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Original Study

Phenotype of Osteosarcopenia in Older Individuals With a History of Falling

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A B S T R A C T

Objectives: In older persons, the combination of osteopenia/osteoporosis and sarcopenia has been proposed as a subset of frailer individuals at higher risk of institutionalization, falls, and fractures. However, the particular clinical, biochemical, and functional characteristics of the osteosarcopenic (OS) patients remain unknown. In this study, we used a clinical definition of osteosarcopenia aiming to determine the clinical, functional, and biochemical features that are unique to these patients within a population of older people who fall.
Design: Cross-sectional study.
Setting: Falls and Fractures Clinic, Nepean Hospital (Penrith, NSW, Australia).
Participants: A total of 680 people (mean age = 79, 65% women) assessed between 2009 and 2013.
Measurements: Assessment included medical history, physical examination, bone densitometry and body composition by dual-energy X-ray absorptiometry, posturography, grip strength, gait parameters (GaitRITE), and blood tests for nutrition and secondary causes of sarcopenia and osteoporosis. Patients were divided into 4 groups: (1) osteopenic (BMD <−1.0 SD), (2) sarcopenic, (3) OS, and (4) non-sarcopenic/nonosteopenic. Difference between groups was assessed with 1-way ANOVA and χ^2 analysis. Multivariable linear regression evaluated the association between the groups and measures of physical function. Multivariable logistic regression evaluated risk factors for being in the OS group.
Results: Mean age of the OS patients was 80.4 ± 7.0 years. Our analyses showed that OS patients are older, mostly women, are at high risk for depression and malnutrition, have body mass index lower than 25, and showed a higher prevalence of peptic disease, inflammatory arthritis, maternal hip fracture, history of atraumatic fracture, and impaired mobility.
Conclusion: We have reported a set of characteristics that are highly prevalent in OS patients. This study could be used to inform the design of future trials and to develop interventions to prevent institutionalization and poor outcomes in this particular set of high-risk patients.

There are currently 2 epidemics within the aging population: osteoporosis and sarcopenia.[1,2] Unsurprising, there is a subpopulation of elderly individuals who suffer from both diseases, a group that is likely to be at an even higher risk of falls and fractures than those with osteopenia/osteoporosis (OP) or sarcopenia (SP) alone.[3] These individuals are termed as osteosarcopenic for some[3,4] and as sarco-osteoporotic by other groups.[5,6] Despite the multitude of studies

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that have examined the phenotype of SP and OP separately, few have examined the phenotype of individuals with both entities being part of a particular syndrome.[3–6]

The combined effect of SP and OP, otherwise termed "the hazardous duet," is a serious threat to elderly adults, especially when they are frail.[7] The SP propensity for falls compounds the vulnerability of bones in those with OP.[8,9] This combination may result in a hip fracture, an event that would equate to 13.7 potential years of life lost in 65- to 69-year-old women.[10] Furthermore, morbidity and impaired mobility is increased, resulting in an additional years spent in nursing homes.[11]

The general consensus on the interaction between these 2 conditions is that it is first the loss of muscle that reduces bone mineral density (BMD) via a reduction in mechanical loading by gravitational forces, which usually stimulate bone formation.[12,13] If this were indeed the case, it would be interesting to compare those with osteosarcopenia (OS) with those with only OP and only SP, allowing us to hypothesize that those with OS would have a set of particular characteristics exclusive for this group. This differentiation could reveal contrasting pathophysiological processes for the development of OP in individuals with SP, and would facilitate the prediction of OS in older persons, hence requiring different prevention and treatment strategies.

The aim of this study was to understand the phenotype of those with OS, comparing them not only with those who are non-sarcopenic/nonosteoporotic, but also those with only OP and those with only SP. This would provide insight as to the possible risk factors and pathogenesis for the progression of those with OP or SP to eventually become OS, thus increasing their risk for institutionalization, falls, and fractures.

Methods

Participants

This cross-sectional observational study assessed all patients referred to the Falls and Fractures Clinic at Nepean Hospital (Penrith, NSW, Australia) between 2008 and 2013. Referrals were from local general practitioners, medical clinics, and Nepean Hospital wards. Eligibility criteria included Mini-Mental State Examination score higher than 17 of 30, able to mobilize with a walker or cane(s), and willing to attend the clinic, as well as at least 1 of the following: multiple falls (more than 2 in the last year), single fall with established gait and/or balance problem (eg, by Get Up and Go Test), unexplained fall with apparent complex medical cause(s), history of symptomatic or asymptomatic fragility fracture(s) (past 5 years), and clinical or paraclinical (BMD) risk of fractures. This study was approved by the local Human Ethics Research Committee.

Definition of Falls

Falls were defined as "unexpected and involuntary loss of balance, causing the person an undesired contact with the ground."[14] The occurrence of falls was assessed in a retrospective manner, asking participants (1) whether they have suffered a fall, and (2) the number of experienced falls during the 6 months before the day of the assessment.

Fear of Falling

The Survey of Activities and Fear of Falling in the Elderly (SAFFE)[15] was used to assess fear of falling. To facilitate the analysis, a total SAFFE fear-of-falling score (based on a 5-point Likert) was generated as previously described.[16]

Clinical Assessment

Depression was assessed using the Geriatric Depression Scale (GDS). Height was measured with a digital stadiometer. Nutritional assessment was performed by body mass index (BMI) calculation and by completing the Mini-nutritional Assessment (MNA) tool. A comprehensive medical assessment is performed, including comorbidities, family history, fracture history, osteoporosis risk assessment (hormone replacement therapy [HRT], menopause age, smoking, alcohol), falls risk (hearing and visual deficit, altered elimination, impaired mobility), and assessment for postural drop.

BMD and Body Composition by Dual-Energy X-ray Absorptiometry

BMD and body composition (fat and lean mass) were assessed using a Hologic DPX-IQ Discovery Dual-Energy X-ray Absorptiometry machine (GE Healthcare, Pollards Wood, UK). OP was defined using the World Health Organization standard criteria of T-score less than −1.0 SD.

Grip Strength

Grip strength was measured following the Gronigen Elderly Test using a Smedley Hand Dynamometer.[17] The best of 3 attempts (with 30 seconds of rest between them) was recorded.

Gait Assessment

A GAIT Rite (CIR Systems Inc, Havertown, PA) instrumented walkway (810 × 89 × 0.625 cm, sample rate = 80 Hz) was positioned along a straight section of the walkway to record spatiotemporal gait data.

Sarcopenia

SP was determined by fulfillment of at least 2 of the following accepted criteria[18,19]: gait velocity less than 0.8 m per second, grip strength less than 20 kg for women and less than 30 kg for men, and height-adjusted appendicular lean mass (ALM/height^2) less than 5.5 kg/m^2 (women) and less than 7.26 kg/m^2 (men). Patients were then divided into 4 groups: (1) OP (BMD < −1.0 SD), (2) SP,[18,19] (3) OS, and (4) nonsarcopenic/nonosteopenic.

Serum Measurements

Venous blood was collected from resting patients for the measurement of serum 25(OH) vitamin D3 (VitD), parathyroid hormone (PTH), calcium, phosphorus, thyroid stimulating hormone, creatinine, and albumin. Serum VitD concentration was measured by chemiluminescence using the Elecsys 25(OH)D3 assay (Roche Diagnostics, Mannheim, Germany). The intra- and interassay precisions were respectively 7.5% and 10.6% (normal range 10–132 nmol/L). Intact PTH was measured by immunochemoluminometric assay (Immulite 2000, Tarrytown, NY; normal range 12–72 pg/mL). The intra- and interassay precisions were 7% and 5%, respectively. Serum calcium, phosphorus, albumin, and creatinine were determined using automated standard laboratory methods. Because of the high prevalence of hypoalbuminemia in older adults, the serum concentration of albumin and calcium were used to correct the calcium value (calcium corrected value = Ca + 0.8 [40-albumin]). The calcium corrected value was used in the subsequent analysis. The clearance of creatinine was calculated from the Cockcroft formula ([(140 − age in years) × weight in kg/72 × creatinine mol/L]). All measurements