

The temporal evolution of Diffusion kurtosis imaging in ischemic stroke

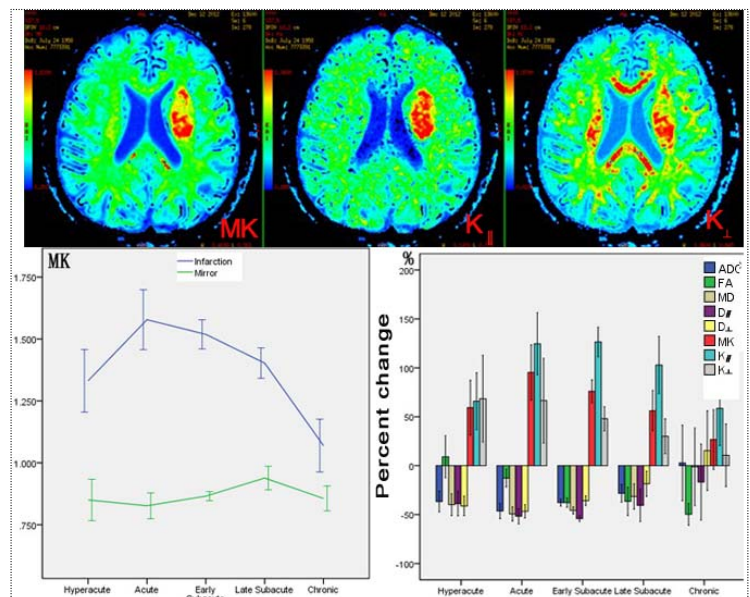
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Objective: Diffusion kurtosis imaging (DKI) is a quantitative measure of the non-Gaussianity of the diffusion process in both white matter and gray matter; it has more advantages over DTI and can yield additional kurtosis information, so DKI may better characterize the complexity or heterogeneity of the tissue microenvironment. The purpose of this study is to investigate the temporal evolution of DKI-derived parameters and their application value in ischemic stroke.

Methods: 114 patients with ischemic stroke were recruited in the study, including 8 cases of hyperacute infarction(<6hours), 14 acute infarction(7~24hours), 60 early subacute infarction(1~7days), 20 late subacute infarction(8~14days), and 12 chronic infarction (15days~2months). All the patients underwent routine DWI and DKI scan($b=0,1250,2500\text{s/mm}^2$). ADC and DKI-derived parameters were obtained within the lesions and contralateral mirror areas with ROI methods. The quantitative parameters includes MK, K_{\parallel} , K_{\perp} ,MD, D_{\parallel} and D_{\perp} .

Results: MK, K_{\parallel} , K_{\perp} map showed heterogeneous high signal in the infarcted area. MK, K_{\parallel} , K_{\perp} elevated to a peak in acute, early subacute phase, then gradually reduced, and tends to normalize. MK value in the infarct area(1.445 ± 0.432) was higher than that in the contralateral mirror area (0.870 ± 0.174)(paired t-test), and so was K_{\parallel} and K_{\perp} . Except for the hyperacute phase, the percent change of K_{\parallel} was higher than K_{\perp} , and D_{\parallel} has more lower amplitude than D_{\perp} . In about each phase of ischemic stroke, the amplitude of percent change of MK, K_{\parallel} , K_{\perp} was over 50%, MK, K_{\parallel} exceeded 100% in acute phase, while the percent change of MD, D_{\parallel} , D_{\perp} were all lower than 50%.



Discussion and conclusion: Based on the results above, it can be predicted that, it is more sensitive to identify ischemic lesions in hyperacute, acute phase with MK, K_{\parallel} , K_{\perp} than with ADC,MD, D_{\parallel} , D_{\perp} . The diffusion change parallel to the axons is greater than that perpendicular to the axons (e.g. myelin). When infarction occurs, axonal injury was the primary cause of infarction, which can be expressed as axonal swelling, endoplasmic reticulum and other intracellular fine structure. The decrease of ADC in infarcted area was mainly due to axonal damage. So diffusion kurtosis imaging can better reflect the microstructure changes in tissue, and is more sensitive in discovering diffusion restricted areas, and can be a complementary method in clinical diagnosis.

References

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