Intra-and interscanner variability of magnetic resonance imaging based volumetry in multiple sclerosis

Brain volumetric measurements in multiple sclerosis (MS) reflect not only disease-specific processes but also other sources of variability. The latter has to be considered especially in multicenter and longitudinal studies. Here, we compare data generated by three different 3-Tesla magnetic resonance scanners (Philips Achieva; Siemens Verio; GE Signa MR750). We scanned two patients diagnosed with relapsing remitting MS six times per scanner within three weeks (T1w and FLAIR, 3D). We assessed T2-hyperintense lesions by an automated lesion segmentation tool and determined volumes of grey matter (GM), white matter (WM) and whole brain (GM + WM) from the lesion-filled T1-weighted images using voxel-based morphometry (SPM8/VBM8) and SIENAX (FSL). We measured cortical thickness using FreeSurfer from both, lesion-filled and original T1-weighted images. We quantified brain volume changes with SIENA. In both patients, we found significant differences in total lesion volume, global brain tissue volumes and cortical thickness measures between the scanners. Morphometric measures varied remarkably between repeated scans at each scanner, independent of the brain imaging software tool used. We conclude that for cross-sectional multicenter studies, the effect of different scanners has to be taken into account. For longitudinal...
monocentric studies, the expected effect size should exceed the size of false positive findings observed in this study. Assuming a physiological loss of brain volume of about 0.3% per year in healthy adult subjects (Good et al., 2001), which may double in MS (De Stefano et al., 2010; De Stefano et al., 2015), with current tools reliable estimation of brain atrophy in individual patients is only possible over periods of several years. (C) 2016 Elsevier Inc. All rights reserved.