Self correction of blood flow effect for brain-fluctuation MRI

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INTRODUCTION:

We have reported that the apparent diffusion coefficient (ADC) obtained from diffusion MRI in brain tissue significantly changed during the cardiac cycle because of the water-molecule fluctuation, and this information assist in the diagnosis of idiopathic normal pressure hydrocephalus (I-NPH) [1]. However, these changes (Δ ADC) are affected by the regional cerebral blood flow (rCBF) [2]. To evaluate hemodynamic independent water fluctuation, we corrected the rCBF effect by using the diffusion data itself.

METHODS:

On a 3.0-T MRI, ECG-triggered single-shot diffusion EPI (b = 0, 200, 600 and 1000 s/mm^2) was used with sensitivity encoding and half-scan techniques to minimize the bulk motion. Then, the maximum ADC (ADC_{max}) and minimum ADC (ADC_{min}) in cardiac cycle (perfusion-related diffusion; b = 0 - 200, 0 - 600), and ΔADC (fluctuation-related diffusion; b = 0 - 1000) were determined in the frontal white matter in healthy volunteers (n = 10). These values were compared with the rCBF obtained by pseudo-continuous arterial spin labeling technique. Finally, we corrected Δ ADC by ADC_{max} having the highest correlation with the rCBF, i.e., Δ ADC divided by the perfusion-related diffusion.

RESULTS AND DISCUSSION:

There was significant correlation between Δ ADC and rCBF (Fig. 1), indicating hemodynamic dependence of the Δ ADC. ADC_{max} with b = 0 - 200 had the strongest positive correlation of all perfusion-related diffusion values (Fig. 2). However, no significant correlation was fund between ADC_{min} and rCBF (Fig. 3). There was no significant correlation between corrected-Δ ADC (= Δ ADC / ADC_{max} with b = 0 - 200) and rCBF, indicating the hemodynamic independence of the corrected-Δ ADC.

CONCLUSION:

Corrected-Δ ADC makes it possible to obtain the degree of fluctuation of the water molecules hemodynamic independently in the brain without additional rCBF scan and measurement.

REFERENCES:

[1] Ohno N, et al, *Radiology* 2011; 261: 560-5.
[2] Kan H, et al, *Medical Imaging and Information Sciences* 2011; 28: 23-7.

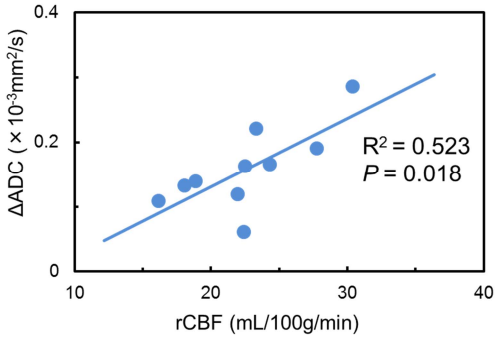

Fig. 1. Relation between ΔADC and rCBF.

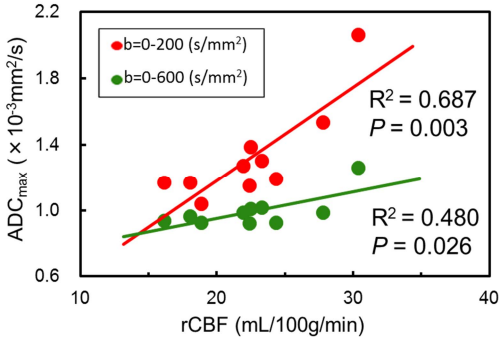

Fig. 2. Relation between ADC_{max} and rCBF with each b value.

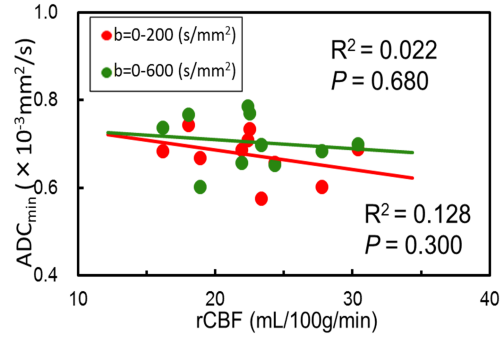

Fig. 3. Relation between ADC_{min} and rCBF with each b value.

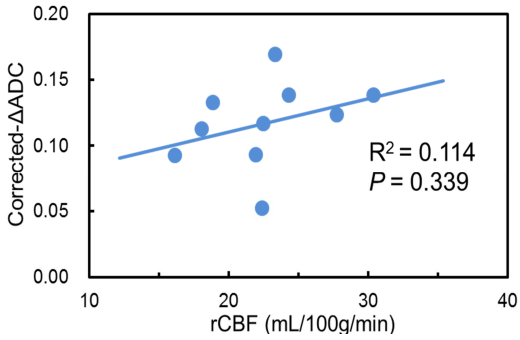

Fig. 4. Relation corrected-Δ ADC and rCBF.