



Texture analysis of magnetic resonance images of rat muscles during atrophy and regeneration

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Résumé en anglais

OBJECTIVES: The goals of the current study were (i) to introduce texture analysis on magnetic resonance imaging (MRI-TA) as a noninvasive method of muscle investigation that can discriminate three muscle conditions in rats; these are normal, atrophy and regeneration; and (ii) to show consistency between MRI-TA results and histological results of muscle type 2 fibers' cross-sectional area.

METHOD: Twenty-three adult female Wistar rats were randomized into (i) control (C), (ii) immobilized (I) and (iii) recovering (R) groups. For the last two groups, the right hind limb calf muscles were immobilized against the abdomen for 14 days; then, the hind limb was remobilized only for the R group for 40 days. At the end of each experimental period, MRI was performed using 7-T magnet Bruker Avance DRX 300 (Bruker, Wissembourg); T1-weighted MRI acquisition parameters were applied to show predominantly muscle fibers. Rats were sacrificed, and the gastrocnemius muscle (GM) was excised immediately after imaging. (A) Histology: GM type 2 fibers (fast twitch) were selectively stained using the adenosine triphosphatase (ATPase) technique. The mean cross-sectional areas were compared between the three groups. (B) Image analysis: regions of interest (ROIs) were selected on GM MR images where statistical methods of texture analysis were applied followed by linear discriminant analysis (LDA) and classification.

RESULTS: Histological analysis showed that the fibers' mean cross-sectional areas on GM transversal sections represented a significant statistical difference between I and C rats (ANOVA, $P < .001$) as well as between R and I rats (ANOVA, $P < .01$), but not between C and R rats. Similarly, MRI-TA on GM transversal images detected different texture for each group with the highest discrimination values (Fisher F coefficient) between the C and I groups, as well as between I and R groups. The lowest discrimination values were found between C and R groups. LDA showed three texture classes schematically separated.

CONCLUSION: Quantitative results of MRI-TA were statistically consistent with histology. MRI-TA can be considered as a potentially interesting, reproducible and nondestructive method for muscle examination during atrophy and regeneration.

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