

Exercise Treatment Effect: The Brain Metabolite Change of Magnetic Resonance Spectroscopy in Intracerebral Haemorrhage Rat Model

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Extended Abstract

Intracerebral haemorrhage (ICH) consisting in an acute and spontaneous extravasation of blood into the brain parenchyma accounts for 10–15% of all stroke cases and results in the highest rates of mortality and disability of all stroke subtypes [1]. Magnetic resonance spectroscopy (MRS) has been widely used to diagnose neuro-disease. MRS is a non-invasive and in vivo method with high sensitivity and specificity [2]. The objective of this study were to examine the brain metabolite concentration quantification change by in-vivo ¹H-MRS analysis in animal haemorrhage model, and we determined the bio-marker that was shown the effect of exercise treatment in haemorrhage disease.

The 6-weeks-old 24 Sprague-Dawley rats were anaesthetized with chloral hydrate (400mg/kg, i.p.) and placed in a stereotactic frame, collagenase injected over the next 5min using a pump. The experimental group 12rats were conducted treadmill training. The training program of this research was implemented in 2 weeks with 55 to 85 percent of $\dot{V}O_2\text{max}$ and during determined period 15min one a day. All MRI and ¹H-MRS experiments were performed on a 3.0Tesla MRI scanner (Achiva Tx 3.0 T; Philips Medical Systems, Netherlands) with a maximum gradient of 200 mT/m using a 4-channel animal coil (CG-MUC18-H300-AP, Shanghai Chenguang Medical Technologies Co., Ltd., China). A 8×6×6 mm³ voxel was placed within a whole brain parenchyma with hemorrhage area. The ¹H-MRS raw data were analyzed using LCModel software (version 6.3-¹H, Stephen W. Provencher). The integrating areas under peaks were measured as follows: glutamate (Glu), glutamine (Gln), Choline-containing Compounds (tCho, phosphoryl choline + glycerophosphocholine), N-Acetyl Aspartate (NAA), N-Acetyl Aspartyl Glutamate (NAAG). Less than 15% standard deviation (%SD) of metabolite quantification data was allowed. The %SD called the Cramér-Rao lower bound of useful reliability indicators was used for error estimates. The concentration value of (Glu+Gln)/tCr at experimental group after applying the exercise treatment was 1.838±0.606, which was significantly (p=0.021) higher than control group (1.270±0.283). Although the Glu concentration of experimental group (1.340±0.197) was higher than control group (1.153±0.132), but there was statically insignificant (p=0.067). The tCho/tCr concentration value of experimental group was 0.267±0.012, which was significantly (p=0.000) lower than control group (0.352±0.051). The NAA/tCr and NAAG/tCr of concentration could not separate, the (NAA+NAAG)/tCr concentration value for experimental and control group were 1.258±0.226 and 1.2742±0.093 respectively. No significant difference in the concentration levels of experimental and control group were observed (p=0.839).

There was great significance in revealing that (Glu+Gln)/tCr value was increased, and tCho/tCr concentration level was decrease applying exercise treatment methods on hemorrhage animal model. Therefore, the metabolite concentration change of (Glu+Gln)/tCr and tCho/tCr can be used as a powerful bio-marker that represented an exercise treatment in hemorrhage patients.

References

- [1] V. Beray-Berthat, C. Delifer, V. C. Besson, H. Girgis, B. Coqueran, M. Plotkine, C. Marchand-Leroux, and I. Margail, “Long-term histological and behavioural characterization of a collagenase-induced model of intracerebral haemorrhage in rats,” *J. Neuro Methods.*, vol. 191, pp. 180-190, 2010.
- [2] V. Govindaraju, K. Young, and A. Maudsley. “Proton NMR chemical shifts and coupling constants for brain metabolites,” *NMR in Biomed.*, vol. 13, pp. 129-153, 2000.