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Ultrasonographic evaluation of the calf muscle mass and architecture in elderly patients with and without sarcopenia

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ABSTRACT

Background/objectives: To sonographically assess the muscle mass and architecture of sarcopenic elderly subjects, and to explore the utility of ultrasound (US) measurements in predicting sarcopenia.
Methods: One hundred elderly subjects were enrolled in this cross-sectional study. Mean age value of our study population was 73.08 ± 6.18 years. The diagnosis of sarcopenia was confirmed by measuring fat-free mass index (using bioelectrical impedance analysis) and handgrip strength. Calf circumference was measured and US evaluations comprised bilateral gastrocnemius muscle (MG) thickness, fascicle length and pennate angles; subcutaneous fat and dermis thicknesses in the calf.
Results: Bilateral muscle thickness and fascicle length values were significantly lower in patients with sarcopenia (both $p < 0.05$). Sarcopenic and nonsarcopenic subjects had similar pennate angles, subcutaneous fat and dermis thicknesses. Median thickness ratio (100 × t (MG)/[t (subcutaneous tissue) + t (dermis) + t (MG)]) values were 64% (40–88%) in the right and 64% (38–86%) in the left calf. Bilateral MG thickness and fascicle length values showed high sensitivity in predicting sarcopenia (all values > 76.92%).
Conclusions: Gastrocnemius muscle thickness and fascicle length values are lower in sarcopenic elderly and these two parameters can serve as alternative measurements for predicting/quantifying sarcopenia. Calf circumference measurements alone may not be appropriate for assessing sarcopenia. Instead, US imaging can conveniently be used to evaluate different compartments of the musculoskelal system in (sarcopenic) elderly.

1. Introduction

Sarcopenia is a geriatric syndrome characterised by progressive and generalised loss of skeletal muscle mass and strength, with a risk of adverse outcomes such as physical disability, falls, poor quality of life and death (Cruz-Jentoft et al., 2010; Visser & Schaap, 2011). The prevalence of sarcopeniais 5–13% amongelderly aged 60–70years and11-50% after the age of80 years (Morley, 2008).The current diagnosis of sarcopenia depends on the measurement of muscle mass and function (Abellan van Kan, Houles, & Vellas, 2012; Chien, Huang, & Wu, 2008). There are different methods for evaluating muscle mass and function but the challenge is to decide which one is the best (Cruz-Jentoft et al., 2010).

Muscle architecture plays an important role in muscle functions (Blazevich, Cannavan, Coleman, & Horne, 2007; Mahlfeld, Franke, & Awiszus, 2004). Pennation angle, fascicle length and muscle thickness are the pertinent parameters measured to assess the structural properties of muscles (Kaya et al., 2013; Scanlon et al., 2014). Further, ultrasound (US) imaging has been shown to be suitable in this regard (Blazevich et al., 2007; Thomaes et al., 2012). There are only a few studies reporting on the evaluation of muscle architecture in sarcopenic subjects and they mainly comprise comparisons between young and elderly subjects (whom were accepted to be sarcopenic without any relevant assessments) (Narici, Maganaris, Reeves, & Capodaglio, 2003; Strasser, Draskovits, Praschak, Quittan, & Graf, 2013). On the other hand, differences between sarcopenic and non-sarcopenic elderly has not been studied yet.

Accordingly, the purpose of this study was two-fold; first we aimed tosonographicallyassess the muscle mass and architecture

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ofsarcopenic elderly subjects; and second we aimed to explore the utilityofsuch measurements in predictingsarcopenia.

2. Materials and methods

2.1. Study design and subjects

In this cross-sectional study, 100 elderly subjects (41 M, 59 F; aged 73.08 ± 6.18 years) who admitted to the outpatient clinic of geriatric medicine were consecutively enrolled. All subjects were evaluated with medical history and standardized clinical examinations.

Co-morbidities (diabetes mellitus, hypertension, coronary heart disease, osteoporosis, hyperlipidemia, hypothyroidism, lung disease, depression, atrial fibrillation) were defined reviewing current medications, using patients' self-report and comprehensive geriatric assessment and laboratory tests.

Patients with pacemaker, prosthesis, severe edema and electrolyte imbalance (owing to the possibility of incorrect measurements of bioelectrical impedance analysis (BIA)) and patients with advanced dementia and severe mobility problems (owing to the difficulties during the tests/measurements) were excluded from study.

This study was approved by the local ethical committee. Subjects were informed about the study procedure and they consented participate were taken.

2.2. Comprehensive geriatric assessment tests

Katz index of independence in activities of daily living (ADL) (Katz, 1983), Lawton-Brody instrumental activities of daily living (IADL) (Lawton & Brody, 1969), Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975), Mini Nutritional Assessment Tool-short form (MNA-SF) (Cohendy, Rubenstein, & Eledjam, 2001), Yesavage geriatric depression scale-short form (GDS-SF) (Burke, Roccaforte, & Wengel, 1991)and Tinetti balance test (Tinetti, 1986; Tinetti, Williams, & Mayewski, 1986) were used.

2.3. Anthropometric parameters

Current weight, height, body mass index (BMI), waist, hip, bilateral mid-upper arm (MAC) and calf circumferences (CC) of all

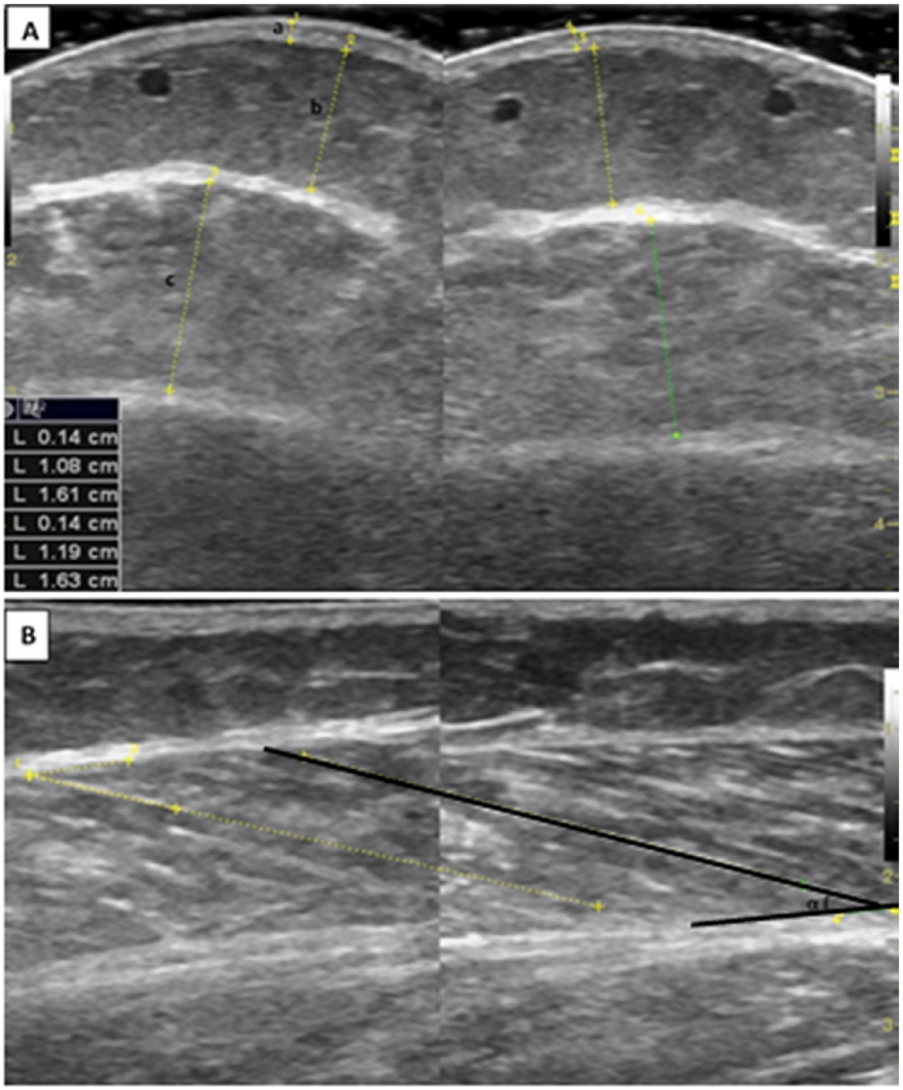

Fig. 1. Comparative ultrasound imaging of the calf region.
On the axial view (A); dermis (a), subcutaneous fat (b) and medial head of the gastrocnemius muscle thickness measurements are illustrated.
On the longitudinal view (B); fascicle length and pennation angle measurements are exemplified from the medial head of the gastrocnemius muscle.