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EDITORIAL

Getting to the heart of the muscle: Sarcopenia in advanced heart failure

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Metabolic disturbances (including sarcopenia, frailty, and cachexia) are associated with reduced survival, functional capacity, and quality of life in patients with heart failure (HF), including those being considered for cardiac transplant and/or durable left ventricular assist device (LVAD) support.[1] Sarcopenia is defined as low muscle strength in conjunction with low muscle quantity or quality.[2] In patients with advanced HF, loss of skeletal muscle mass can precede or coincide with cardiac cachexia, which is defined as an imbalance between catabolic and anabolic mechanisms leading to unintentional weight loss. The loss of muscle in sarcopenia can exist despite increased body fat, a condition called sarcopenic obesity. In addition, sarcopenic patients often exhibit criteria associated with the frailty phenotype, including exhaustion, slow gait speed, and/or diminished exercise tolerance.

Several mechanisms have been proposed to underlie sarcopenia in HF, including neurohormonal changes, inflammation, malnutrition, mitochondrial dysfunction, physical inactivity, and reduced muscle blood flow.[1] To date, preoperative assessment for sarcopenia has not been routinely recommended in society guideline documents for patients being considered for advanced HF therapies, and the field lacks an agreed upon, reproducible, accurate, and reliable measure for sarcopenia. Studies by Dr Cogswell and others,[3,4] however, are closing knowledge gaps in HF-related sarcopenia. In LVAD recipients, reduced preoperative abdominal, erector spinae, psoas, and pectoralis muscle size have been associated with increased postoperative mortality.[3,4] Recent studies by Dr Cogswell and team have focused on the use of computerized tomography (CT)-derived pectoralis muscle area and muscle attenuation for sarcopenia assessment. In a study of durable LVAD recipients, the adjusted hazard of death was reduced 27% for each 1-unit increase in preoperative pectoralis muscle mass index, and 22% each 5-unit increase in pectoralis muscle mean Hounsfield unit (a relative quantitative measurement of muscle radiodensity).[4] In a separate analysis limited to patients in INTERMACS profiles 3 to 4, preoperative reductions in pectoralis muscle mass index and attenuation were associated with inferior 1-year survival following durable LVAD implant, findings that were largely driven by adverse outcomes within the first 3-4 months of implant.[5]

In this issue of the *JHLT*, Dr Cogswell's team[6] identified high pectoralis muscle area and muscle attenuation on preoperative chest CT as protective against postoperative gastrointestinal (GI) bleeding events in LVAD recipients. Each 5-unit increase in pectoralis muscle attenuation (approximated by mean Hounsfield unit) reduced bleeding by 19%, and each 1-unit increase in unilateral pectoralis muscle area (indexed to height) associated with a 17% reduction in incidence rates of postoperative GI bleeding. While the association between preoperative sarcopenia and mortality in a prior study[4] appeared greatest in the first 3-4 months following LVAD implant, in the current study[6] the correlation between preoperative sarcopenia and GI bleeding appeared to persist beyond the early postoperative period (median time to first bleed was 206 days).

The authors should be commended for their continued work highlighting the significance of sarcopenia in advanced HF and for development of any easy to use, readily available sarcopenia assessment tool. As with all analyses, limitations should be noted. First, muscle strength or physical performance, which are key components of the sarcopenia definition, were not assessed and some analyses suggest that muscle strength is superior to muscle mass in predicting adverse outcomes in adults.[2] Importantly, as acknowledged by the authors, correlation between sarcopenia and GI bleeding does not translate to causation. The CT derived sarcopenia assessments may just be identifying patients with confounding pre- and postoperative right

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ventricular (RV) failure, as patients with gastrointestinal bleeding in the lowest tertile of pectoralis muscle mass had several laboratory and clinical features also common to those with RV failure (example: older age, lower serum albumin, higher bilirubin and natriuretic peptides). Also, data on postoperative characterization of RV function was lacking. Additionally, while sex-specific sensitivity analyses were undertaken, pectoralis muscle mass is also heavily influenced by patient age and body mass index (BMI).[7] Thus, it is unclear if a percent predicted value (similar to peak oxygen consumption referencing) for a given patient's age, sex, and BMI may provide greater utility and applicability across different HF patient cohorts. Finally, it is important for readers to be aware that exact Hounsfield unit dynamics can vary from one CT study to another due to differences in CT acquisition and reconstruction parameters (kV, filters, reconstruction algorithms, contrast usage, etc.). While Hounsfield unit ranges are well established for blood, water, bone, etc., small variations in measurement may exist between CT technologies. Therefore, employing patient categorizations using pectoralis muscle assessments performed with CT technologies different from those used in this research study must be done with these important considerations, especially since numerically small differences were noted in Hounsfield unit measurement in those with and without bleeding (mean Hounsfield unit was 25-30 with standard deviations of 8-15).[6]

As the advanced HF field is anticipated to expand LVAD therapy to older individuals and those with multiple comorbidities prohibitive of transplant, the ability to better risk stratify candidates for LVAD implantation using measures of sarcopenia certainly deserves attention. Further investigations are needed to determine if there are patient phenotypes more likely to have persistent sarcopenia following LVAD implant. In patients who remain sarcopenic despite LVAD support, interventions to increase muscle mass and strength need to be established. Physical activity programs, resistance exercise training, and protein and micronutrient supplementation have demonstrated positive effects in older adults with sarcopenia but studies including LVAD recipients are lacking.[1] The impact of exercise rehabilitation and dietary therapy before surgery and during LVAD support as well as the Enhanced Recovery After Surgery care pathways aiming to facilitate early mobility and recovery after surgery need to be investigated.[8]

As we continue to appreciate the impact that modern durable LVAD support has had on patients facing imminent mortality, we must also continue to drive the field forward. A better understanding of sarcopenia and frailty may help the field reduce variability in LVAD recipient outcomes, comfortably expand LVAD therapy to more advanced age patients, and allow for development of targeted interventions in LVAD recipients to improve morbidity and mortality.

Disclosure statement

The authors have no conflicts of interest to disclose.

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References

1. Suzuki T, Palus S, Springer J. Skeletal muscle wasting in chronic heart failure. ESC Heart Fail 2016;5:1099-107.
2. Cruz-Jentoft A, Bahat G, Bauer J, et al. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing 2019;48:16-31.
3. Roehrich L, Sundermann S, Just IA, et al. Comparison of feasibility and results of frailty assessment methods prior to left ventricular assist device implantation [e-pub ahead of print]. ESC Heart Fail 2022. https://doi.org/10.1002/ehf2.13764. accessed July 2, 2022.
4. Teigen L, John R, Kuchnia AJ, et al. Preoperative pectoralis muscle quantity and attenuation by computed tomography are novel and powerful predictors of mortality after left ventricular assist device implantation. Circ Heart Fail 2017;10.
5. Cogswell R, Estep J, Araujo-Gutierrez R, et al. Heart failure severity stratification beyond INTERMACS profiles: a step toward optimal left ventricular assist device timing. ASAIO J 2021;67:554-60.
6. Klajda M, Trachtenberg B, Araujo R, et al. Pre-operative sarcopenia is predictive of recurrent gastrointestinal bleeding on left ventricular assist device support: a multicenter analysis [e-pub ahead of print]. JHLT. http://doi.org/10.1016/j.healun.2022.01.004, accessed July 2, 2022.
7. Kinsey CM, Estepar RSJ, Van der Velden J, et al. Lower pectoralis muscle area is associated with a worse overall survival in non-small cell lung cancer. Cancer Epidemiol Biomarkers Prev 2017;26:38-43.
8. Lindenmuth DM, Chase K, Cheyne C, et al. Enhanced recovery after surgery in patients implanted with left ventricular assist device. J Card Fail 2021;27:1195-202.