Dynamic Evolution of Diffusion Abnormalities of Experimental Spinal Cord Infarction

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Objective

To establish canine spinal cord infarction models by DSA-guided intercostal arteries embolization method and determine dynamic evolution of diffusion abnormalities of experimental spinal cord infarction.

Methods Embolism agent of lipiodol and diatrizoate meglumine was injected into bilateral T9-11 intercostal arteries of six dogs guided by DSA monitor, and thus to embolize the spinal branches of intercostals arteries and establish the canine spinal cord infarciton models. The progression of experimental spinal cord infarction was followed with in vivo dynamic magnetic resonance imaging (MRI) including diffusion weighted imaging by a 1.5 tesla MR system (Philips Intera Master) at post-embolization one hour, two hours, six hours, 24 hours, 80 hours and 168 hours (seven days). Apparent diffusion coefficient (ADC) values were calculated and analyzed. The changes of canine motor functions were also evaluated. At the end of the MRI experiments, spinal cords of animals were fixed for histology.

Results Six experimental models were established successfully. Diffusion-weighted images of all cases showed slight hyperintensity within 1 hour after the onset of spinal cord embolization; whereas only four cases present slight hyper-intensity on T_2-weighted images. Six hours later, ADC value of infarction lesions diminished continuously. At 24 hours ADC value fell to the bottom and then began to increase gradually at 80 hours and later. In these infarction lesions, ADC values of both transverse-diffusion and longitudinal-diffusion diminished. Hemorrhage might present low signal at 24 hours or later on diffusion-weighted images. At the same time, the signal of infarction vertebrae bodies and surrounding tissues also showed series signal changes on both conventional MRI and diffusion weighted imaging. Based on histology, these MRI findings appear to represent hydropic degeneration, hyperemia, hemorrhage and necrosis in spinal cord.

Conclusions ADC values of spinal cord infarction lesions may decrease rapidly at early stage (several hours to one day), and then increase gradually. Dynamic evolution of diffusion abnormality of experimental spinal cord and vertebrae infarction may help us better understand diffusion weighted imaging signals' variety in the process of human spinal cord infarction.

Fig1

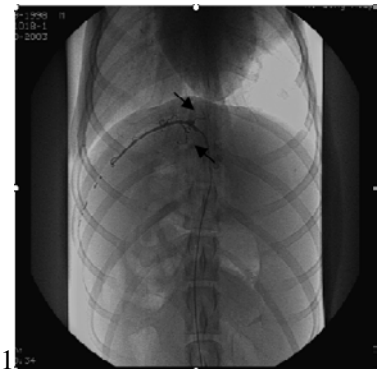

Fig3

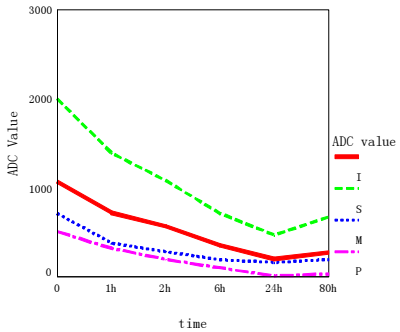

Fig2

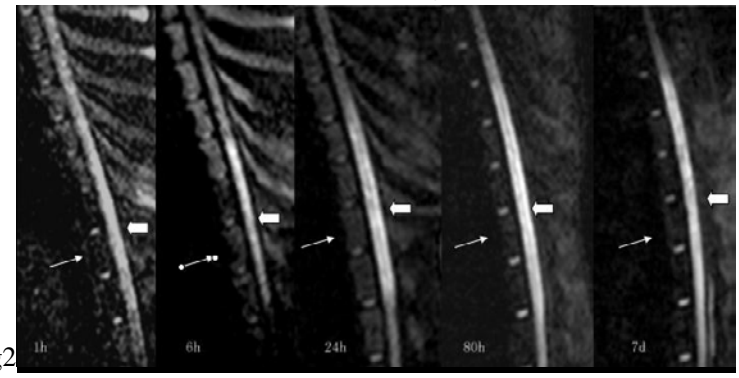

Fig1. Embolization of right T10 intercostal artery and spinal branch (arrows).

Fig2. Dynamic diffusion weighted imaging of experimental spinal cord infarction. (Dog#1, post-embolization 1h, 6h, 24h, 80h, 7d).

Fig3. Time course variation of ADC value in different diffusion direction ($\times 10^{-6}mm^2/s$) after spinal cord infarction