Integration of MRS and DWI in The Diagnosis of Prostate Cancer

D. J. Lu[1,2], X. M. Guo[2,3], F. Y. Li[2,3], J. Zhang[1,2], X. Y. Wang[2,3], and J. Fang[1,2]

[1]Dept. of Biomedical Engineering, Peking University, Beijing, China, People's Republic of, [2]Center for Functional Imaging, Peking University, Beijing, China, People's Republic of, [3]Dept. of Radiology, Peking University First Hospital, Beijing, China, People's Republic of

Purpose:

Magnetic Resonance Spectroscopy (MRS) and Diffusion Weighted Imaging (DWI) play different roles in the detection of prostate cancer (Pca). Their importance in diagnosis may be reflected by their weights. In this study, we make an effort to investigate the performances of MRS and DWI in the detection of Pca by Fisher linear discriminant analysis.

Materials and Methods:

Seventy patients (mean age 68.2±9.3 years, range 52-78 years) with biopsy-proved prostate peripheral zone cancer were retrospectively evaluated in this study. The prostate peripheral zone was divided into 6 regions (left/right bottom, middle and tip). According to the pathological results obtained by ultrasound guided systemic biopsy, the locations of the prostate cancerous region were marked as one or more of the sextants. All patients were examined by single-shot diffusion-weighted echo-planar imaging (TR 3000 ms, TE 56.7 [b =500 s/mm^2] or 76.7 [b =800 s/mm^2] ms, field of view 24×24 cm, matrix size 96×96, section thickness 6 mm, no intersection gap) and 1H MRS PROSE sequence (TR 1000 ms, TE 130 ms, field of view 11×11 cm, matrix size 16×8, NEX 1) at 1.5T system (Twinspeed, GE Medical Systems). Totally 228 regions were available for both DWI and 1H MRS measurement. ADC values and the ratios of (Choline+Creatine)/Citrate in each region were calculated for the weight analysis.

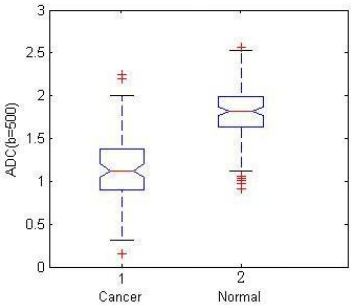

Fig. 1 The box plot of the ADC values (b = 500 s/mm2)

Fisher Linear Discriminant Analysis (FLDA):

Given a pair of classes with means m_1, m_2, the goal of FLDA is to find the linear projection, x, which maximizes the contrast criterion $J(x)$, the ratio of inter-cluster distance to intra-cluster variance:

$$J(x) = (x'S_B x)/(x'S_w x)$$

where

$$S_w = \sum_{k=1}^{2} \sum_{x \in C_k} (x - m_k)(x - m_k)'$$

and

$$S_B = (m_1 - m_2)(m_1 - m_2)'$$

are the intra-cluster variance and inter-cluster distance, respectively. When $x = S_w^{-1}(m_1 - m_2)$ is satisfied, $J(x)$ reaches the maximum.

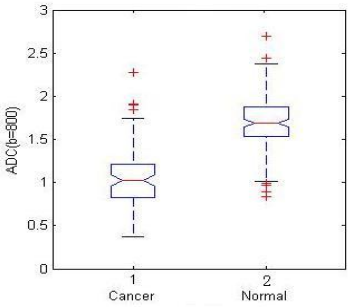

Fig. 2 The box plot of the ADC values (b = 800 s/mm2)

Results:

The 228 regions consist of 82 cancerous regions and 146 noncancerous regions. The mean and standard deviation of ADC values (b =500 s/mm2) are 1.8213±0.1126 (mm^2/ s) and 1.1441±0.1710 (mm^2/ s), and those of ADC values (b =800 s/mm2) are 1.7053±0.1040 (mm^2/ s) and 1.0603±0.1362 (mm^2/ s),for the noncancerous regions and cancerous regions, respectively. The mean and standard deviation of (Cho+Cre)/Cit ratios are 1.1197±0.6636 and 2.7062±4.7290 for the noncancerous regions and cancerous regions, respectively. For the detection of prostate peripheral cancer, Fisher weights of ADC values (b =500 s/mm2) and (Cho+Cre)/Cit ratios in FLDA are 0.9388 and -0.0612, respectively. Similarly, Fisher weights of ADC values (b =800 s/mm2) and (Cho+Cre)/Cit ratios are 0.9374 and -0.0626, respectively.

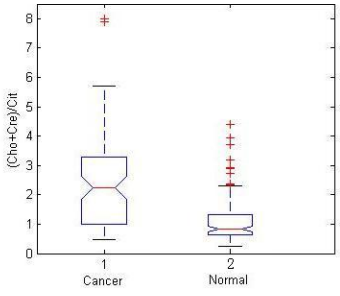

Fig. 3 The box plot of the ratios of (Choline+Creatine)/Citrate

Conclusion:

The results of weight analysis show that the weight of ADC is much higher than that of (Cho+Cre)/Cit ratio, which suggests that DWI is more efficient in the detection of Pca.