deltaADC

Ohno et al [1] reported that the maximum change in the ADC (deltaADC) reflected the degree of the fluctuation of water molecules and the deltaADC was significantly higher in iNPH. Subsequently, it has been suggested that the deltaADC makes it possible to obtain brain biomechanics information such as intracranial compliance. [2], [3] Kitanaka et al [4] normalized the deltaADC by using regional cerebral blood flow (rCBF), because the deltaADC was affected by the rCBF, which was a driving force for water molecule fluctuation [5].

However, to acquire the rCBF values, an additional scan or examination must be performed, such as arterial spin labeling, dynamic contrast-enhanced study, or nuclear medicine examination. Thus, we speculated that the peak ADC in the cardiac cycle obtained with low b-value data sets (e.g. b = 0 and b ≤ 500 s/mm2) was sensitive to microcapillary perfusion [6] [7] [8].

This perfusion-related diffusion could be simultaneously obtained during a deltaADC scan, and we normalized the blood flow effect of deltaADC by using the perfusion-related diffusion.16 This hemodynamic-independent method, i.e. self-corrected deltaADC, was thought to be useful for obtaining more detailed information on iNPH, because iNPH potentially changed the CBF as well as the intracranial compliance.

Osawa et al. assessed the dynamic changes in the apparent diffusion coefficient (ADC) during the cardiac cycle (deltaADC) of the brain before and after the lumbar tap and shunt surgery for the purpose of determining changes in hydrodynamic and biomechanical properties in the brain after cerebrospinal fluid (CSF) drainage for iNPH.

22 patients suspected to have iNPH were examined before and after the lumbar tap and were divided into patients who showed symptomatic improvements (positive group, n = 17) and those without improvement (negative group, n = 5) after the lumbar tap. Seven patients in the positive group were examined after the shunt surgery.

Field strength/sequence: 1.5T, electrocardiographically synchronized single-shot diffusion echo-planar imaging.

The frontal white matter deltaADC and mean ADC (ADCmean) were compared between before and 24 hours after the lumbar tap and from 1 week to 1 month after the shunt surgery.

Statistical tests: Wilcoxon signed-rank test was used. $P < 0.05$ was considered statistically significant.

The deltaADC after the lumbar tap in the positive group was significantly lower than that before ($P < 0.05$), whereas no significant difference was found in the negative group ($P = 0.23$). After the lumbar tap, deltaADC decreased in 16 of 17 patients in the positive group, whereas ADCmean did not significantly change ($P = 0.96$). After the shunt surgery, deltaADC decreased in all seven patients ($P < 0.05$), whereas ADCmean did not significantly change ($P = 0.87$).

The frontal white matter deltaADC in iNPH decreased after the lumbar tap and shunt surgery. deltaADC analysis may provide detailed information regarding changes in the hydrodynamic and biomechanical properties through CSF drainage.

Level of evidence: 4.

Technical efficacy stage: 4 [9].

To clarify the cause of higher water fluctuation of the brain in idiopathic normal pressure hydrocephalus (iNPH), we assessed change in hemodynamic-independent apparent diffusion coefficient during the cardiac cycle (deltaADC) in iNPH.

Methods: Electrocardiographically synchronized single-shot diffusion echo-planer imaging (b = 0, 500, and 1000 s/mm2) was performed in healthy volunteers, atrophic ventricular dilation group, and iNPH group, respectively. The deltaADC (b = 0 and 1000 s/mm2) and maximum ADC (b = 0 and 500 s/mm2) in the cardiac cycles were measured at the frontal white matter in the brain. Then, self-corrected deltaADC was obtained from the deltaADC divided by the maximum ADC (ADCpeak: perfusion-related diffusion) to correct the blood flow effect.

Results: The deltaADC after correction was significantly higher in the iNPH group than in the other two groups. However, there was no significant difference in ADCpeak values among the groups.

Conclusion: Self-corrected deltaADC in iNPH increased because of changes in the biomechanical properties of the brain. Self-corrected deltaADC analysis makes it possible to obtain information on hemodynamically independent water fluctuation as well as perfusion in iNPH.

Advances in knowledge: Analysis self-corrected deltaADC provides simultaneously information on biomechanical properties, perfusion, and water fluctuation in iNPH [10].

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