Diffusion Weighted MRI in Experimental Hydrocephalus

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Purpose: In this study, we evaluate the sequential apparent diffusion coefficient (ADC) changes of several gray and white matter regions in experimentally induced hydrocephalic cat brain in order to investigate the progression of hydrocephalus in time.

Materials and Method: Hydrocephalus was experimentally induced in three cats. After penetration of the dura with a 25 gauge needle, 1ml of CSF was allowed to drain and an equal amount of sterile kaolin suspension (250 mg/ml) was injected into the cisterna magna. Multislice diffusion weighted MRI studies were performed on a 1.5 T scanner (Vision Plus, Siemens, Elrangen, Germany) at pre-treatment, 3, 7, 14, 21, and 28 days after the kaolin injection. Diffusion sensitized gradients were applied in three principal directions and the ADC trace maps were evaluated using three b-values (0, 500, 1000). The ADC values at periventricular WM, cortical GM, thalamus, and CSF were then estimated.

Results: The calculated ADC of cortical gray matter before kaolin injection was $(0.85\pm0.05)10^{-3}$ mm^2/s, compared with (0.83 ± 0.04) in hydrocephalic cats at 3 days, (0.82 ± 0.07) at 2 weeks, and (0.84 ± 0.09) at 3 weeks. In the periventricular white matter of pre-treated cats, the ADC was $(0.75\pm0.05)10^{-3}$ mm^2/s, compared with (0.70 ± 0.03) at 3 days, (0.65 ± 0.04) at 2 weeks, and (0.60 ± 0.05) at 3 weeks after kaolin injection. The ADC of thalamus was $(0.71\pm0.03)10^{-3}$ mm^2/s before kaolin injection, (0.71 ± 0.02) at 3 days, (0.61 ± 0.04) at 2 weeks, and (0.68 ± 0.05) at 3 weeks. The ADC of CSF increased continuously from $(1.43\pm0.11)10^{-3}$ mm^2/s before kaolin injection to (2.40 ± 0.15) at 3 weeks.

Conclusion: The cytotoxic gray matter edema was not detected in cortical region. The ADC changes of periventricular white matter in time suggest that the white matter is most susceptible to increased intracranial pressure. Thalamus showed initial decrease of ADC values while ADC's were recovered at late phase. It is also noteworth that the ADC of CSF was continuously increases along with ventricular enlargement.