37 Scientific Session - Clinical Applications

10:50 - 12:20 *Caravelle 2*

Brain applications of spectroscopy

211

Metabolite variability in gliomas using SENSE-accelerated Magnetic Resonance Spectroscopic Imaging at 3T: a statistical perspective

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Purpose/Introduction: A rapid acquisition protocol for 2D short-echo time 1H MRSI of the brain has been validated in a test-retest setting on healthy volunteers [1]. We hypothesized that this protocol, which shows variations <20% for NAA, Cre, tCho, Glx and <50% for Myo, should be sufficient for diseases with large metabolic alterations. The protocol has been implemented for patients with suspicion of cerebral glioma. We examine which metabolite values and ratios have sufficient power for diagnosis and grading.

Subjects and Methods: 2D 1H MRSI from 10 volunteers and 29 glioma patients (11 low grade-LG, 18 high grade-HG) were acquired on 3T MR scanner (Achieva, Philips, Best, the Netherlands), with PRESS volume selection, TR/TE:2000/35 msec, FOV:160x160mm^2, maximal VOI:80x80mm^2, thickness:10mm, reconstruction voxel size: 5x5mm^2, receiver bandwidth:2000Hz, MOIST water suppression, pencil beam shimming, SENSE parallel imaging, scan time: 3min30s. AQSES-MRSI [2] was used for quantifying N-acetyl-aspartate (NAA), glutamine+glutamate (Glx), total creatine (Cre), total choline (tCho), myo-inositol/glycine (Myo), lipids/lactate (Lips) in institutional units. Metabolite ratios were computed and averaged over regions of interest in the solid part of the tumor for patients. The mean and standard deviation of metabolite values in the central 8x8 voxels from healthy volunteers have been used to define statistics of the 'control' population, which include variations due to partial volume between white and gray matter, but no significant CSF proportion. Mann-Whitney U-test was used for testing differences of each parameter among populations.

Results:

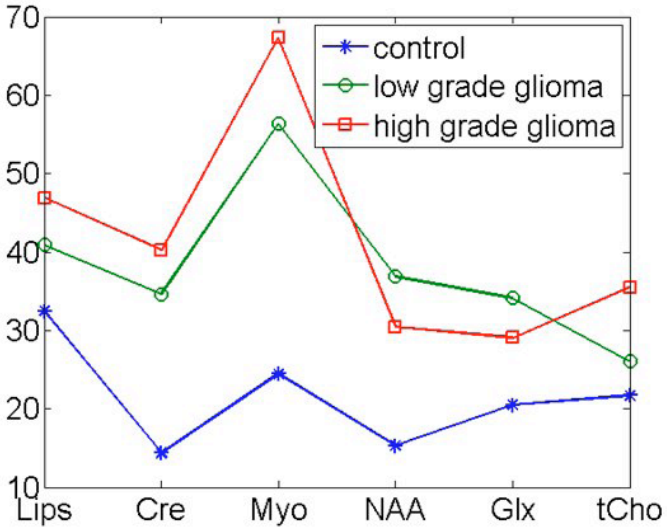


Figure 1. *Coefficients of variation (100*standard deviation over mean) per metabolite and group.*

Coefficients-of-variation (Figure1) show larger variations in gliomas compared to controls, but have similar patterns. Figure2 shows metabolite means and standard deviations in gliomas compared to controls, where values are divided by the mean over the controls. NAA, Glx and Cre are decreased in all gliomas compared to controls ($p<0.05$), while tCho and Lips increase significantly in HG. Only Lips show a significant difference between grades. Ratios involving Lips, NAA and the sum of all quantified metabolites were found significant in discriminating all three groups (Table1). Some ratios involving Cre and tCho were able to differentiate controls from all gliomas, while some ratios involving Myo and Glx separated controls from only one of the glioma groups but not the other.

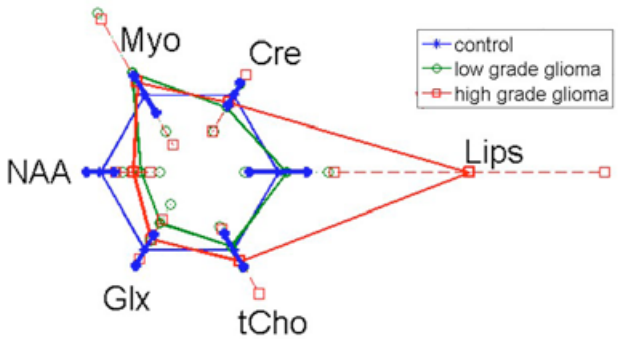


Figure 2. *Mean and standard deviations of metabolite values divided by the mean over controls. Patterns for LG and HG gliomas deviate significantly from the mean over controls, represented by the regular hexagon.*

Table 1. *Significance of each ratio in separating controls, LG and HG gliomas. Cells containing a 'v' at the intersection of row i and column j indicate that the ratio of metabolite j to i is a statistically significant parameter (p<0.05).*

Lips						
				Control vs. LG glioma		
v	Cre					
-	v	Myo				
v	v	v	NAA			
v	v	-	-	Glx		
v	v	v	v	v	tCho	
v	-	v	v	v	v	sum

Lips						
				Control vs. HG glioma		
v	Cre					
v	v	Myo				
v	v	v	NAA			
v	-	v	-	Glx		
v	v	-	v	v	tCho	
v	v	-	v	v	-	sum

Lips						
				LG vs. HG glioma		
v	Cre					
v	-	Myo				
v	-	-	NAA			
v	v	-	-	Glx		
v	-	-	-	-	tCho	
v	v	v	v	-	v	sum

Discussion/Conclusion: Several metabolite values and ratios computed from MRSI data acquired with a rapid protocol can discriminate, at group level, glioma patients from controls. For grading, parameters involving lipids+lactate are essential.

References:

[1] Van Cauter et al. J Magn Reson Imaging. 2013;37(2):445-56.
[2] Croitor-Sava et al. NMR Biomed. 2011; 24(7):824-35.

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212

DTI and 1H-MRS of the corpus callosum in young male patients with recently onset schizophrenia

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Purpose/Introduction: The aim of the study was to analyze the microstructural and metabolic features of the corpus callosum in recently onset schizophrenia.
Subjects and Methods: 13 young (17-28 years old) male patients with recently onset schizophrenia (F20, ICD-10) and 15 sex and age matched mentally healthy subjects were examined. 3T Philips Achieva scanner with 8-channel SENSE coil was used. DTI was conducted with EPI SENSE (TR=9431 ms; TE=70 ms, EPI Factor 63, FOV=240, NSA=2, gap 0, voxel size 20mm x 20mm x 20mm). DTI data were processed using workstation Philips EBWS 2.6.3.4. The values of diffusion coefficient (ADC), fractional anisotropy (FA), radial (RD) and parallel (PD) diffusivity were calculated. Spectroscopic voxel (2x1x1cm) was placed consequently in the corpus callosum genu and splenium. PRESS (TR/TE=1500/40) was used. Signal intensities were normalized to unsupressed water.
Results: In patients, increased ADC (p=0.02) and RD (p=0.008), decreased FA (p=0.008) and NAA (p=0.03) were found in the corpus callosum genu, No intergroup differences by PD, Cho, Cr, Glx were found in this area. Also, no statistically ignificant intergroup differences were observed for the DTI and MRS characteristics of the corpus callosum splenium.
Discussion/Conclusion:
It has been shown that RD increase is associated with demyelination process [1]. So an increase of RD in the present study could reflect demyelination in CC genu. Cells membranes abnormalities should lead to an increase of Cho which was not found. It could be explained by the relatively low level of demyelination in the early stage of the disease.
NAA reduction could be caused by reduction of axonal integrity. The latter process is considered to precede demyelination and not to be accompanied by PD rise [1]. Thus the present study revealed axonal integrity reduction and low demyelination in the genu but not the splenium of the *corpus callosum* in the early stages of schizophrenia.
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References:
1. Song SK, Yoshino J, Le TQ, Lin S-J, Sun S-W, Cross AH, Armstrong RC. Demyelination increases radial diffusivity in corpus callosum of mouse brain. Neuroimage 2005; 26:132-140.

213

Correlation of glutamate concentration with smoking cue reactivity in the anterior cingulate of smokers compared to never- and ex-smokers

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Purpose/Introduction: Glutamatergic neurotransmission plays an important role in the development of nicotine dependence, nicotine increasing the release of glutamate by binding to excitatory nicotiníc acetycholine receptors located