HYPOINTENSE LESION LOAD ON FAST-FLAIR MRI SCANS FROM MULTIPLE SCLEROSIS PATIENTS: A NEW MARKER OF DISEASE EVOLUTION ?

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Introduction

It has been demonstrated (1-2) that fast-fluid attenuated inversion recovery (fast-FLAIR) MRI sequences, which provide heavily T2-weighted images with cerebrospinal (CSF) signal suppression, are more sensitive than conventional spin echo (CSE) for detecting brain lesions in multiple sclerosis (MS) patients. On fast-FLAIR images hypointense areas are sometimes visible in the context of hyperintense MS lesions and they might represent severely damaged tissue with CSF-like signal. Since hypointense lesions on T1-weighted scans, which represent areas of substantial tissue loss (3), well correlate with MS severity and evolution (4), in this study we assessed the contribution of hypointense lesions on fast-FLAIR to the overall lesion burden and their correlations with clinical findings and other MRI measures.

Patients and methods

Thirty-five MS patients (20 with relapsing-remitting -RR- and 15 with secondary progressive -SP- disease course) were studied; mean age was 36.9 years (range 19-65), median expanded disability status scale (EDSS) score was 4.0 (range 1.0-6.5). On the same 1.5 Tesla scanner, each patient underwent in a single session dual echo rapid acquisition relaxation-enhanced (RARE) (TR = 3300, TE = 16-98, ETL = 6), fast-FLAIR (TR = 9500, TE = 119, TI = 2200) and T1-weighted CSE (TR = 768, TE = 14, NEX = 2) brain MRI scans. For each sequence 24 axial 5-mm thick contiguous interleaved slices were obtained. A single observer marked on MRI hardcopies hyperintense lesions on proton density (PD)-weighted RARE, hypointense lesions on T1-weighted CSE and both hyperintense and hypointense lesions on fast-FLAIR images; the lesion marking was done first presenting the scans in a random order and then comparing the four acquisition schemes to evaluate whether lesions visible exclusively with one strategy could be seen retrospectively. Total lesion loads (LL) for each of the four measures were assessed by a technician, using a semi-automated local thresholding technique and the marked hardcopies as a reference. MRI LL were correlated with patient EDSS scores by using the Spearman Rank Correlation Coefficient (SRCC).

Results

Median LL were 17.4 ml (range: 0.4-76.5 ml) on PD-weighted, 2.7 ml (range: 0.0-47.2 ml) on T1-weighted and 22.3 (range : 1.1-75.7 ml) on fast-FLAIR MRI scans. The median number of hypointense lesions visible on fast-FLAIR images was 0.0 (mean 3.8, range 0-22) and for all these lesions a hypointense area was present on the corresponding T1-weighted images; their median LL was 0.0 ml (range: 0.0-12.6 ml). The median ratios between T1 and PD-weighted and between hypointense and hyperintense fast-FLAIR LL were 24.8% (range: 0.0-70.6%) and 0.0% (range: 0.0-19.4%), respectively.

In Table 1, MRI measures for RRMS and SPMS patients are reported.

Significant correlations were found between patient EDSS scores and LL for all the MRI measures (SRCC values were 0.53 for PD-weighted LL, 0.71 for T1-weighted LL, 0.55 for fast-FLAIR LL and 0.45 for hypointense LL on fast-FLAIR).

Table 1. Median lesion numbers and loads (ml) for patient subgroups.

	RRMS	SPMS	p
PD RARE LL	12.9	22.8	0.03
T1 CSE LL	1.1	7.4	0.005
fast-FLAIR LL	17.4	32.8	0.03
fast-FLAIR hypointense lesions	0.0	5.0	0.02
fast-FLAIR hypointense LL	0.0	1.3	0.02

Conclusions

This study confirms that the hypointense lesion load on T1-weighted MRI has the strongest correlations with MS clinical disability. The correlation between hypointense lesion load on fast-FLAIR scans and EDSS was only moderate, but these lesions were significantly more frequent in the subgroup of patients with marked disability and disease severity. Our data suggest that fast-FLAIR imaging may provide informations about different MS pathological substrates with a single acquisition.

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