Magnetic Resonance Diffusion Tensor Imaging and 1H Magnetic Resonance Spectroscopy in Ischemic Penumbra

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Strokes are the third-leading cause of death in China, after cardiovascular diseases and cancers. And cerebral infarction is contributed to 75 percent of cerebral vascular diseases. Early diagnosis and the presence of ischemic penumbra (IP) play an important role to treatment, because IP is thought of as the target of most recent treatment of acute infarction. The purpose of our study is to determine the value of DTI and ^{1}HMRS in IP.

Material and Methods

Our series consisted of 40 cerebral infarction patients (24 men, 16 women; age range, 42 to 81 years; median age, 64 years). According to the time of symptom onset, 40 cases were divided into four groups: (1)hyeracute group (<12h), n=4; (2)acute group (≥12h, <24h,) n=21; (3)early subacute group (≥24h, <72h) n=10; (4)late subacute group (≥72h, <7 days), n=5.

Images were acquired using GE 1.5T Twin-speed Infinity with Excite I system with a quadrature head coil. Select different regions of interest (ROIs) in each case, including infarct core and margin (both located in high signal intensity region on DWI), infarct periphery (adjacent to infarct margin and located out of high signal intensity region on DWI), and contralateral normal brain tissue. All images were processed on GE Advantage Windows workstation by Function 2 software. DCavg, FA, NAA, Cho, Cr, Lac, NAA/Cr, Cho/Cr and Lac/Cr were measured.

Results

Changes of parameters on DTI in different regions of infarct lesion

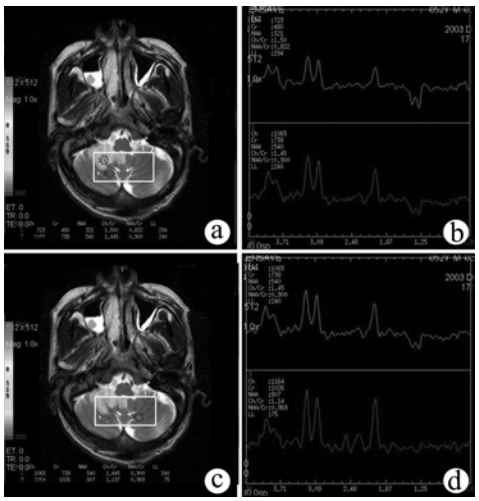
The t test was used to compare DCavg and FA values between infarct core and margin. Their DCavg ratios were significantly different in hyperacute and acute stages (P<0.05), but in early and late subacute stage they could not statistically differ from each other (P>0.05). Their FA ratios were significantly different only in hyperacute stages (P<0.05). DCavg and FA ratios of infarct periphery could not statistically differ from infarct core or margin in any stage (P>0.05).

In 4 of 6 follow-up cases, FA ratios of infarct margin increased than before, but DCavg ratios were still decreased remarkably. In other 2 cases, no obvious change was found. And only one infarct focus of 6 cases showed smaller than before.

Changes of parameters on MRS in different regions of infarct lesion

Comparing DCavg and FA values between infarct core and margin, they were significantly different in hyperacute and acute stages (P<0.001), but in early and late subacute stage they could not statistically differ from each other (P>0.05). Between infarct margin and periphery, their NAA/Cr were significantly different only in acute stages (P<0.001). But between infarct core and periphery, NAA/Cr showed statistically difference in acute and early subacute stages (P<0.001). Cho/Cr showed no statistically difference among three infarct ROIs in any stage (P>0.05).

In hyperacute stage, infarct lesion only demonstrated the presence of Lac without any change of NAA, Cr and Cho. In acute stage, NAA began to decrease accompanied with increased Lac (Fig.).



Conclusions

With the application of DTI and ^{1}HMRS, IP may be present in infarct margin within 24 hours and demonstrates the regions with slightly decreased DCavg, slightly increased Lac, slightly decreased or normal NAA. DCavg is more sensitive than FA in detecting IP. We presume that the ischemic therapy time window may extend to 24h.

Fig. Right cerebellar hemisphere and vermis infarction (hyperacute stage). a and b. Lac peak was in infarct core and margin, and NAA and Cho peaks in infarct core were slightly lower than those in infarct margin. c.and d. Lac peak was also seen and NAA and Cho peaks in infarct periphery were slightly lower than those in normal brain.