Leicester Kidney Exercise Team

SKELETAL MUSCLE QUALITY AS MEASURED BY ECHO INTENSITY CONTRIBUTES TO THE LOSS OF MUSCLE STRENGTH AND FUNCTION IN PATIENTS WITH NON-DIALYSIS CKD.

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Introduction

Skeletal muscle wasting is a characteristic of chronic kidney disease (CKD) resulting in architectural and functional alterations.

Qualitative changes that occur within the muscle of CKD patients also include inter- and intra-muscular adipose tissue (IMAT) accumulation that may contribute to reduce muscle function in this population.

Echo intensity (EI) on ultrasound images of skeletal muscle allows for the quantification of muscle quality based on greyscale analysis and indicates changes in IMAT.

Lean tissue has low EI and appears as black on the image, whilst intra-muscular fat and increases in connective tissue within the muscle give high EI, and appear white.

Currently, it is unknown if muscle quality assessed by EI is associated with muscle function in CKD, or if body composition is associated with IMAT accumulation.

Aims

1. Investigate the association between EI and muscle function in patients with non-dialysis CKD

2. Examine the relationship between muscle EI as a measure of IMAT and body composition.

Methods

22 patients with non-dialysis CKD were included in the analysis (61 ± 9yrs, eGFR 22.4 [9-41] ml/min/1.73m^2).

EI was calculated on ultrasound images of rectus femoris (RF) acquired at the midpoint between the greater trochanter and the superior aspect of the patella.

ImageJ software was used to calculate EI through the pixel count of a region of interest (i.e. RF cross-section) providing a score based on arbitrary units (au) ranging from 0 to 256, where 0 = black (i.e. lean mass); 256 = white (i.e. fat mass).

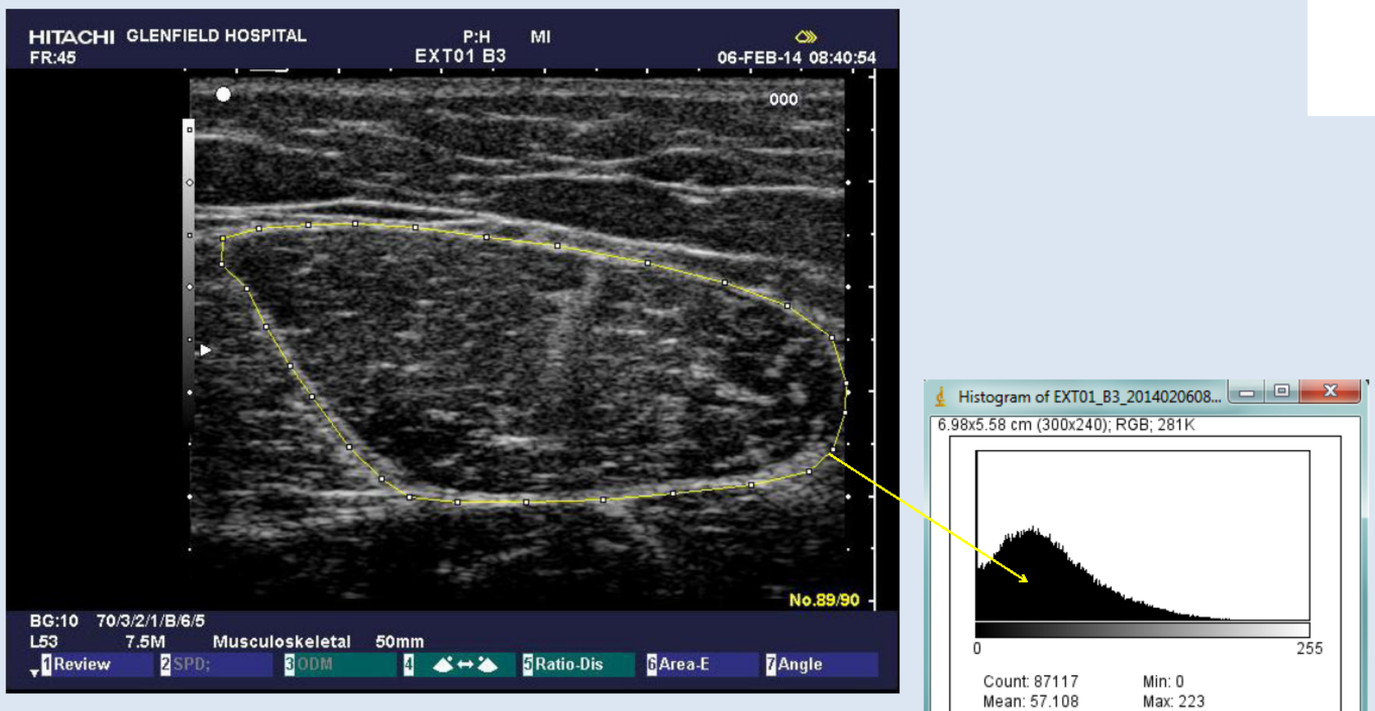

Figure 1. Rectus femoris echo intensity measured using 2D ultrasound & ImageJ analysis

Muscle function was measured as knee extensor strength (estimated 1-RM) and sit to stand (STS) tests (STS5 & STS60)

Body composition (body fat mass [BFkg] and fat percentage [BF%]) was measured using bioelectrical impedance (InBody 370).

Results

Association between EI, strength & function

EI (65.5 ± 17.7au) was negatively associated with est1-RM (47.2 ± 22.3kg, r=-.451, p=.035) and STS60 (28 ± 15reps, r=-.431, p=.033) performance.

No association was found between EI and STS5 scores (12.4 ± 8.0 secs, r= .214, p=.338)

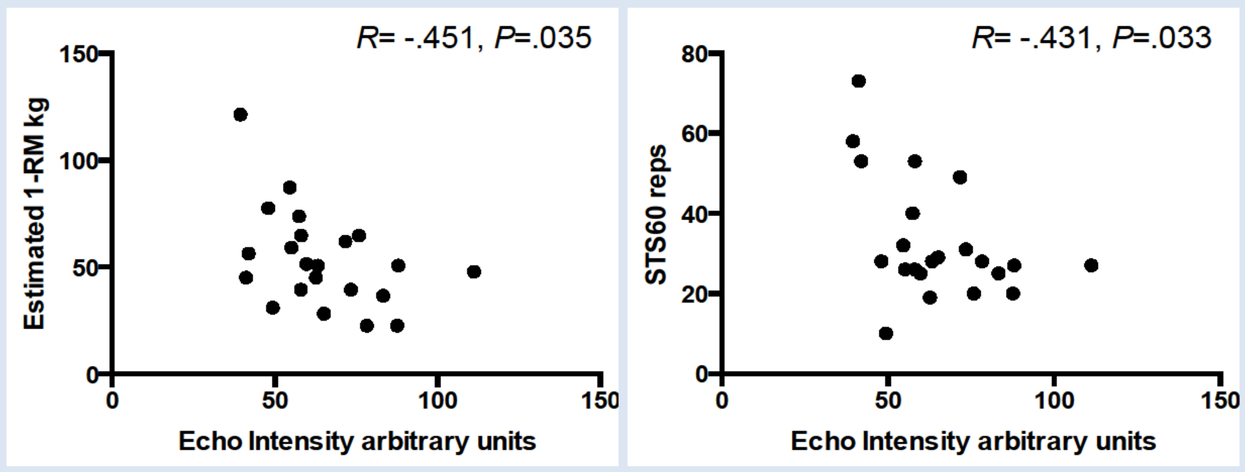

Figure 2. Associations between EI, estimated 1-RM & STS60

Linear regression using these parameters revealed that EI contributes to both reduced muscle strength (B=-.583, R^2=.203) and function (STS60) (B=-.388, R^2=.207, p=.033).

Association between body composition and EI

There were no associations (p>.05) between BMI (29.3 ± 5.6kg/m^2), BFkg (28.7 ± 11.7kg), or BF% (34.9 ± 10.1%) with EI.

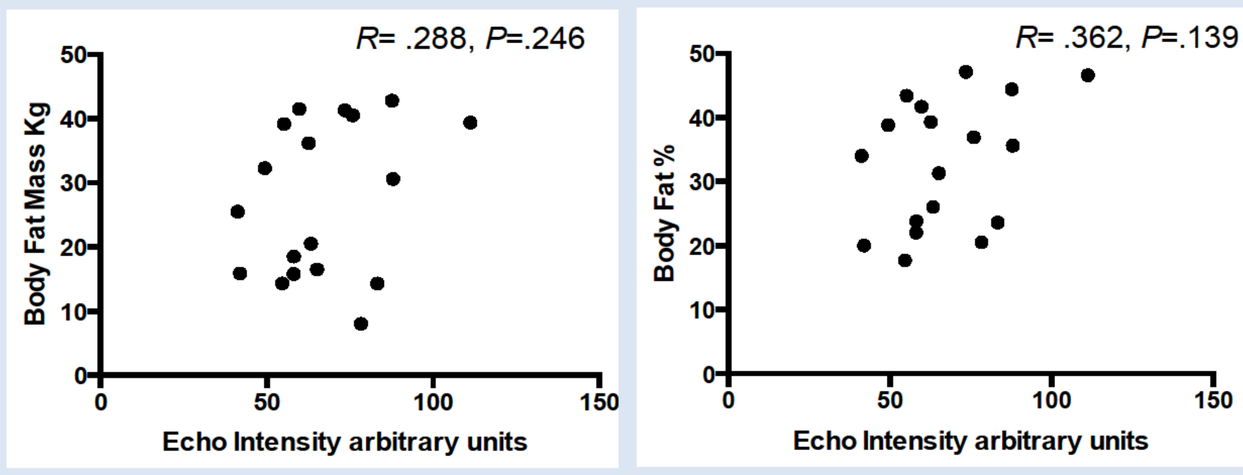

Figure 3. Associations between EI, body fat mass and percentage

Conclusions

These data show that muscle quality, indicated by IMAT and measured as EI, may contribute to loss of muscle strength and function in non-dialysis CKD. This suggests that interventions designed to improve muscle quality may positively impact muscle function.

A lack of association between EI and body composition indicates that IMAT accumulation may occur independently of body fat, and that measures of obesity may not be appropriate surrogates of IMAT.

Future research should aim to identify interventions capable of improving muscle function, in addition to investigating the mechanisms of IMAT accumulation in CKD populations

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