DETECTION OF HIPPOCAMPAL LESIONS IN MULTIPLE SCLEROSIS WITH 3D-DIR

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Introduction: Previous studies have shown metabolic abnormalities in the hippocampus of Multiple Sclerosis (MS) patients.[1,2] It is not known, however, whether this is caused by (focal) demyelination within the hippocampus. Conventional MRI is known to grossly underestimate gray matter (GM) lesion numbers.[3] Cortical GM lesion detection improves when using 3D Double Inversion Recovery MRI (3D-DIR),[4] a sequence that leaves only GM visible by selectively nulling the signals from white matter (WM) and corticospinal fluid (CSF). In the current study, we evaluated whether a recently introduced 3D-DIR[5] (based on single-slab 3D sequences[6], also known as SPACE in Siemens nomenclature) enables detection of hippocampal lesions in a sample of randomly selected MS patients.

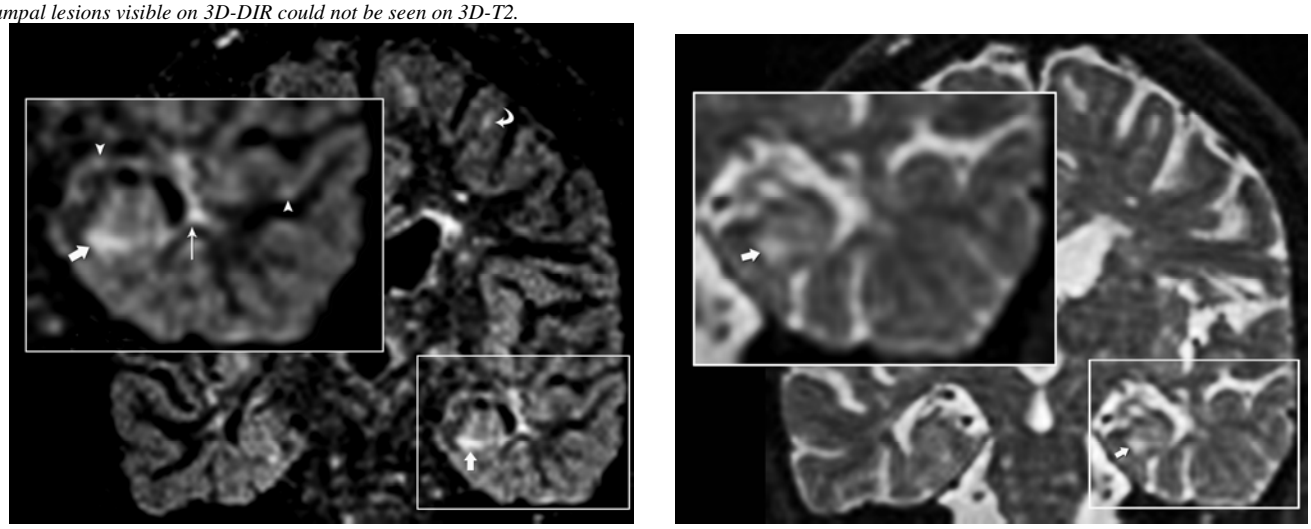
Patients and Methods: MR imaging was performed on a 1.5T whole body scanner (Siemens Sonata, Erlangen, Germany). Sagittal 3D-DIR, 3D-T2 and MPRAGE images (all with voxel dimensions of 1.2x1.2x1.3mm^3) of 16 patients (9 females) and 9 control subjects (3 females) were acquired. Lesions were anatomically classified on 3D-DIR as WM, cortical (including juxtacortical and mixed WM-GM lesions), or hippocampal lesions. Cortical and hippocampal lesions were defined as hyperintense with respect to surrounding normal GM, though less hyperintense than WM lesions. Hippocampal lesions were assessed on orthogonally reformatted coronal 3D-DIR images, assuring optimal anatomical viewing, and retrospectively also on coronal 3D-T2. Other lesions were identified on reconstructed oblique axial images. Normalized brain volume (NBV) and normalized hippocampal volume were measured on MPRAGE images. Spearman's correlation coefficient was used to evaluate all associations, Mann-Whitney U test to evaluate differences. P values < 0.05 were considered statistically significant. Values are reported as mean ± standard deviation.

Table 1: sequence characteristics, in milliseconds.

	TR	TE	TI1	TI2
3D-DIR	6500	349	2350	350
3D-T2	4300	349	-	-
3D-MPRAGE	2700	5	950	-

Results: Artifacts could be clearly distinguished from lesions. No hippocampal lesions were found in control subjects. By contrast, 14 out of 16 patients had at least one hippocampal lesion (Figure 1). The mean number of hippocampal lesions in MS patients detected with 3D-DIR was 2.6 ± 1.8. Hippocampal lesion count correlated with total cortical lesion number (rho=0.56, p=0.025), but not with total WM lesion count (rho=0.28, p=0.3). Retrospectively, 56% of hippocampal lesions could also be detected on the 3D-T2 images. Normalized hippocampal volume did not differ significantly (U=59; p=0.462) between MS patients (8.0 ± 1.1 mL, total of left and right hippocampal volumes) and healthy controls (8.3 ± 0.6 mL), as opposed to NBV (U=25; p=0.008), which was 1530 ± 80 mL for patients and 1610 ± 20 mL for healthy controls.

Fig. 1: Left: 3D-DIR image of an MS patient shows a lesion in the left hippocampus (thick arrow), vessels (arrowheads), periventricular lesions (thin arrow) and a juxtacortical lesion (curved arrow). Right: The hippocampal lesion is also visible on a 3D-T2 image of the same patient (arrow); however, slightly less than half of the hippocampal lesions visible on 3D-DIR could not be seen on 3D-T2.



Conclusion: This study demonstrates that hippocampal lesions occur frequently in a randomly selected sample of MS patients and can be visualized with 3D-DIR. The ability to image hippocampal lesions may be beneficial for future studies focusing on the cognitive correlates of (deep) GM damage in MS.

References:

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