Memory circuit involvement in systematic lupus erythematosus patients

Ivana De Lucia[1], An Vo[1], Meggan Mackay[2], Peter B Kingsley[3], Bruce Volpe[2], Cynthia Aranow[2], David Eidelberg[1], Betty M Diamond[2], and Aziz M Ulug[1,4]

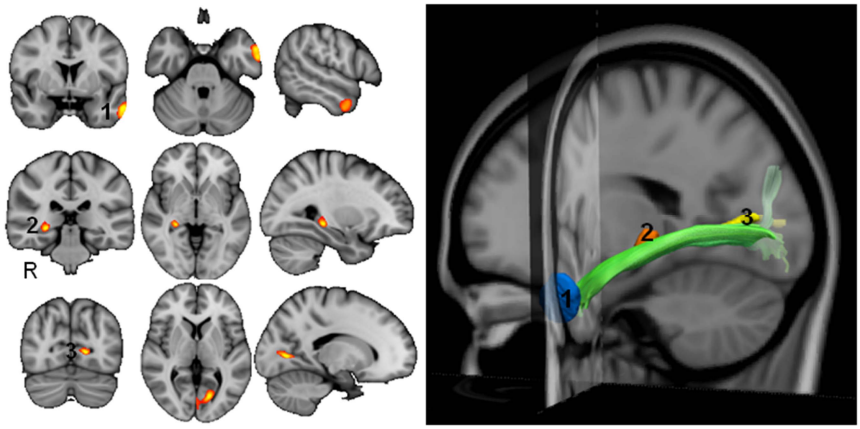
[1]Center for Neurosciences, Feinstein Institute for Medical Research, Manhasset, New York, United States, [2]Center for Autoimmune Diseases, Feinstein Institute for Medical Research, Manhasset, New York, United States, [3]North Shore University Hospital, Manhasset, New York, United States, [4]Institute of Biomedical Engineering, Bogazici University, Istanbul, Turkey

Target Audience Neuroscientists, lupus researchers, neuro-imaging scientists

Purpose: Systemic lupus erythematosus (SLE) is an inflammatory autoimmune disease often accompanied by central nervous system involvement, as evidenced by impairments in attention, processing speed, and working memory[1,2]. Several imaging modalities, including diffusion tensor imaging (DTI), magnetic resonance spectroscopy, and perfusion-weighted imaging[3,4], have been used to study patients with SLE, often finding nonspecific results. We used DTI and volumetric measurements to determine the disease footprint in the brains of the SLE patients. Our purpose is to identify parts of the memory circuit that are involved with the SLE disease process.

Methods: Fourteen SLE patients and fourteen age-matched normal controls were imaged using DTI and volumetric MRI with a clinical 3T scanner. The DTI imaging included 57 slices of 2.5 mm thickness, FOV 240 mm, data acquisition matrix 128 x128 zerofilled to 256 x 256, TR 15s. Five b=0 images and 33 diffusion weighted images with b=800 s/mm^2 were acquired. The DTI images were processed using FSL routines (FMRIB software library: www.fmrib.ox.ac.uk/fsl), and FA and MD maps were calculated. Group analyses were done using SPM (Wellcome Department of Cognitive Neurology, University College, London). The volumetric image protocol included T1-weighted imaging with FOV = 24 cm, TE 2.9 ms, TR = 7.6 ms, TI = 650 ms, flip angle 8 degrees, 176 slices of 1 mm. The volumetric MRI data was analyzed using Freesurfer (freesurfer.net). We used group tractography[5] to show the underlying white matter tracts.

Results: All regions with significant DTI differences between groups are listed in Table 1. Cortical thickness measurements revealed regions of thinning in SLE patients relative to controls (Table 2). Three regions (temporal lobe (1), hippocampus(2), lingual gyrus (3)) involved in the SLE disease process, which are part of the memory circuitry, were identified with DTI are displayed in the Fig.1 (left). The underlying white matter tracts displaying the memory circuitry involved (Fig.1, right).



Discussion/Conclusions:
The results show that there are significant DTI and MRI differences between SLE patients and controls, including several regions involved in memory. DTI revealed three regions of the memory circuitry (hippocampus, left temporal lobe, lingual gyrus) that are affected in the disease process. The lingual gyrus is involved in the recognition of words and semantic processing, as well as visual memory[6]. It also has a role in memory retrival[7]. The temporal lobes are mainly responsible for storing new memories and for language comprehension[8]. The hippocampus is crucial in the formation of new memories. Volumetric analysis also revealed that cortical thickness in the left temporal lobe is decreased in patients relative to controls. Tractography visualized the parts of the memory circuitry connecting the regions involved. While cognitive problems have been reported in SLE patients before[1,2], to our knowledge this is the first study to identify the memory circuity involved in the SLE disease process with multi-modal imaging means.

Table 1: DTI findings	MNI Coordinates			Cluster size	p <
	x	y	z		
Superior parietal cortex, BA 7	23	-70	60	1151	0.006
Frontal Lobes	26	1	35	849	0.015
Frontal Lobes	-16	20	34	2666	0.001
Frontal Lobes	29	21	30	504	0.050
Medial frontal/prefrontal gyrus, BA9	-27	33	23	781	0.043
Occipital Cortex	28	-91	4	1466	0.003
Temporal lobe, BA 41	38	-24	3	915	0.012
Lingual Gyrus	-16	-71	3	1376	0.004
Occipital Cortex	-32	-87	1	1723	0.002
Hippocampus	27	32	-5	551	0.042
Temporal lobe, BA 21	-58	3	-27	2277	0.003
Brain stem, Cerebellum	7	-36	-59	9070	0.001

Table 2: Volumetric Group Comparison	
Region	p <
Right Thalamus Proper	0.010
Right Temporal Pole	0.002
Left Lateral Occipital	0.005
Left BA3	0.004
Left BA3	0.010

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