Assessment of cerebral hemodynamic in patients with schizophrenia by DSC-MRI quantitative imaging

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INTRODUCTION One of most intriguing and recent theory on the pathophysiology of schizophrenia suggests that disruption of brain microvascular system, possibly due to genetically modulated inflammatory reactions, [1] may play a key role. In fact, abnormalities of CNS blood flow [2-3] and volume [4] have repeatedly been observed in people with schizophrenia with different imaging methodologies, however only very few attempts have been made by using quantitative dynamic susceptibility contrast magnetic resonance imaging (DSC-MRI) [5-6]. DSC-MRI allows to quantify cerebral blood flow (CBF), cerebral blood volume (CBV) and mean transit time (MTT) [7], with a greater spatial resolution than other imaging techniques such as SPECT. Thus, the quantification of DSC-MRI images can be of tremendous help to detect differences in cerebral hemodynamics between patients with schizophrenia and normal subjects. Here, as preliminary study, we present the results of the analysis of a part (20 subjects) of a larger data set to evaluate the potential role of DSC-MRI imaging in understanding the pathophysiology of schizophrenia. The analyses regarding the whole dataset (about 100 subjects) are currently undergoing and will be finished in the next few months.

MATERIALS AND METHODS

DATA 20 subjects of the original larger data set were considered: 10 patients with schizophrenia and 10 control subjects. The analyses were performed with a gradient echo EPI (on a 1,5T Siemens Magneton Symphony Maestro class, Syngo MR 2002B; TR=2160ms, TE=47ms, FOV=230x230 mm, 5mm slice thickness). The bolus dose was 0.1mmol/Kg of Gd-DTPA, at a rate of 2.5 ml/s in the right antecubital vein.

QUANTIFICATION CBF maps have been obtained from DSC-MRI images by deconvolution from arterial input function, AIF(t), and tissue concentration, C(t) [7]. AIF was automatically extract [8] from the pericallosal artery. Relative CBV maps were obtained using the relation $CBV=\int C(t)dt$. Absolute CBF and CBV values were obtained by normalization on a white matter region [7, 9]. Finally MTT was computed as MTT=CBV/CBF. Frontal, temporal, occipital and parietal cortex were manually traced, bilaterally, as regions of interest (ROI) as well as whole brain.

RESULTS CBF, CBV and MTT values (means ±SE) are shown in Figure 1. Differences between patients and controls were strongly dependent on considered ROI. Patients presented greater CBF in whole brain and in frontal cortex, while lower CBF characterized occipital and temporal cortex. In contrast, there was no significant difference between patients and controls for parietal cortex CBF. A lower CBV value was present in the whole brain, in the frontal and temporal cortex for patients in comparison with controls. On the other hand in occipital and in parietal cortex there were no differences in CBV. Finally, patients presented lower MTT values in each considered ROI compared to normal controls.

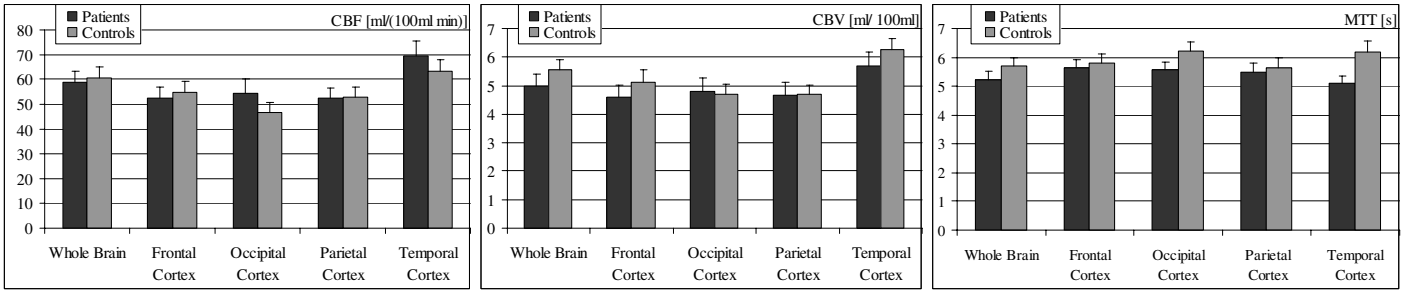

Figure 1: CBF, CBV and MTT values obtained in patients and controls in five different ROIs.

DISCUSSION These preliminary results show that, by considering the whole brain, patients with schizophrenia are generally hypo-perfused and characterized by a lower blood volume. Frontal cortex appears to be the principal area involved in this pattern, it presents both hypoperfusion and low CBV, according to [2]. Temporal is characterized by a low CBV, according to [3], whereas occipital cortex had greater CBF and normal CBV. MTT values reflect the differences present in temporal and occipital areas, while suggest a greater impact of the pathology in CBV than in CBF for frontal region. According to the literature, these findings appear to be dependent on the considered ROI. Thus, these preliminary results show that quantitative DSC-MRI can improve the study of cerebral functional abnormalities affecting patients with schizophrenia. However, due to the small sample size of our study, these results should be seen as very preliminary and any final speculation should be prevented. In fact, to increase the statistical power, our analysis will be applied in the next few months to the entire dataset (about 100 subjects).

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