

## Can Hippocampal Size Predict Cognitive Impairment in Post-Stroke Patients?

E. Kliper<sup>1,2</sup>, E. Ben Assayag<sup>3</sup>, S. Shenhar-Tsarfaty<sup>2,3</sup>, L. Shopin<sup>3</sup>, H. Halleli<sup>3</sup>, E. Uriel<sup>3</sup>, A. Korczyn A<sup>3</sup>, N. M. Bornstein<sup>3</sup>, T. Hendler<sup>1</sup>, O. Aizenstein<sup>4</sup>, and D. Ben Bashat D<sup>5</sup>

<sup>1</sup>The Wohl institute for Advanced Imaging, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel, <sup>2</sup>Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel,

<sup>3</sup>Departments of Neurology, Tel Aviv Sourasky Medical Center, Israel, Israel, <sup>4</sup>Departments of Radiology, Tel Aviv Sourasky Medical Center, Israel, Israel, <sup>5</sup>The Wohl Institute for Advanced Imaging, Tel Aviv Sourasky Medical Center, Israel, Israel

### Background / Aims:

Patients with ischemic stroke are at risk for developing cognitive impairment. Therefore, the early identification of these patients is essential. The hippocampus plays a vital role in learning and memory; hence it may be linked with post-stroke cognitive outcomes. We present preliminary results regarding the prediction of cognitive outcomes using the total hippocampal size as measured immediately after the event.

### Methods:

**Subjects:** Data from 102 first-ever stroke or transient ischemic attack (TIA) patients were included as part of a large study performed in our center. Patients with suspected cognitive decline prior to the event were not included.

**Scan parameters:** Subjects were scanned within 7 days of admission in a 3T GE scanner (GE Signa EXCITE, Milwaukee, WI, USA) using an 8-channel head coil. Axial high resolution 3-dimensional fast-spoiled gradient recalled (fSPGR) T1-weighted image was acquired with voxel size of 1x1x1 (isovoxels).

**Data analysis:** Total hippocampal size was calculated using the FreeSurfer V4.5 image analysis suite<sup>1</sup>, an automated software tool for all brain segmentation and cortical parcellation. The complete FreeSurfer analysis pipeline was performed with manual intervention and quality assurance of the data (Fig.1). The estimated left and right hippocampi were extracted directly from the aseg.stats files. Subjects were then divided into two groups by total hippocampal size: above and below the median.

**Clinical and Cognitive Assessments:** Stroke severity was evaluated using the National Institutes of Health Stroke Scale (NIHSS) and cognitive assessments were performed with a computerized neuropsychological battery (NeuroTrax®)<sup>2</sup> and with the Montreal Cognitive Assessment test (MoCA) at three time points: within 3 days of symptom onset (baseline), 6 and 12 months thereafter.

**Results:** One hundred and two patients were available for assessment. Median hippocampal size of all patients was 7950mm<sup>3</sup>. Patients with smaller hippocampal size (below median) were significantly older than patients with larger hippocampal size (above median) ( $p<0.05$ ). Longitudinal changes in MoCA scores in the two groups are presented in Figure 2. At baseline, patients with smaller hippocampi did not differ significantly from those with larger hippocampi in their cognitive scores; MoCA ( $p=0.17$ ) and NeuroTrax scores ( $p=0.44$ ), nor in their NIHSS ( $p=0.66$ ) or years of education ( $p=0.14$ ). As expected, six months after symptom onset, both groups showed significant improvements in their MoCA scores compared to baseline. Yet, patients with larger hippocampal size demonstrated significantly larger improvement compared to the other group. Twelve months after symptom onset, the two groups differed significantly in their MoCA scores ( $p<0.05$ ); patients with larger hippocampal size significantly improved in their MoCA scores compared to the 6 month evaluation ( $p<0.05$ ), while the smaller hippocampal group demonstrated no significant changes. Similar results are seen in the NeuroTrax battery at 6 and 12 months after symptom onset.

### Conclusions and Discussion:

The above results may suggest that stroke patients presenting with smaller hippocampi may be prone to developing cognitive decline 12 months later. The age difference between groups could be a possible source of bias, although the two groups did not differ significantly in their cognitive results at both baseline and 6 months and the significant difference emerged only 12 months later. Further exploration is needed to strengthen these results in order to identify patients at high risk of developing post-stroke cognitive impairment, thus enabling early and intensive intervention.

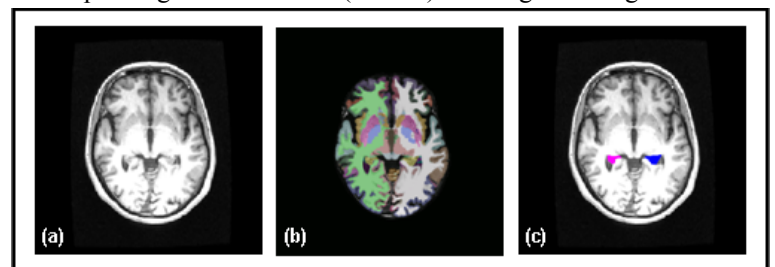


Fig 1: Results from a 61 year old subject; anatomy image (a); T1W fSPGR image (b); FreeSurfer all brain segmentation results (c); Right (pink) and left (blue) hippocampi extraction.

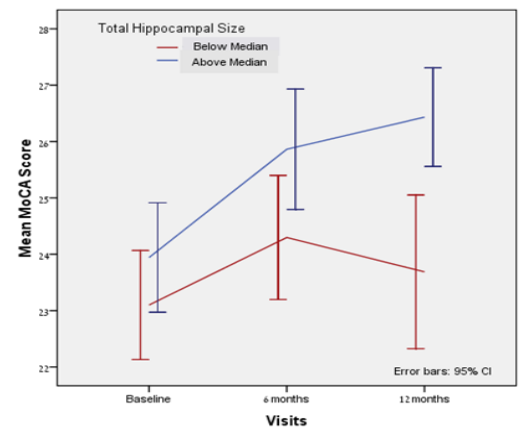


Fig 2: Longitudinal association between the hippocampal size and cognitive function measured by MoCA.

<sup>1</sup><http://surfer.nmr.mgh.harvard.edu/>; <sup>2</sup>Doniger, G.M., et al, Am J Alzheimers Dis Other Dement, 2006. 21(1): p. 28-36.