Detection of Change in CNS Involvement in NPSLE with Magnetization Transfer Imaging

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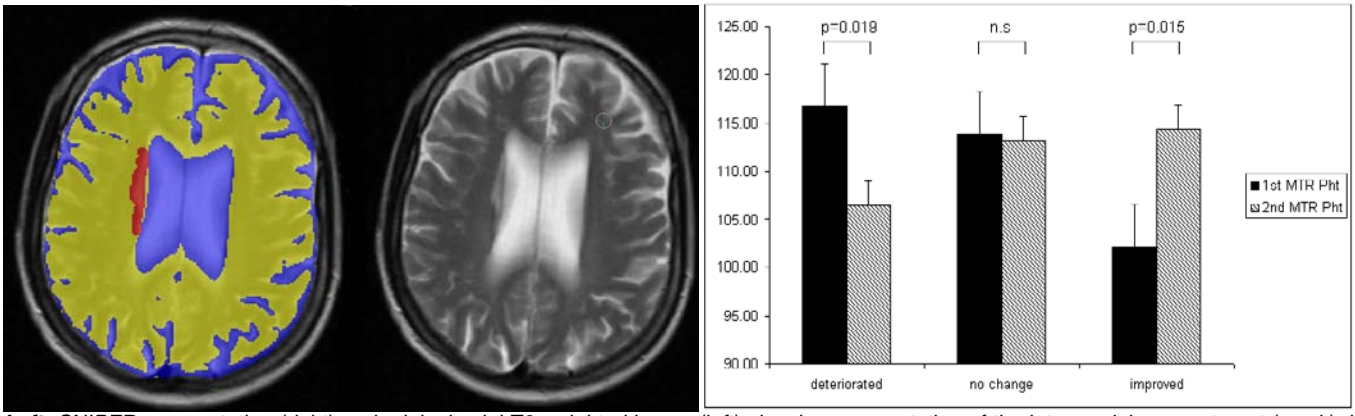
Introduction: Systemic lupus erythematosus (SLE) is an autoimmune disease with a relapsing-remitting course and symptoms based on multi-organ involvement.(1) Up to 80 percent of SLE patients develop neurological or psychiatric symptoms.(2) In 40% of the cases, neurological or psychiatric symptoms are the consequence of secondary causes such as infections, metabolic derangement based on SLE damage to organs other than the brain or due to side effects of drug treatment.(3) In the remaining 60% the symptoms are ascribed to primary SLE involvement of the brain, which is referred to as primary neuropsychiatric SLE (NPSLE). In most NPSLE patients with diffuse symptoms, such as headache, cognitive impairment, and coma, conventional diagnostic imaging and other clinical tests fail to provide an explanation for the clinical picture. Magnetization transfer imaging (MTI) can be used to detect the severity of cerebral involvement in NPSLE. MTI has proven to be more sensitive to the presence of disease than conventional MRI techniques in normal appearing brain tissue.(4) The aim of this study was to assess whether MTI parameters change during clinical changes in NPSLE patients.

Materials and methods: 19 female patients (mean age 37.5 years; range 19–64) were subjected to MTI on, at least, two separate occasions (mean time between scans 25.4 months; range 5.4-52.3). Patients were classified as having active or inactive NPSLE at the time of MRI, and the neuropsychiatric status between the first and the second MRI was classified in three groups as deteriorated, stable, or improved by the same observer. None of the three groups contained more than one paired analysis of the same patient. Two experienced raters performed classification independently, and in case of doubt or disagreement an experienced rheumatologist in NPSLE classified the patient independently as well after which consensus was reached during a discussion between all raters to obtain a final classification. In addition, the experienced rheumatologist classified every 5th case as a quality control. Of the 24 scores there was disagreement in 2 between the two raters. All three raters were blinded for the results of MTI. Subsequently, the paired measurements were divided into three groups: deteriorated, stable and improved. Transaxial proton-density (TR/TE: 2500/30 ms), T2-weighted (TR/TE: 2500/120ms) and FLAIR (TR/TI/TE: 8000ms/ 2000ms/120ms) were acquired with the following parameters: field of view 220mm, matrix 256x256, 22 6mm slices with 0.6mm slice gap. MTI was performed using a 3D gradient-echo pulse sequence with a TE/TR of 6/106 ms and a flip angle of 12º(4). An MTI study comprised two consecutive sets of axial images, the first with and the second without a radio frequency saturation pulse (sinc-shaped, 1100 Hz upfield of H_2O resonance). Twenty-eight contiguous 5 mm slices were acquired with a field of view of 220mm and a matrix of 256x256 (acquisition percentage 50%). Twenty-four pairs of scans of 19 patients were available. Whole brain magnetization transfer ratio (MTR) histograms were generated. The peak height of these histograms was used as an estimate of parenchymal integrity. Based on the change in clinical status paired examinations were grouped and tested for significant differences between the first and the second examination using paired samples *t*-tests.



Left: *SNIPER segmentation (right) and original axial T2 weighted image (left) showing segmentation of the intracranial compartment (mask), brain parenchyma (yellow), CSF (blue) and lesions (red).* ***Right:*** *Mean MTR peak height and standard error of the first and the second scan per clinically classified patient group (deteriorated, stable and improved).*

Results: None of the NPSLE patients had major abnormalities on conventional MRI. From the 24 pairs of observations that were made in our 19 patients, 4 were classified as deteriorated. In all clinically deteriorated patients the MTR peak height decreased between the first and second scan. On average this decrease was 8.6% (p=0.02) on average (range: -13.0% to -5.9%) in this group. 14 Patients were classified as stable disease. In this group the peak height did not change (p=0.79) between the first and second scan (range -9.8% to 10.1%). 6 Patients were classified as improved. In all clinically improved patients the MTR peak height increased between the first and second scan. On average this group showed a relative increase in peak height of 12.0% (p=0.02) on average (range 4.9% to 27.6%).

Conclusion: The increase in MTR peak height during clinical improvement in NPSLE patients suggests that the MTR peak height reflects, at least in part, reversible damage. Peak height of whole brain MTR histograms corresponds with changes in the clinical status of individual NPSLE patients. This study suggests that MTI, besides neuropsychological and neurological evaluation can be a valuable addition in the assessment of cerebral involvement in NPSLE patients.

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