High directional coherence in renal cortex as shown in diffusion tensor imaging

M-C. Wu[1], Y-C. Lin[1,2], C-H. Hsieh[1], Y. Wai[1,3], and J. Wang[1,3]

[1]Department of Medical Imaging and Intervention, Chang Gung Memorial Hospital, LinKou, Tao Yuan, Taiwan, Taiwan, [2]Department of Electrical Engineering, Chang Gung University, [3]Department of Medical Imaging and Radiological Sciences, ChangGung University

Introduction: The diffusion anisotropy in kidney is considered as a result of the radially oriented architecture along the Henle loops, collecting tubules and vascular bundles[1]. Diffusion Tensor Imaging was often used to investigate the diffusion process of tissue microenvironment *in vivo*. Fractional Anisotropy (FA) measures the diffusion anisotropy within the voxel of interest. However, FA described the difference among the principal diffusivities in a voxel of interest and therefore, did not provide information related to orientation coherence among voxels in a neighborhood. In the current study, the directional coherence in kidney was visualized in a different index 'Intervoxel diffusion coherence (IVDC)' [2].

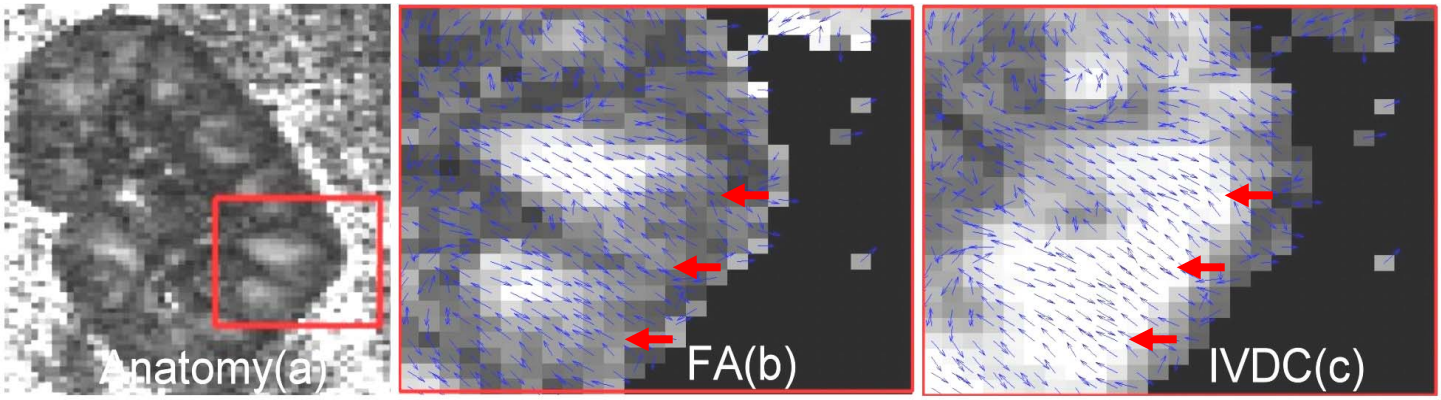

Fig 1: Regions of interest was selected from the left kidney (a). The principal eigenvectors were projected onto the x-y plane and overlaid onto the corresponding FA (b) and IVDC (c) maps. Blue arrows represent the principal eigenvectors. Red arrows indicated renal cortex.

Method and Material: DTI from 10 healthy volunteers were acquired using a 3T scanner (Trio a TIM system, Siemens, Germany) with respiratory-triggering. A diffusion weighted Echo Planar Imaging sequence was used with the imaging parameters are TR/TE = 1300 /78 ms, 154 x 154 matrix, voxel size of 1.5 x 1.5 x 5 mm^3, 12 averages, parallel imaging factor of 3 and b-value of 300 s/mm^2. Both FA and IVDC of the cortex and medulla were calculated.

Result and Discussion: Regions of interest was selected from Figure 1(a). Blue arrows representing the principal eigenvector are projected onto the x-y plane for each voxel and are superimposed onto the maps of FA (b) and IVDC (c). In cortex as indicated by the red arrows, IVDC demonstrates a homogeneous region of increased values where the principal eigenvectors are locally uniform. In contrast, the corresponding FA showed an inhomogeneous decrease. In medulla, both FA and IVDC are high, which suggested a consistent flow of high diffusion anisotropy. Renal cortex is the part of renal columns that contain the renal corpuscles and the renal tubules, which extended down the renal pyramid. The direction of water diffusion, therefore, is consistent, which was properly reflected in the map of IVDC. In the other hand, low FA in cortex suggested diffusion isotropy within the voxels in cortex.

Conclusion: High uniformity of the eigenvector distribution in the renal cortex was detected, which can be properly reflected in InterVoxel Diffusion Coherence rather than FA.

Reference: 1.Fukuda, Y., et al. J Magn Reson Imaging.11, 156-160 (2000). 2.Wang, JJ, et al. Magn Reson in Medicine.59, 764-770 (2008)