EVALUATION OF THE SKELETAL MUSCLE MORPHOLOGICAL TRANSFORMATION BY STRESS

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Introduction:

It is of detection in diffusion Tensor Imaging: DTI that used MRI as for water diffusive motion of internal organ. The water diffusion greatly influences structure of internal organ. The skeletal muscle is especially diffusion anisotropy quality. It can be thought that various myopathy and myofunction can be analyzed by thing to measure diffusion anisotropy of skeletal muscle. This research added stress to the thigh lower skeletal muscle. The change in muscle cell structure by stress was evaluated by water diffusion anisotropy. However, T2-value of the skeletal muscle is very short [1] and SNR is very low. Therefore, it is difficult to evaluate water diffusion anisotropy. To improve SNR [2], single-shot Diffusion Tensor Stimulated Echo -Echo Planner Imaging (ss DT STE-EPI) pulse sequence was developed and mounted at MR scanner.

Material and Method:

DTI was done on a 1.5T MR scanner (signa Horizon Lx Ver.9.0, greatest slope magnetic field strength: 22[mT/m]) using a extreem coil. The pulse sequence programming uses EPIC ver. 9.0 (GE). I performed image analysis by IDL ver6.1 (ITT-vis). The parameter setting of ss DT STE- EPI is TR/ TE/ TM: 4,000/ 44.1/ 208.2[ms], Δ/ δ: 225.9/ 11.4[ms], b-value: 1000[s/mm^2], an MPG axis to impress: 6(xy, xz, yz, -xy, -xz, -yz). The imaging intended for a healthy volunteer (10 example; Age 22.2±1.11) and the part assumed it a lower thigh skeletal muscle (Tibialis Anterior muscle: TA, GAstrocnemius muscle: GA, SOLeus muscle: SOL). At first, we changed b-value (100～1000 [s/mm^2]) and measured diffusion value (FA, λ). We added the stress to the healthy volunteer and measured FA. We rolled the manchette in the muscle and added the stress to the volunteer. In addition, we applied constant stress using the mercury sphygmomanometer. The setting of ROI was set as region where blood vessel in muscle of object and surrounding fat tissue is not included from T1 weighted image acquired simultaneously.

Result and Discussion:

We got FA value of skeletal muscle of the healthy volunteer using SS-DT-STE-EPI. FA value acquired from several steps of b-value [s/mm^2] is shown in Figure 1. In various skeletal muscles, FA value converged in the case of b-value 700-1000 [s/mm^2]. As a result, because perfusion will be reflected in low b-value, it is necessary to impress about at least of b-value 700-1000 [s/mm^2] to the diffusion measurement. Constant stress is applied to the skeletal muscle of the lower thigh, and the result of measuring the FA value is shown in Figure 2(a) and λ 1/ λ 3 value is shown in Figure 2(b). When stress strengthened, FA value became results to rise. This phenomenon is because λ 3 has received the large limit compared with λ 1 by stress. As a result, Water diffusion anisotropy in the skeletal muscle greatly reflects the skeletal muscle cell structure. It reports on diffusion value change by condition and movement. As for it, the influence of not element change but change of structure is thought. The DTI analysis will contribute to new development such as disease diagnosis and sport medicine of the skeletal muscle, etc in the future. It is thought that FA and λ value become important on these development.

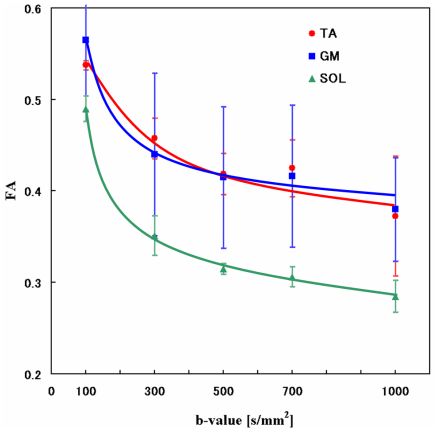

Figure 1. Relation between FA of some skeletal muscles and b-value

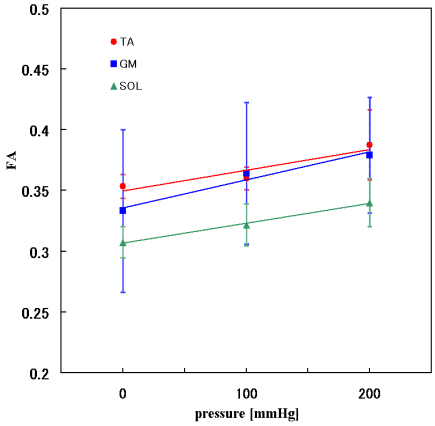

Figure 2(a). FA of some skeletal muscles when added stress

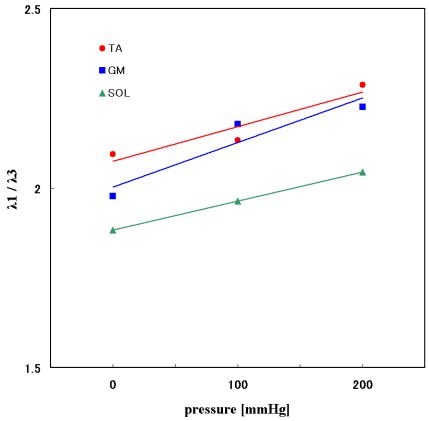

Figure 2(b). λ of some skeletal muscles when added stress

References: [1] Hazlewood et al, Biophysical Journal.14 (8) : 583. (1974) [2] G. Steidle et al, Magnetic Resonance in Medicine 55: 541-548 (2006)