Ultrasound muscle quality metrics: identifying key markers for sarcopenia diagnosis

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Summary

This study examines the effectiveness of ultrasound-derived muscle quality metrics from six lower-limb muscles in differentiating younger adults, older adults without sarcopenia, and older adults with sarcopenia. The findings suggest that rectus femoris echo intensity, contrast, and homogeneity may serve as key markers for sarcopenia diagnosis.

Introduction

Sarcopenia is a progressive and generalized skeletal muscle disorder [1]. Early detection provides a valuable chance to slow its progression. Muscle quality assessment is increasingly recognized as crucial in confirming sarcopenia. While new methods and metrics for measuring muscle quality are emerging, it remains unclear which muscles and metrics best differentiate younger adults, older adults without sarcopenia, and older adults with sarcopenia. Therefore, this study compares various ultrasound-derived muscle quality metrics from six lower-limb muscles across these groups.

Methods

Study design and participants

This cross-sectional study recruited 40 younger adults (Y: 14 females, 26 males; aged 21-35 years) and 96 older adults (85 females, 11 males, aged 55-92 years). All younger participants were university students, while older adults were recruited from three local communities in Ningbo, China. Sarcopenia was diagnosed in older adults based on the Asian Working Group for Sarcopenia 2019 criteria [2], classifying them into Older Normal (ON: n=82, 69.3±6.42 years) and Older Sarcopenia (OS: n=14, 76.7±8.63 years) groups.

B-mode ultrasonography measures

Ultrasound measurements were performed using a C30L Healson micro-color ultrasound diagnostic system. Scanning sites for the Rectus Femoris (RF), Vastus Lateralis (VL), Biceps Femoris long head (BF), Tibialis Anterior (TA), Medial (MG), and Lateral Gastrocnemius (LG) were based on previous studies [2]. B-mode images were analyzed using grey-scale and gray-level co-occurrence matrix (GLCM) texture analysis (256 gray levels, pixel distance=1, angle=0°) by a custom Matlab program. Muscle thickness, echo intensity, contrast, correlation, energy, and homogeneity of each image were computed and averaged across two scans.

Statistics

One-way ANOVA was performed to assess group differences in muscle quality metrics. If the normality assumption was violated, a Kruskal Wallis test was conducted. Alpha level was set as $p \leq 0.05$, while effect size defined as $\eta^2 \geq 0.0676$.

Results and Discussion

Significant group effects were observed in muscle thickness ($p \leq 0.001, \eta^2 \geq 0.1074$), echo intensity ($p \leq 0.001, \eta^2 \geq 0.1468$), contrast ($p \leq 0.001$, $\eta^2 \geq 0.1360$), energy ($p \leq 0.005$, $\eta^2 \geq 0.0732$), and homogeneity ($p \leq 0.001, \eta^2 \geq 0.2483$) for RF, VL, BF and TA. Correlation ($p \leq 0.001$, $\eta^2 \geq 0.0691$) showed significant group effects for VL, BF, TA, and MG.

Post hoc comparisons revealed significant differences in muscle thickness for RF ($p \leq 0.036$), VL ($p \leq 0.047$) and TA ($p \leq 0.001$) between Y vs. ON, Y vs. OS, and ON vs. OS (Figure 1A). Similarly, significant differences were observed in RF echo intensity ($p \leq 0.034$), contrast ($p < 0.001$) and homogeneity ($p \leq 0.026$) across these comparisons (Figure 1B-D).

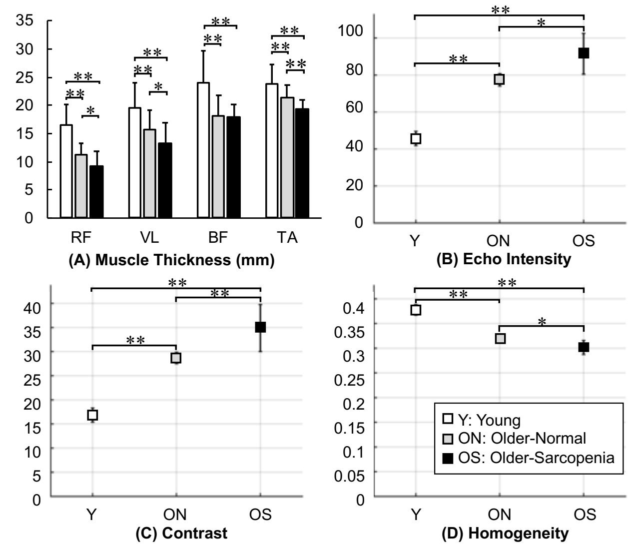

Figure 1: Group differences in muscle thickness (A) and rectus femoris muscle quality metrics (B-D). *$p < 0.05$, **$p < 0.01$

Conclusions

Among the six lower-limb muscles, RF consistently showed group differences in muscle thickness, echo intensity, contrast, and homogeneity, suggesting these muscle quality metrics in RF may serve as reliable markers for sarcopenia diagnosis.

References

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