Magnetization Transfer Imaging of Progressive Multifocal Leukoencephalopathy and HIV-Associated White Matter Lesions in AIDS

Thomas Ernst, Linda Chang, Mallory Witt, Howard Aronow, Irvin Walot, Marie Leonido-Yee, Elyse Singer
Harbor-UCLA Medical Center, Torrance, CA, USC Medical School and UCLA Medical School, LA, CA.

Objective: To determine whether there are differences in magnetization transfer ratio (MTR) between progressive multifocal leukoencephalopathy (PML) lesions and HIV-associated white matter lesions (HIV-WML) in patients with AIDS.

Background: MRI is a standard technique in the diagnosis of HIV-positive patients with neurological symptoms. While MRI is very sensitive in detecting brain abnormalities, it lacks specificity with respect to the degree of brain injury and is unable to differentiate between gliosis and demyelination. This problem might be resolved by magnetization transfer (MT) MRI, a relatively new contrast option that promises to be more specific to myelin destruction than T2-weighted MRI.

Design and Methods: MRI was performed in 9 patients with PML (13 lesions) and 6 patients with HIV-WML (11 lesions) using a 1.5-T GE scanner. MT images were obtained with a spin-echo sequence (TE/TR 11/650, 5 gap 0, 24 cm FOV), which was acquired both with and without off-resonance saturation pulses (offset frequency 600 Hz). For each pixel, the MTR was calculated as the difference between the images without (signal $S_0$) and with MT (signal $S_{MT}$), divided by the image without MT: $MTR = (S_0 - S_{MT}) / S_0$. The MTR in the lesions was expressed relative to the MTR in contralateral or adjacent normal appearing white matter. The average and minimum MTR of all pixels in each lesion were determined.

Results: Compared to normal appearing white matter, the MTR was reduced in PML lesions as well as in HIV white matter lesions. The MTR was significantly lower in PML lesions (average MTR = 52% of normal) than in HIV-WML (average MTR = 79% of normal, $p < 0.0001$ with unpaired t-test). Furthermore, there was no overlap between the minimum MTR values of PML lesions and of HIV-WML (see Figure).

Discussion: PML and HIV-WML are two common white matter abnormalities observed in patients with AIDS. PML is a viral infection of the oligodendrocytes causing demyelination, whereas HIV-WML are due to the direct effects of the HIV infection of the brain, with little damage to myelin. Because the high MTR of normal white matter is most likely related to the high concentration of myelin (1-4), the greatly reduced MTR in PML lesions reflects the demyelination in PML lesions. This is in agreement with preliminary reports showing large reductions of MTR in PML lesions (5,6). In contrast, HIV-WML show only moderate decreases in MTR.

In conclusion, quantitative MT imaging is a noninvasive tool that may allow differentiation between PML and HIV WML in patients with AIDS. MT MRI may also be useful to monitor disease progression in AIDS patients with PML.

Acknowledgments: This study was supported in part by NIH (DA 00280) and the grant from the State of California Universitywide AIDS Research Program to the UCLA Care Center (CC97 LA 175).

References