Abstract: Increased echo intensity of skeletal muscle is associated with exercise intolerance in patients with heart failure

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Topic(s): Chronic Heart Failure - Other

Citation: Background: Skeletal muscle has been shown to be quantitively and qualitatively impaired in patients with heart failure (HF), which is closely linked to lowered exercise capacity, a strong prognostic determinant in HF. The ultrasonic echo in skeletal muscle has emerged as the non-invasive, easily accessible tool to evaluate muscle quality and muscle mass. Specifically, muscle quality can be evaluated by echo intensity (EI), which is reported to represent increased intramuscular fibrous and adipose tissue. Increased EI has been shown to have negative correlations with strength and cardiovascular performance in healthy subjects. In addition, EI has been reported to increase in various disease conditions such as sarcopenia, frailty, neuromuscular disorders, and chronic kidney disease, associated with lowered muscle function and disease severity. Therefore, evaluating skeletal muscle quality by EI in HF patients could be a convenient and valuable approach to assessing muscle function and cardiovascular performance. However, little is known regarding the role of skeletal muscle EI in HF patients.

Purpose: The aim of the study is to investigate whether skeletal muscle echo parameters, especially EI, are associated with exercise capacity in patients with HF.

Methods: Fifty-eight patients with HF (61±12 years, NYHA functional class I-III) and 28 age-matched subjects as controls (58±14 years) were studied. Ultrasound images of the quadriceps femoris muscle were obtained, and quadriceps muscle thickness (QMT) and quadriceps echo intensity (QEI) were determined. Cardiopulmonary exercise testing was performed to evaluate peak oxygen uptake (peak VO₂) and anaerobic threshold (AT). To assess muscle mass and strength, bioelectrical impedance analysis and dynamometry test were conducted.

Results: Age, gender, and past history were comparable between HF patients and controls, whereas BMI was lower in the HF patients. QMT was significantly lower, and QEI was significantly higher in HF patients than controls (5.21±1.10 vs. 6.54±5.34 cm, P<0.001, 88.3±13.4 vs. 81.1±7.5, P=0.010, respectively). Peak VO₂ and AT were significantly lower in HF patients. By univariate analysis, QEI was significantly correlated with Age (r=−0.266, P=0.046), peak VO₂ (r=−0.378, P=0.006), and NYHA class (r=0.395, P=0.023) among HF patients. There was no significant association between QEI and cardiac function, muscle volume, or muscle strength. By multivariate analysis, QEI was independently associated with peak VO₂ after the adjustment of age, gender, body mass index, and QMT (β-coefficient=−11.80, 95%CI [-20.73, -2.86], P=0.011).

Conclusion: The echo-assessed skeletal muscle quantity and quality in HF patients are clearly distinguished from the controls, and the increased echo intensity in skeletal muscle is independently associated with lowered exercise capacity in HF. This practical approach could facilitate the assessment of skeletal muscle abnormalities seen in HF.
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Increased echo intensity of skeletal muscle is associated with exercise intolerance in patients with heart failure.

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Background: Skeletal muscle has been shown to be quantitatively and qualitatively impaired in patients with heart failure (HF), which is closely linked to lowered exercise capacity, a strong prognostic determinant in HF. The ultrasonic echo in skeletal muscle has emerged as the non-invasive, easily accessible tool to evaluate muscle quality and muscle mass. Specifically, muscle quality can be evaluated by echo intensity (EI), which is reported to represent increased intramuscular fibrous and adipose tissue. Increased EI has been shown to have negative correlations with strength and cardiovascular performance in healthy subjects. In addition, EI has been reported to increase in various disease conditions such as sarcopenia, frailty, neuromuscular disorders, and chronic kidney disease, associated with lowered muscle function and disease severity. Therefore, evaluating skeletal muscle quality by EI in HF patients could be a convenient and valuable approach to assessing muscle function and cardiovascular performance. However, little is known regarding the role of skeletal muscle EI in HF patients.

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Conclusion: The echo-assessed skeletal muscle quantity and quality in HF patients are clearly distinguished from the controls, and the increased echo intensity in skeletal muscle is independently associated with lowered exercise capacity in HF. This practical approach could facilitate the assessment of skeletal muscle abnormalities seen in HF.

\[ r = 0.53, P < 0.001 \]
\[ r = 0.29, P = 0.038 \]
\[ r = -0.34, P = 0.002 \]
\[ r = -0.38, P = 0.006 \]