High Prevalence of Sarcopenia and Decreased Muscle Mass in Patients with Osteoporotic Vertebral Fracture

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ABSTRACT: INTRODUCTION: As populations are aging worldwide, the number of patients with osteoporotic fracture such as osteoporotic vertebral fracture is increasing. Because fractured patients consume much public resources such as hospitalization, medication, surgery and nursing care. The financial burden for osteoporosis is getting more critical. On the other hand, sarcopenia, the attenuation of skeletal muscle due to aging, is known to increase the risk of fall and is indicated for the risk factor of the osteoporotic fracture. But the impact in osteoporotic vertebral fracture has never been reported. This study is aimed to estimate the prevalence of sarcopenia in osteoporotic vertebral fracture patients compared with patients from out-patient clinic without vertebral fracture.

METHODS: A total of 265 patients with acute osteoporotic vertebral fracture who were at least 55 years of age were admitted in the study institution from June 2002 to January 2009. All patients underwent whole-body dual energy X-ray absorptiometry (DXA) on admission. These patients were assigned to the vertebral fracture (VF) group (mean age ±SD; 82.3 years±9.4, female ratio; 85.2%). The diagnoses of acute vertebral fracture were confirmed by magnetic resonance imaging for all of the patients in the VF group. A total of 2154 patients without vertebral fracture (mean age ±SD; 69.8 years±11.6, female ratio; 75.4%) from outpatient clinic in the same institute and the same period were assigned to the non-fracture (NF) group. All patients in the NF group underwent whole-body DXA for diagnosis of osteoporosis. Body compositions were measured using whole-body DXA (DPX-NT, GE Medical Systems Lunar, Madison, WI). Bone mineral content, fat mass, and lean soft-tissue mass were measured separately for each part of the body, including the arms and legs. The sum of the lean soft-tissue masses for the arms and the legs were considered to be the appendicular skeletal muscle mass. Since the absolute muscle mass is correlate with height, the appendicular muscle mass index (appendicular SMI) defined as appendicular SMI (kg/height² (m²)) is commonly used to assess sarcopenia. The appendicular SMI is directly analogous to the body mass index (weight / height² (m²)). The criteria of sarcopenia were based on the report by Baumgartner, et al, which defined sarcopenia as below 2 standard deviations of the mean appendicular SMI from young healthy volunteers. [1] The criterion values of appendicular SMI for sarcopenia were below 5.46 kg/m² in female and below 6.87 kg/m² in male for the study population from previous report [2] We simultaneously evaluated bone mineral density (BMD) of whole body. For statistical analyses, we used SPSS for WINDOWS software (version 11.0; SPSS Inc, Chicago, IL). We evaluated the appendicular SMI value and incidence of sarcopenia on continuous variables by using a general linear model to control for covariates such as age and sex, which were highly correlated to appendicular SMI or BMD. Results are expressed as means ± SEs. To determine significant relation between appendicular SMI and BMD, Pearson’s correlation was used. A P value of <0.05 was considered significant.

RESULTS: The Age and the female ratio were controlled to be 71 years and 77% by general linear model. Mean height was 151.9 cm in the VF group and 152.3 cm in the NF group. There was no significant difference (P=0.95). Mean body weight was 48.9 kg in the VF group and 51.8 kg in the NF group (P=0.001). Mean BMD of whole body was 0.93 g/cm² in the VF group and 0.97g/cm² in the NF group (P=0.0001). The appendicular SMI was 5.81 kg/m² in the VF group and 6.13kg/m² in the NF group (P=0.0001). The prevalence of sarcopenia was 49% in the VF group and 31% in the NF group (P=0.01). In overall patients (n=2419), appendicular SMI showed a positive correlation with the whole body BMD (Pearson’s correlation coefficient = 0.42 and P value of <0.001).

DISCUSSION: Muscle plays an essential role in elderly to maintain their functional performance and prevent falls. The mass and strength of muscle decrease with age. Humans lose approximately 20-30% of their skeletal muscle, and the loss accelerates after 65 years of age. Preferential loss of type II muscle fibers (fast twitch muscle) with ageing was identified. This condition, called sarcopenia, had received wide attention in recent years. This study showed the prevalence of sarcopenia in osteoporotic vertebral fracture patient. The prevalence of sarcopenia in vertebral fracture patients (49%) was much higher than in the patients without fracture (31%). The prevalence in fractured patient was quite higher than those previously reported (23%). Severe muscle loss in vertebral fracture patients indicates that sarcopenia is one of the risk factor for compressive vertebral fracture.

Several ways to assess muscle volume have been established. [3] DXA is a standard method for determining skeletal muscle mass. Evaluation of cross sectional area by computed tomography or magnetic resonance imaging is the criterion measurement of body composition, whereas DXA has enough precision and reproducibility, and is more accessible, less invasive, and lower-cost alternative. Technical errors of DXA compared with computed tomography scan was reported to be only 2.5%. Anthropometric measurements such as calf circumference were traditional and convenient way to measure skeletal muscle mass, but the accuracy was inadequate for screening of sarcopenia. Bioelectrical impedance analysis for sarcopenia was also an non-invasive and easy-to-use method. The validity of bioelectrical impedance analysis, however, was not ascertained for the population whose hydration status alters, such as extremely elderly and fractured patient. DXA is currently the preferred method for sarcopenia study. In addition, there was a significant positive correlation between muscle mass and BMD in our study, a finding that is compatible with past reports. The mechanisms underlying disease, such as malnutrition, insufficiency of vitamin D, and lack of physical activity, are common to sarcopenia and osteopenia. Simultaneous muscle and bone loss may cause more severe instability in the frail elderly, which leads to falls and subsequent fracture. Muscle and bone mineral volume regulate by similar factors. [4] Possible causes of sarcopenia include decreased muscle protein synthesis due to dysfunction of sex-hormone, nervous system degeneration such as apoptosis of alpha motor neuron at anterior horn cell of spinal cord, malnutrition with chronic disease, or physical inactivity due to changes of lifestyle with ageing.

In conclusion, this study has revealed that 86% of patients with osteoporotic vertebral fracture had sarcopenia and that bone mineral density correlated with appendicular SMI. Therefore the combination of sarcopenia and osteoporosis poses the potential risk for osteoporotic vertebral fracture. Simultaneous screening for sarcopenia and osteoporosis by DXA serves to determine the patients in need of nutrition support or strength-training.

SIGNIFICANCE: This study is first to demonstrate the higher prevalence of sarcopenia in patients with osteoporotic vertebral fracture than in those patients without fracture.

REFERENCES: