and secondly quantified. Metabolic ratios (choline/N-acetyl-aspartate (Cho/NAA), NAA/creatine (NAA/Cr) and choline/creatine (Cho/Cr)) from each ROI voxels were then summed. Obtained value was finally compared to SVS result. P-values were Kolmogorov-Smirnov non-parametric test results.

Results

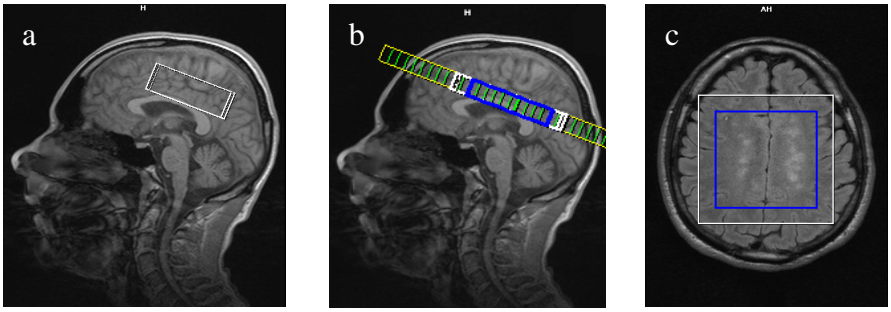

Fig. 1 SVS volume (a), CSI slice (b) and corresponding intersection voxel in blue (c) in MS patient and controls

	Cho/NAA		NAA/Cr		Cho/Cr	
	CSI	SVS	CSI	SVS	CSI	SVS
Controls	0.69 ± 0.06	0.68 ± 0.07	1.99 ± 0.11	1.82 ± 0.15	1.37 ± 0.09	1.24 ± 0.09
RR	0.75 ± 0.06	0.72 ± 0.07	1.87 ± 0.17•	1.77 ± 0.15	1.40 ± 0.08	1.26 ± 0.07
SP	0.78 ± 0.11	0.76 ± 0.11	1.70 ± 0.12**	1.65 ± 0.14	1.32 ± 0.17	1.25 ± 0.10
PP	0.85 ± 0.06**	0.74 ± 0.08	1.73 ± 0.15*	1.67 ± 0.17	1.47 ± 0.14•	1.23 ± 0.14

Tab. 1 Metabolic ratios in function of MS forms. Comparison of CSI and SVS approaches
**p<0.001 and *p<0.05 compared to controls / •p<0.05 compared to SP

As reported in Tab. 1, CSI results showed a significant increase of Cho/NAA ratio in PP compared to RR patients and controls, a significant decrease of NAA/Cr ratio in SP compared to RR and controls, and in PP patients compared to controls, and an increase of Cho/Cr ratio in PP compared to SP patients. None of these changes were observed (p>0.176) by the SVS method.

Conclusion and discussion

CSI provided significant differences in metabolic characterization of MS forms in contrast to the SVS approach, likely due to methodological aspects. Although CSI provide a lower SNR than SVS, its voxel-based phasing and quantification is less subject to B_0 inhomogeneities and destructive phase interferences. Methodological differences between these two approaches will be further investigated by phantoms studies. This work could open promising perspectives to distinguish MS forms with CSI, and provide improvements in diagnostic and therapeutic management of MS patients.

[1] Naressi A et al, MAGMA 2001;12:141-152 [2] Ratiney H et al, NMR in Biomed. 2005;18:1-13 [3] Graveron-Demilly D et al, J Magn Reson B. 1993;101(3):233-239