

Mean displacement map of spine and spinal cord disorders using high b-value q-space imaging; Feasibility study.

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Introduction: High b-value Q-space imaging (QSI) is an MR imaging technique providing non-Gaussian water diffusion in the tissue. This sequence has showed promise for evaluating brain and spinal disorders in animal models and human brain in vivo [1-6] because it is possible to distinguish quite accurately between restricted and unrestricted modes of diffusion with higher sensitivity compared with clinically used diffusion-weighted imaging. However, its contrast of pathologic lesions remains to be known in clinical cases, compared with conventional diffusion-weighted imaging. The purpose of this study was to investigate the use of mean displacement (MD) maps of QSI to characterization of spine and spinal cord lesions in vivo.

Methods: A total of ten patients (4 women and 6 men, mean age 56 y.o.) with spine or spinal cord disorders participated in this study. The diseases consisted of two neurinomas, one myeloma, two abscesses, three syringohydromyelia and two cervical myelopathy. All MR imaging were performed on a 1.5 Tesla MR imager (Signa HD ver.12, GE Healthcare, Milwaukee, Illinois). MR imaging protocol consisted of conventional MR sequences (T1-weighted spin-echo imaging and T2-weighted fast spin-echo imaging in both sagittal and axial plane), conventional diffusion-weighted imaging (b=1000) and high b-value QSI. Imaging parameters of QSI were as follows: TR/ TE =10000/ 147.6 ms, matrix=128x128, bandwidth = 250 kHz, FOV = 240x240 mm, slice thickness/gap=5/1.5 mm and number of average=1. The diffusion gradients were applied in three axes(x, y, z) with the b value of 0 – 12000 s/mm² (13 steps, a maximum q value was 838 cm⁻¹). The time between the two leading edges of diffusion gradient (Δ) was 62 ms. Post-processing of the images was done by an IDL-based in-house software. ADC maps of conventional DWI and MD maps of QSI data were obtained and region of analysis for the lesions, normal spinal cord and CSF was performed.

Results: MDs of normal spinal cord and CSF were ranged from 6.84-8.15 μ m and 19.3-22.1 μ m, respectively. Spondylotic lesion tended to be higher MD values (7.74-8.99 μ m). In the lesions of the syringohydromyelia, MD values were slightly lower (15-16.7 μ m) than CSF. In cases of abscess, MD values were heterogenous (8.18-17.8 μ m) and MD maps were not well correlated with corresponding ADC maps. Intra-tumoral MD values were ranged 8.18-17.8 μ m in neurinomas and 6.72-8.83 in myeloma, respectively. Intra-tumoral structures were clearly demonstrated on MD maps (Figure 1).

Discussion: The heterogeneous values of MD in the spine/spinal cord lesions are possibly due to different tissue or pathologic structures. Even more studies regarding imaging-pathologic correlation will be needed, this technique has potential to provide new information in addition to conventional sequences in routine clinical study.

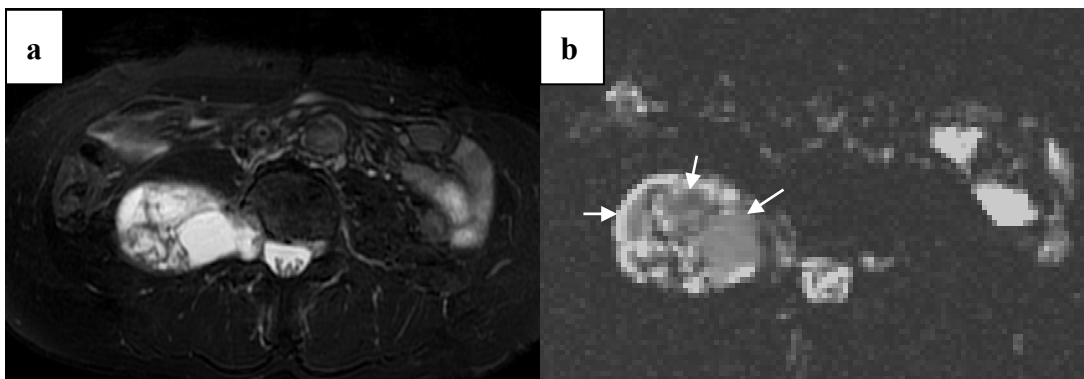


Figure 1. Neurinoma in a 69-year-old man. Fat-suppressed T2-weighted image (a) shows a heterogeneous hyperintensity mass lesion indicating paravertebral dumbbell-type neurinoma. MD map (b) shows intra-tumoral structures in detail. Note that various intensities (values) were demonstrated in the tumor (arrows), showed T2 elongated area on T2-weighted image.

Reference: [1] Assaf Y, et al. Magn Reson Med 2000;44:713–22. [2] Cohen Y, et al. NMR Biomed 2002;15:516– 42. [3] Assaf Y, et al. Magn Reson Imaging 2005;23:703– 710. [4] J.Latt et al. in Proc. ISMRM; 2008, p.40 [5] J.F. Jansen et al. in Proc. ISMRM; 2009, p.1319. [6] J.A. Helpem et al. in Proc. ISMRM; 2009, p.3494