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Background: The presence of white matter (WM) multiple sclerosis (MS) lesions can significantly affect the accuracy of tissue segmentation algorithms. Even though several automated lesion segmentation and lesion filling tools have been proposed, an extensive analysis of fully automated tissue segmentation pipelines incorporating both automated lesion segmentation and lesion filling has not been performed yet.

Aim: To analyze the effect of manual or automated lesion annotations on the computation of WM and gray matter (GM) tissue volume employing SPM8 or FAST segmentation methods. The study includes two different automated lesion segmentation and filling tools (LST and SLS).

Methods: Seventy clinically isolated syndrome patients were scanned in a 3.0 T system (Trio, Siemens). Image acquisition protocol included 3D T1-w sagittal, 2D FLAIR and PD/T2-w sequences. Manual annotations were performed by a trained technician over PD/T2 images. For each automated pipeline, we calculated the % difference in GM and WM volume obtained from: a) T1-w images where manual annotated lesion masks were used to refill lesions before tissue segmentation; b) T1-w images where lesions were automatically segmented on the FLAIR modality and filled after. Moreover, we also evaluated the % differences between the previous estimations and those obtained with original T1-w images containing lesions.

Results: Differences in total and normal-appearing tissue volume between manually annotated and SLS/LST were small (< 0.20%) for both GM and WM, and independently of the segmentation method. Differences did not increase in images with higher lesion load (9-18ml) and did not correlate with lesion load ($p > 0.43$). In contrast, for images segmented without lesion filling, differences were significantly higher for GM (0.25%, $p < 0.05$) and WM (0.39%, $p < 0.05$) when FAST was used, but not for SPM8 ($p > 0.30$), while the differences in normal-appearing tissue were only significant when SPM8 was used (GM: -0.2%, $p < 0.002$; WM: 0.3%, $p < 0.02$). Observed values in total tissue in SPM8 and normal-appearing in FAST were produced by a canceling effect between the differences in lesion regions and the effects of these lesions on normal-appearing tissue.

Conclusion: Differences between tissue volumes computed using manual annotations for lesion filling and using fully automated LST and SLS were not statistically significant, independently of the tissue segmentation employed.

Disclosure

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Evaluation of two automated lesion segmentation and filling pipelines for brain tissue segmentation of multiple sclerosis patients

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