Diffusion tensor imaging and tractography of cervical cord in normal and spinal cord compression: a preliminary study at 3.0 T MR

W. Wang[1], S-X. Chang[1], N-X. Hao[1], and S-G. Hu[2]

[1]Department of Radiology, East Hospital, Tongji University, Shanghai, China, People's Republic of, [2]Philips Medical System, Guangzhou, China, People's Republic of

Introduction: Diffusion tensor imaging (DTI) and tractography (DTT) are useful tool for assessment of various brain disorders. Alteration of the spinal cord structural integrity can also be assessed by using DTI method. Spinal cord compression due to various diseases is a major cause of motor dysfunction. Our objective is to study the clinical value of DTI and DTT in cervical cord compression at 3.0 T MR.

Method and Materials: Twenty-one patients with cervical spinal cord compression and 34 healthy volunteers were imaged by sagittal single-shot SE echo-planar diffusion tensor sequence at 3.0 T MR scanner. The diseases of those patients included cervical spondylosis (12 cases), tumors in cervical canal (4 cases, 3 cases were confirmed by operations) and injury in cervical cord (5 cases). The values of mean apparent diffusion coefficient (mADC), fractional anisotropy (FA) and principal anisotropy (PA) were measured in regions of interest (ROI) positioned in each cervical disc (C2-C6 level) of the normal or in abnormal level of patients' cervical cords. The tracts were visualized by setting 1 or 3 ROI on a reconstructed axial image using in-house software. FA value (0.2-0.3) was selected.

Results: For the healthy subjects, there was no statistically significant level of dependence between each cervical disc level. So, mADC, FA and PA values were identical at the different cervical cord levels, that is, $(453.9\pm49.0)\times10^{-6}$ mm^2/s, $(751.6\pm55.2)\times10^{-3}$ and $(734.7\pm59.0)\times10^{-3}$, respectively. All patients had increased mADC values, decreased FA values and PA values in the lesion site. mADC, FA and PA values in patients with cervical spondylosis were $(692.5\pm106.0)\times10^{-6}$, $(434.2\pm135.7)\times10^{-3}$ and $(401.7\pm122.5)\times10^{-3}$, respectively. Those values in patients with tumors were $(1257.5\pm741.1)\times10^{-3}$, $(232.5\pm57.4)\times10^{-3}$ and $(207.5\pm66.5)\times10^{-3}$, respectively. mADC, FA and PA values in patients with injury were $(736.0\pm340.2)\times10^{-3}$, $(322.0\pm73.3)\times10^{-3}$ and $(306.1\pm112.6)\times10^{-3}$, respectively. There was a statistically significant difference in the mADC, FA and PA values between volunteers and 3 group patients ($P<0.001$). In DTT maps, fibers were depicted as a bundle of tracts cephalocaudally. The main fiber tracts of cervical cord were visualized by ROI method. DTT maps showed that the tracts of all patients were oppressed and fibers were damaged in different degrees.

Discussion and Conclusion: Because of the small size, partial volume effect and various influencing factors, the clinical application of the spinal cord with DTI is limited. However, several groups have successfully performed DTI of spinal cord [1,2]. In this study, we evaluated and compared normal subjects and patients with cervical cord compression by quantitative assessment and fibertracking. DTI is a promising method to study spinal cord compression, which can provide quantitation analysis to the degree of spinal cord compression. Meanwhile, DTT is very helpful in order to locate the precise site of compression on the white matter tracts and to visualize the extent of impairment in spinal cord.

References

[1] David F, et al. MR Diffusion Tensor Imaging and Fiber Tracking in spinal Cord Compression. AJNR, 2005, 26:1587-1594.

[2] D. Ducreux, et al. MR Diffusion Tensor Imaging and Fiber Tracking in 5 Spinal cord Astrocytomas. AJNR, 2006, 27:214-216.

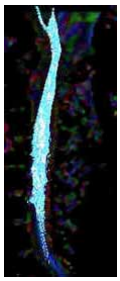

Fig.1

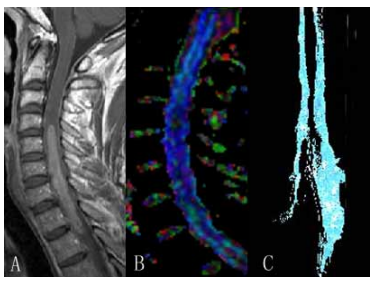

Fig.2

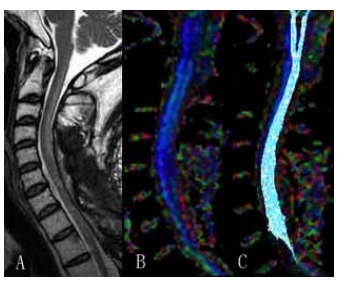

Fig.3

Figure 1: DTT map in normal subject. Fibers were depicted as a bundle of tracts cephalocaudally.

Figure 2-3: Enhanced T_1WI, FA and DTT map in an ependymoma within cervical cord pre- (Fig 2)and post- (Fig 3) operation. Figure2 A-C showed markedly enhanced tumor, inhomogeneous green areas and a little damage or compression of lesion level within cervical cord. Figure 3 A-C appearance seemed similar as normal cervical cord.