学 位 論 文 の 要 旨

氏名　吉田理佳

学 位 論 文 名	Computed Diffusion-weighted Imaging Using 1.5-T Magnetic Resonance Imaging for Prostate Cancer Diagnosis
発 表 雑 誌 名 (巻, 初頁-終頁, 年)	Clinical Imaging (in press)
著 者 名	Rika Yoshida, Takeshi Yoshizako, Takashi Katsube, Yukihisa Tamaki, Noriyoshi Ishikawa, Hajime Kitagaki

論 文 内 容 の 要 旨

INTRODUCTION

Diffusion-weighted and magnetic resonance imaging (DWI and MRI, respectively) are now being widely used in the body cancer imaging for detection, characterization, and assessment of treatment response. It has been reported that DWI obtained with ultra-high b-values provide good contrast between cancerous and background tissue for a better prostate cancer (PCa) detection.

The Computed DWI (cDWI) is an introduced computational technique that can produce any b-value images from DWI acquired with at least two different b-values. The cDWI technique allows higher b-value images to be obtained with a good SNR (signal noise ratio) at 1.5T MRI because it can suppress background noise while maintaining the original lesion signal.

The cDWIs of b=2000 s/mm2 (cDWIs-2000) in MRI have gradually become known to be useful in detecting prostate cancer compared with measured original DWIs (mDWIs) of low b-value, using 3-T MR systems. To our knowledge, there are few reports about cDWIs-2000 to detect prostate cancer using 1.5-T MR systems.

This study aims are to show the contrast ratio (CR) of computed diffusion-weighted images of b=2000 s/mm2 (cDWIs2000) comparing with measured DWIs of b=1000 (mDWIs1000) and b=2000 (mDWIs2000) for the prostate cancer (PCa) and to evaluate the prostate cancer detection of cDWIs2000 comparison with those of mDWIs using 1.5-T MR systems.

MATERIALS AND METHODS

The study protocol was approved by the Ethics Committee of Shimane University and written informed consent was obtained from all subjects.

mDWIs for 24 patients with PCa were obtained preoperatively at different b-values (0, 1000, 2000 s/mm2) on 1.5-T MR. cDWIs2000 were generated by using two b-value combinations: 0-1000 s/mm2, with image procession using image J and Windows-based calculation formula. cDWIs2000 and mDWIs were evaluated to assess image quality for each DWIs, CRs of cancerous and non-cancerous lesion were evaluated and to compare the detectability of PCa for each DWIs, referencing histopathological findings. Receiver operating characteristic analysis was used.

CRs of cDWIs2000 were significantly higher than those of mDWIs ($p<0.05$ Tukey-Kramer's test). Furthermore the detectability of PCa in cDWIs2000 was as well as that of mDWIs2000. Area under the curve of cDWIs2000 was equivalent to mDWIs2000.

RESULTS AND DISCUSSION

CRs of cDWIs2000 were significantly higher than those of mDWIs ($p<0.05$ Tukey-Kramer's test). Furthermore the detectability of PCa in cDWIs2000 was as well as that of mDWIs2000. Area under the curve of cDWIs2000 was equivalent to mDWIs2000.

The DWIs and ADC map using a high b-value is generally known to be useful to detect prostate cancer on 3T-MRI and 1.5T-MRI. High b-value on mDWI produce decreasing SNR. Using mDWIs2000 on 1.5T MRI unit, it needs more time than only mDWIs1000 in order to obtain the same image quality and mDWIs2000 have the more noise problem. Therefore the high power field system with high SNR fit high b-value on mDWI. The 3.0T MR system is now widely used, there are many hospitals in which only 1.5T MR system is running.cDWI2000 is more effective on 1.5T MR system than on 3.0T MR system.

The previous reports about the detectability of prostate cancer on 3T MRI using cDWIs showed that cDWIs are useful in detecting prostate cancer and are as valuable as mDWIs-2000.

In this study, the diagnostic performance of all methods did not differ significantly, however the sensitivity of cDWI-2000 was superior to that of mDWI. On the other hand, the specificity of cDWIs-2000 was inferior to that of mDWI. Because cDWIs had higher CR than that of mDWI, the readers might more easily detect abnormal signal intensity as a prostate cancer. The cDWIs-2000 by adding the other sequences, such as ADC map and dynamic MRI, may be able to improve specificity.

The cDWI has several advantages. One is that images with high b-values can be obtained regardless of the MR system's ability. Moreover, cDWI can make high b-value images maintain tissue signal intensity without depending on TE. Another possible advantage is that distortion on images with high b-values would be reduced with cDWI. Images with high b-values for the MR

system sometimes suffer from distortion because of the heterogeneity of the gradient field. Such distortion can be reduced with cDWI because images with lower b-values can be used for creating images with higher b-values. Moreover, we do not need special computers or special software to create cDWIs, which means that they do not need to cost extra. We can easily create cDWIs from another hospital's MR DICOM data, unaffected by imaging devices or magnetic forces.

CONCLUSION

CRs of cDWIs2000 appears to be higher than CRs of mDWIs1000 and mDWIs2000. The diagnostic ability of cDWIs2000 for PCa detection was equivalent to mDWIs2000. There is a possibility that cDWIs2000 can replace mDWIs2000.