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Original article

Association between nutritional blood-based biomarkers and clinical outcome in sarcopenia patients☆

Salah Gariballa [a, b, *], Awad Alessa [a]

[a] Internal Medicine, Faculty of Medicine & Health Sciences, United Arab Emirates University (UAEU), United Arab Emirates
[b] University of Sheffield, UK

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SUMMARY

Background: Although several micronutrients deficiency were reported to be associated with poor muscle function, however information on sarcopenia patients is still lacking. The aim of this report was to measure some micronutrients blood-based status in sarcopenia patients during both acute illness and recovery.

Design: We assessed nutritional status of randomly selected hospitalised patients using anthropometric, haematological and biochemical data at baseline, 6 weeks and at 6 months. Sarcopenia was diagnosed from low muscle mass and low muscle strength using anthropometric measures based on the European Working Group criteria. Micronutrient status was compared between sarcopenia patients and those without sarcopenia over a 6 months period.

Results: Forty-four out of 432 patients (10%) were diagnosed with sarcopenia on admission. Patients diagnosed with sarcopenia had lower micronutrients concentrations compared to those patients without sarcopenia however, the results were statistically significant only for baseline serum albumin, red cell folate and plasma zinc ($p < 0.05$). Lycopene, retinol, red cell folate and zinc were also significantly lower in sarcopenia patients at 6 weeks. Sarcopenia patients readmitted to hospital had poor baseline micronutrient status compared with sarcopenia patients stayed in the community during the 6-months follow up period but differences were not statistically significant. Both baseline serum albumin and plasma zinc were significantly higher in sarcopenia patients who were alive compared with those died at 6 months follow up.

Conclusion: Baseline serum albumin and plasma zinc concentrations were lower in patients diagnosed with sarcopenia compared to those without sarcopenia, and also in sarcopenia patients who died compared with those alive at 6 months follow up.

1. Introduction

Sarcopenia is defined by presence of low muscle mass and either low muscle strength or performance and associated with poor health outcome, including frailty, falls, disability, hospitalisation and death [1,2]. Causes of sarcopenia are heterogeneous and may include age, chronic disease, increased inflammation, hormonal change, and poor nutrition [3]. Inflammation is known to be part of the mechanism of muscle wasting associated with sarcopenia. In addition inflammation accompanying acute illness has been shown to decrease food intake, nutrient status and leads to increased length of hospital stay and risk of death [4]. Overall there is limited information, about the prevalence of micronutrient deficiencies in sarcopenia patients and whether improving nutritional status would lead to improvement or prevention of sarcopenia [5]. We have recently shown that older people with sarcopenia have increased risk of readmission and mortality following acute illness compared with those without sarcopenia [6]. The aim of this report is to present data on the prevalence of micronutrients deficiency in sarcopenia patients during both acute illness and recovery.

List of abbreviations: CRP, C-reactive protein; EGRAC, Erythrocyte Glutathione Reductase Activity Coefficient.

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* Corresponding author. Internal Medicine, Faculty of Medicine & Health Sciences, United Arab Emirates University (UAEU), United Arab Emirates.
E-mail address: s.gariballa@uaeu.ac.ae (S. Gariballa).

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2. Methods

2.1. Subjects

Four hundred and thirty two unselected acutely ill older patients aged 65–92 years [211 (49%) female] were included. Details of study population were published before [6]. All subjects admitted to Barnsley District General Hospital 7 days a week were considered for the study. Barnsley District General has 650 beds Hospital and serves a total population of 234,000, in South Yorkshire, UK. The hospital medical unit has 250 beds for acute medical admissions. Subjects were first identified through the computerised databases of all patients in hospital. This allowed all patients to be screened for suitability including those admitted over the week end. The medical notes of those identified from the database were examined and eligible patients approached. Common admission diagnoses were ischaemic heart disease, chest infection, chronic obstructive lung disease, heart failure, falls, stroke, syncope, urinary tract infection, anaemia, septicaemia, diabetes, osteoarthritis and fractured limbs were included. Inclusion criteria were: age $\geq$65 years; stable medical condition and able to sign an informed written consent form. Patients excluded from the study were those with severe medical or psychiatric illness including those with malignancy, severe dementia and living in institution. The study received local research ethics committee approval. All patients had baseline clinical assessment such as demographic and medical data, current diagnosis, history of chronic illnesses, smoking, alcohol and drug intake, nutritional status and disability. Follow up assessments at 6 weeks and 6 months were either in hospital or in the community for patients discharged earlier than 6 weeks. Nutritional status was assessed from anthropometric, haematological and biochemical data [6]. Mid-arm circumference and triceps skin folds were measured by a flexible tape and Happened Skin fold callipers accurate to 0.2 mm (Practical Metrology Sussex UK) respectively and the mean of three measures was recorded. All anthropometric measurements were performed using standard methods with intra observer's differences assessed prior to the commencement of the study. The local Pathology Laboratory performed routine tests including haemoglobin, albumin and transferrin measurements. Methods for determination of micronutrient concentrations has been published before [4,6]. Measurement of zinc, copper and selenium was by inductively coupled plasma mass spectrometer (ICP-MS) method (HP 4500; Agilent, Cheadle, Cheshire, UK).

Sarcopenia was diagnosed using the European Working Group on Sarcopenia in Older people criteria of both low muscle mass and strength [1,2].

2.2. Statistical analyses

Statistical analyses were performed with SPSS software, version 22.0 (SPSS Inc., Chicago). Descriptive tests (mean [SD]) were used to describe the baseline characteristics of the subjects. Independent student-*t* test or the nonparametric Mann-u-Whitney was used depending on data distribution to test between group differences with a p-value of <0.05 regarded as statistically significant.

3. Results

All 432 acutely ill older patients who took part in a previously published trial with complete data were included in this analysis[6]. Forty-four out of 432 patients (10%) were diagnosed with sarcopenia on admission. Table 1 shows baseline tissue inflammation C-reactive protein (CRP), plasma proteins, b-group vitamins, antioxidants, and some trace elements at baseline and at 6 weeks follow up following acute illness. Patients diagnosed with sarcopenia had lower micronutrients concentrations compared to those patients without sarcopenia however, the results were statistically significant only for baseline serum albumin, red cell folate and plasma zinc ($p < 0.05$). Lycopene, retinol, red cell folate and zinc were also significantly lower in sarcopenia patients at 6 weeks [Table 1]. Sarcopenia patients readmitted to hospital had poor baseline micronutrient status compared with sarcopenia patients stayed in the community during the 6-months follow up period but differences were not statistically significant (Table 2). Both baseline serum albumin and plasma zinc were significantly higher in sarcopenia patients who were alive compared with those died at 6 months follow up (Table 3).

4. Discussion

We compared micronutrients status including plasma proteins, B-group vitamins antioxidants and trace elements of older patients with sarcopenia and those without sarcopenia over a 6 months follow up period. In addition we compared micronutrients status between survivors and non-survivors and those sarcopenia patients readmitted to hospital with those stayed in the community. As well as poor muscle mass and function we found that sarcopenia patients had poor micronutrient status compared to non-sarcopenia patients.

Although there have been a number of studies examining the role of nutrition in functional decline relating to sarcopenia in the community no data exist for patient in acute and non-acute care settings, hence the importance of these results [7,8]. Possible causes of micronutrients undernutrition in this cohort of patients include inflammation associated with acute and chronic illness which leads to decreased energy intake, increased demands and loss of lean mass [4]. Firstly, inflammation is part of the mechanism of muscle wasting associated with sarcopenia and chronic diseases [9]. Secondly, inflammation and tissue necrosis associated with acute illness is known to be associated with both macro and micronutrient deficiencies [4,9]. Inflammation induced cytokines and reactive oxygen species can directly mediate muscle damage resulting in accumulation of protein carbonyls known to be a powerful independent predictor of low grip strength an important component of sarcopenia [10,11]. Several antioxidants and other nutrients known to protect against inflammation and associated oxidative damage were reported to be associated with muscle strength, physical performance and or sarcopenia [10–12]. Our results reveal low concentrations of a number of nutrients with antioxidant properties including lycopene, retinol, red cell folate and zinc in sarcopenia patients. Lack of adherence to a healthy diet rich in fruits and vegetables reflected by low serum concentration of antioxidants known to protect against inflammation could also have an influence on the development of sarcopenia. For example, several studies have shown that carotenoids protect against or independently associated with sarcopenia [12]. The concentration of vitamin C has also been shown to be a significant determinant of muscle strength in elderly Japanese women [13]. An animal study has shown that treatment with a diet rich in rutin, vitamin E, vitamin A, Zinc and selenium has been shown to improve the ability of the amino acid leucine to stimulate protein synthesis in muscles of old rats independently of an increase in leucine availability. This effect may be mediated through reduction of inflammation and/or oxidative stress however the authors acknowledged the need for further research to determine exact mechanisms involved and possible side effects of antioxidants supplementation [14]. There is also an intense interest in vitamin D as a risk factor for sarcopenia given it is importance in the development of muscle fibres and with deficiency adversely influencing muscle strength and performance [5,15,16]. Although mild to moderate vitamin D deficiency may not be a risk factor for sarcopenia, severe vitamin D deficiency may be associated with increased risk of sarcopenia however further research is needed to elucidate the role of vitamin D in sarcopenia

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