Patterns of Neurodegeneration in Macula Differs in Multiple Sclerosis Subtypes: a Voxel-Based Morphometry Study with Optical Coherence Tomography

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BACKGROUND

Neurodegeneration of multiple sclerosis(MS) can be measured with optic coherence tomography(OCT), as thinning of peripapillary retinal nerve fiber layer(pRNFL), or as reduced total macula volume(TMV). The macula scan can be further segmented into ganglion cell layer(GCL), inner plexiform layer(IPL), and inner nuclear layer(INL), which are plausible markers for neuronal loss, dendritic loss, or ongoing inflammation. Unlike traditional method, voxel-based morphometry(VBM) can visualize and compare the whole macula map, therefore can be more sensitive in detecting focal lesions. Here we applied VBM to macula OCT in different types of MS and compared the results with traditional pRNFL analysis.

METHODS

Three groups of patients with CIS, RRMS, PPMS(N=10 each) and fifteen healthy subjects were enrolled. Peripapillary and macula volume scans were performed on eyes without optic neuritis and segmented with Heidelberg Spectralis OCT. The segmented thickness maps of the retinal layers were registered to generate group maps with VBM and 99% confidence interval was calculated as the cutoff. Voxels in individual maps with thickness above/under the cutoff of the healthy group maps were considered as thicken/atrophy. Ultimately, the difference maps of the patient groups were generated, the value in each voxel represents the percentage of patients showed thicken/atrophy at the certain location.

RESULTS

Among the 30 patients, only 1 eye showed borderline atrophy in pRNFL compared with healthy, however, all the patients showed focal RNFL atrophy in macula map. Macula GCL, IPL atrophy and INL thickening were found in all patients, with the lesion area increased from CIS to RRMS to PPMS. The atrophy of GCL in RRMS located at nasal-inferior macula,

while in PPMS was mainly at temporal-superior area. Further, thickening of nasal INL was found in 100% RRMS and PPMS patients, but not in all CIS

DISCUSSION

Our results suggest that macula OCT is more sensitive in detecting neurodegeneration in MS patients than pRNFL. Also, RRMS and PPMS showed different patterns of neurodegeneration within macula GCL, which could be a marker for early diagnosis of progressive patients. Long-term follow-up is needed to examine if the nasal INL thickening can be a marker to predict the converter from CIS to MS.