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Study of the technique of magnetic resonance spectroscopic imaging (MRSI) and application to evaluation of brain metabolites of systemic lupus erythematosus patients

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Abstract

In this study, we used the magnetic resonance spectroscopy imaging (MRSI) technique to evaluate metabolite levels in the corpus callosum of systemic lupus erythematosus (SLE) patients and to compare them to those of healthy subjects. Furthermore, a software that automatically matches MRSI data to corresponding anatomical MR images was tested for the first time.

Key words:

MRSI, corpus callosum, systemic lupus erythematosus.

Introduction

The major measurable metabolites in proton magnetic resonance spectra of the brain are N-acetylaspartate and N-acetylaspartylglutamate (NAA+NAAG), creatine and phosphocreatine (Cr+PCr), glycerolphosphorylcholine and phosphorylcholine (GPC+PCh). A study carried out by Appenzeller et al. [1] showed that patients with systemic lupus erythematosus (SLE) have a decrease in the ratio NAA+NAAG/Cr+PCr, and an increase in GPC+PCh/Cr+PCr, compared to healthy subjects. These findings were achieved using the magnetic resonance spectroscopy (MRS) technique, with a single-voxel acquisition. In this study, we used multivoxel spectroscopy (MRSI, magnetic resonance spectroscopy imaging) to evaluate metabolite levels in the corpus callosum of SLE patients and to compare them to those of healthy subjects. We also tested, for the first time, a software, developed by Pereira et al. [2], which automatically matches MRSI data to corresponding anatomical MR images, which is something that was previously only possible to perform at the scanner console.

Results and Discussion

Spectra of 15 patients (mean age 34 ± 14 years) and of an equal number of healthy subjects (mean age 35 ± 12 years), all women, were analyzed. Initially, the MRSI/MRI matching software [2] was used to combine the MR images with the MRSI grids and thus enable the verification of the positioning of the spectra grids, which were, in this case, in the upper region of the corpus callosum, to avoid cerebrospinal fluid. After this, the software allowed, through the use of a segmentation mask, the selection of only a part of the acquired spectra, that were, in this case, spectra containing at least 90% of white matter.

After this preprocessing of the data, the software *LCModel* [3] was studied and used to quantify the selected MRSI spectra. The results obtained for the metabolite concentrations for each group (patients and healthy subjects) were compared and, in order to guarantee if the differences between the results of each group were significant, a statistical analysis was performed using the Wilcoxon signed-rank test. The results obtained in the quantification of the spectra and in the statistical test are shown in Table 1.

Metabolites	Mean concentrations (mMol/kg)		Wilcoxon test - p value
	Patients	Healthy Subjects	
Cr+PCr (abs)	0.410	0.309	0.178
Cr/Cr+PCr	0.743	0.672	0.350
Glu/Cr+PCr	0.720	0.717	0.772
PCh/Cr+PCr	0.268	0.245	0.407
Ins/Cr+PCr	0.882	1.041	0.068
NAA/Cr+PCr	2.021	2.115	0.281
Gua/Cr+PCr	0.178	0.161	0.604
GPC+PCh/Cr+PCr	0.353	0.339	0.407
NAA+NAAG/Cr+PCr	2.030	2.115	0.319
Glu+Gln/Cr+PCr	0.720	0.717	0.772

Table 1. Mean concentrations obtained for the metabolites of interest and the results of the statistical test.

Usually, two groups are considered significantly different if the p value of the corresponding Wilcoxon test is below 0.05. As can be seen in Table 1, no case presented a p value below 0.05 and, therefore, we could not reach the same conclusion of [1].

Conclusions

It may be possible to reach the same conclusion of the study [1] if the number of subjects analyzed is increased, which will be done in the next steps of this study.

However, important objectives of this study were achieved, such as the study of the theme and the test of the MRSI/MRI matching software [2].

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¹ Appenzeller S. et al., *Arthritis Rheum.* 55(5):807-11, 2006.

² Pereira, D. R.; Fritolli, R. B.; Lapa, A. T.; Appenzeller, S.; Lotufo, R. A.; Rittner, L. *Metodologia para seleção de espectros de interesse em espectroscopia multi-voxel por ressonância magnética.* XXV Congresso Brasileiro de Engenharia Biomédica – CBEB, Foz do Iguaçu-PR, 2016.

³ Provencher SW. *Magn Reson Med.* 30: 672-679, 1993.