NAA, Cho, Cr and mI Changes in Parietal Lobe White Matter and Right Putamen in Patient with Preeclampsia

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Proton MR spectroscopy (MRS) is powerful and noninvasive chemical analysis and it is widely used in the CNS lesions such as neurodegenerative diseases and brain tumors. MRS permits the in vivo measurement of distinct neurochemicals, which can provide information regarding the cellular composition of various brain lesions. We used proton MRS imaging in patient with preeclampsia to assess the effects of preeclampsia on the brain. We measured metabolites in parietal lobe and putamen using single voxel MR spectroscopy. Spectra were analyzed for the presence of choline (Cho), creatine (Cr), N-acetylaspartate (NAA), and myo-inositol (mI). MRS studies were performed initially and ten days later in preeclamptic woman. The aim of this study was to evaluate maternal basal ganglions and parietal lobe MR spectroscopy changes in preeclamptic patient.

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Key Words: Pre-eclampsia, MR spectroscopy, Parietal lobe, Putamen

Preeclampsia and eclampsia have been found to be responsible for the majority of maternal and fetal mortality.[1] Preeclamptic pregnancies are usually associated with an impairment of maternal cerebral hemodynamics which is mainly a consequence of generalized vasospasm and cerebral edema.[2] The background of the cerebral processes is still not clarified. The frequent occurrence of pre-eclamptic brain lesions in the subcortical area seen using CT and MRI is compatible with such a widespread leak from endothelial damage.[3] Proton magnetic resonance spectroscopy provides information about the contents of organic compounds in living tissues and lead to a better understanding of the biochemical pathways found within a lesion.[4] Only isolated reports of MRS of pre-eclampsia have been published.[5] We here report the findings of MR spectroscopic analysis of parietal lobe white matter and putamen in patient with preeclampsia.

Case Report

A 36-year-old woman who was 33 weeks pregnant was admitted to the hospital after two days of increasing blood pressure, pedal edema and proteinuria. The patient was treated with magnesium sulfate and antihypertensive medications. Biochemical-test results were normal. The neurologic examination showed drowsiness and confusion. Due to the fetal distress, cesarean section was performed through a classical uterine incision and healty female infant was delivered. The neonate did well. Cranial MRS was performed and T_2- weighted MR images showed extensive bilateral white-matter abnormalities suggestive of vasogenic edema in the posterior regions of the cerebral hemispheres, but the changes often involved other cerebral areas, such as putamen, and capsula interna. Metabolite peak areas were measured using a simplex routine, assuming gaussian line shapes. We measured the distribution and relative signal intensities of N-acetylaspartate, of choline residues representing lipid metabolites, myoinositol and of creatine-containing metabolites. Voxels were analyzed in the parietal lobe and putamen containing white matter and results were compared with published normal values.[6,7] Concentrations of these metabolities were estimated by the phantom replacement technique.[6,7] Four days later patient's blood pressure improved and the neurologic examination was normal and patient was discharged.

Discussion

The cranial lesions of pre-eclamptic patients are best visualised with magnetic resonance imaging.[8] There is edema of the white matter with a posterior predominance. MRI shows high signal, mostly transient, in subcortical areas especially parieto-occipital lobe. Although the underlying pathophysiology of edema is not well understood, most authorities believe that hypertensive encephalopathy and pre-eclampsia share similar pathophysiologic mechanism.[9] The blood pressure exceeds the range of autoregulation and breakdown of the blood-brain barrier create a vasogenic edema[9] and neurological symptoms occur.[10] MR spectroscopy is a recently developed neuroimaging technique that appears

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superior to other processes for defining intracranial molecular pathophysiology.[11] This technique has been used to measure proton-containing compounds, such as amnio acids and organic acids in tissue specimens.[12]

We utilized proton MRS to assess amplitudes and areas of NAA, as well as Cho, Cr and mI in patient with pre-eclampsia. While in the brain, NAA, choline and creatine were found as major metabolites,[11] myo-inositol and lactate were found a minor metabolite.[11] N-acetylaspartate[11] is a marker of neuronal content and observed at 2.02 ppm in the spectrum. Choline[11] is a cell membrane and myelin marker and observed at 3.2 ppm. Creatine[11] is a marker for brain energy metabolism and displayed at 3.0 ppm. Myoinositol[11] is an astrocyte marker and observed at 3.6 ppm. Lactate[11] is end product of anaerobe glycolysis and appears at 1.3 ppm.

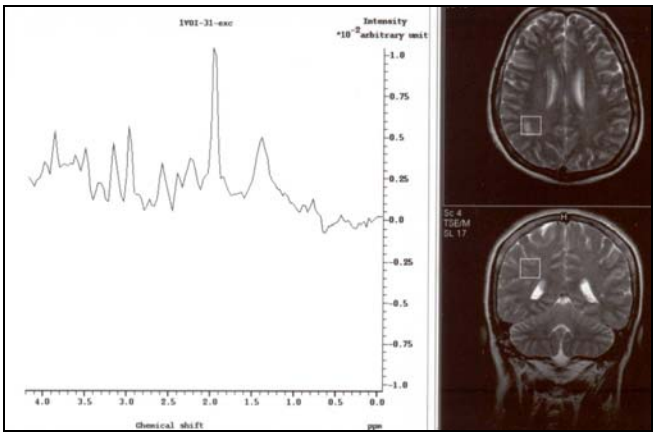

Figure I. Images was obtained after C/S. Spectra are shown from selected regions of interest in parietal lobe white matter. Metabolic *Cho*, *Cr*, *NAA* and mI images, and spectra are shown. Decreased level of NAA are apparent relatively to choline, myoinositol and creatine metabolites suggesting dilution of NAA metabolite concentration (increased vasogenic edema).

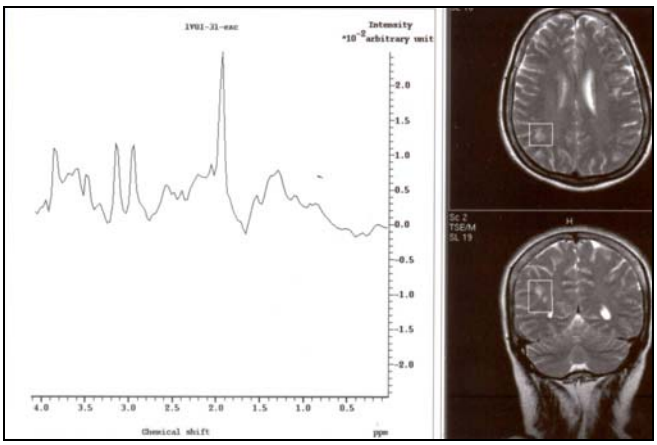

Figure II. Images obtained at 10th days follow-up. Spectral analysis showed increased NAA/Cr ratio, with the minimally decreased choline-creatine and minimally increased mI/Cr ratios in parietal lobe.

We describe a patient with pre-eclampsia who suffered drowsiness and confusion as a clinical onset. MRS of the brain showed high intensity lesions on T_2-weighted images. Regions with MR T_2 hyperintensity also showed lower levels of NAA, consistent with increased vasogenic edema. Initially spectral analysis was displayed decreased level of N-acetylaspartate relatively to choline, myoinositol and creatine putamen and parietal lobe white matter (Figure I). This findings are consistent with previous studies of preeclampsia.[5,13] Eichler et al.[13] reported that mildly reduced N-acetylaspartate concentrations in both white and gray matter of eclamptic patient. Follow-up of patient revealed that these abnormalities had resolved, with near normal levels of all metabolites. Likewise, Sengar et al.[5] demonstrated significant decrese in NAA in patients with eclampsia. Celik et al.[14] reported that unchanged N-acetylaspartate concentrations in white matter of eclamptic patient. Ten days later, our patient fully recovered and on follow-up MRI the abnormal lesions were almost totally resolved. MR spectroscopy was showed unchanged choline-creatine and myoinositol-creatine ratios in parietal lobe (Figure II) with the minimally decreased choline-creatine and minimally increased mI/Cr ratios in putamen. A mildly reduced NAA/Cr ratio was observed that normalized by the time of follow-up in putamen and parietal lobe. This findings suggest that some pre-eclamptic brain lesions (especially vasogenic edema) are reversible and don't cause neuronal damage. These spectroscopic findings give suggestive evidence of membrane alterations in white matter of the parietal lobe and putamen in patients with preeclampsia. But there was no evidence of neuronal injury. Our study confirms that proton MRS can identify distinct physicochemical alterations in pre-eclamptic brain lesions, reflecting neuronal membrane changes and, differentiated between cerebral neuronal demage and vasogenic edema.

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