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Original article

Sarcopenia affects conservative treatment of osteoporotic vertebral fracture

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ABSTRACT

Objectives: Sarcopenia and osteoporosis affects activities of daily living and quality of elderly people. However, little is known about its impact on elderly locomotor diseases, such as osteoporotic vertebral fracture (OVF). There is no report investigating the influence of both sarcopenia and osteoporosis on outcomes of OVF. This study aimed to evaluate the clinical outcomes of OVF in elderly patients from sarcopenic perspectives.

Methods: This prospective study was conducted with 396 patients, aged 65 years or more, hospitalized for the treatment of OVF (mean age, 81.9 ± 7.1 years; 111 males, 285 females). The primary outcome was the Japanese Orthopaedic Association (JOA) score for lumbar disease (at first visit, hospital discharge, and 1 year after treatment) and Barthel index (at the same time and before hospitalization). The second outcome was living place after discharge. Susceptibility to sarcopenia and osteoporosis were evaluated and clinical results of conservative treatment were compared.

Results: Sarcopenia significantly affected Barthel index at first visit and discharge. Sarcopenia patients had significantly higher rate for discharge to nursing home and living in nursing home after 1 year than patients without sarcopenia. Osteoporosis significantly affected the JOA score at the first visit and the Barthel index before hospitalization, at the first visit, discharge, and after 1 year. Osteoporosis did not affect the living place at discharge and after 1 year.

Conclusions: Sarcopenia and osteoporosis affected outcomes of conservative treatment for OVF; moreover, sarcopenia affected the living place of OVF patients at discharge and after 1 year.

1. Introduction

Sarcopenia means age-related involuntary loss of skeletal muscle mass (SMI) and function, which was proposed by Rosenberg [1]. Sarcopenia affects activities of daily living (ADL) and quality of life (QoL) of elderly people; however, little is known about an impact on elderly locomotor disease, such as osteoporotic vertebral fracture (OVF). The pathogenesis of sarcopenia is unknown, and prevention and treatment have not been established. Recently, the relationship between sarcopenia and osteoporosis, that is, a positive correlation between bone density and SMI, has been reported [2,3]. Hida et al. [4] reported sarcopenia as a risk factor for OVF. Thus, sarcopenic state in the elderly patients has a potential influence on the outcomes of OVF.

Meanwhile, compared with other countries, aging is proceeding at an unprecedented speed in Japan. With the increasing number of older people increasing in the future, medical and nursing care services are expected to increase. We suggest patients to consider to live an independent life in a familiar place and return home to reduce health care costs.

The aim of this study is to evaluate the outcomes of OVF in elderly patients from sarcopenic perspectives.

2. Methods

This prospective study was conducted on 396 patients (mean

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age, 81.9 ± 7.1 years; 111 males, 285 females), who were 65 years of age or older and who were hospitalized for the treatment of OVF in our department from August 2009 to February 2017. About 336 patients were followed-up after 1 year.

Inclusion criteria were presence of back pain within 1 month and presence of 1 or 2 recent vertebral fractures defined as an abnormal intensity change or fracture line within the vertebral bodies on magnetic resonance imaging. All patients were treated with pain control and rehabilitation under wearing hard corset. The primary outcome variables, observed at first visit, hospital discharge, and 1 year after treatment, were the Japanese Orthopaedic Association (JOA) score for back pain (0–29) [5] and Barthel index (0–100) [6] for evaluation of patient's pain and activity level.

When the patient became able to walk alone with/without walker or T cane, permitted to discharge from the hospital. Our exclusion criteria include: previous back surgery, paralysis, glucocorticoid-induced osteoporosis, pathological fractures, fresh fractures other than vertebral body fractures, bedriddenness before injury, and severe dementia. Body composition was measured using whole-body DXA (iDXA, GE Healthcare, Tokyo, Japan). Osteoporosis was defined as T-score ≤ -2.5 SD in the lumbar vertebrae (L2–4) or femoral neck. The lean soft-tissue mass of the arms and legs was nearly equal to the SMI. Therefore, in the present study, sarcopenia was defined as the loss of SMI of the arms and legs as appendicular skeletal muscle mass (ASM), and SMI was obtained from ASM/height^2 (kg/m^2) [7]. We used the criteria for the Asian Working Group for Sarcopenia (male, <7.00 kg/m^2; female, <5.40 kg/m^2) [8]. Walking speed and hand grip strength were excluded because many patients could not get up.

The second outcome is living place at discharge and after 1 year. We investigated factors relating to home discharge using multivariate analysis. This study has been approved by the ethics and conflicts of interest committee of the National Center for Geriatrics and Gerontology (receipt number 406). Study details have been fully explained to the patients, and those who provided their consent were included in this study.

IBM SPSS Statistics ver. 23.0 (IBM Co., Armonk, NY, USA) was used to carry out statistical analysis, and statistical significance was set at $P < 0.05$. Comparison between the 2 groups (sarcopenia and not sarcopenia) was conducted using the *t*-test and chi-square test. To determine the risk factors that cannot be live at home, multivariable regression analysis was performed.

3. Results

Table 1 shows the patient's characteristics. There were 277 cases (69.9%) and 272 cases (68.7%) in total that met the criteria of sarcopenia and osteoporosis, respectively. There were 102 male (91.9%) and 175 female sarcopenia patients (61.4%) and 61 (55.0%) and 211 female osteoporosis patients (74.0%). The majority of men met criteria for sarcopenia, while osteoporosis was seen in women.

Comparison between patients with sarcopenia patients and patients without sarcopenia is shown in Table 2. Sarcopenia affected Barthel index at first visit ($P < 0.0001$) and discharge ($P < 0.05$) but did not affect it after 1 year. A significantly larger number of sarcopenia patients were discharged to the nursing home than patients without sarcopenia ($P < 0.005$). After 1 year as well, more sarcopenia patients were living at nursing home than patients without sarcopenia ($P < 0.05$).

Comparison between patients with and without osteoporosis is shown in Table 3. Osteoporosis affected the JOA score at the first visit and the Barthel index before hospitalization ($P < 0.01$), at the first visit ($P < 0.05$), at discharge ($P < 0.005$), and after 1 year ($P < 0.05$). Osteoporosis did not affect the living place at discharge and after 1 year.

Multivariable analysis was calculated to predict frequency living in nursing home after 1 year based on Age, sex, Barthel index at discharge, Osteoporosis, Sarcopenia. As the result, both Sarcopenia (odds ratio [OR], 0.46; 95% confidence interval [CI], 0.231–0.918; $P = 0.028$) and Barthel index at discharge (OR, 0.96; 95% CI, 0.95–0.971; $P = 0.0001$) were significant predictors of living in nursing home after 1 year (Table 4).

4. Discussion

OVF affects ADL and QoL of the elderly [9], and the treatment is often treated conservatively [10,11]. In addition to medication analgesic treatment, 1–2 weeks resting on the floor and wearing corset are performed as conservative treatment, but the evidence for its effectiveness is not sufficient [12,13]. Optimal conservative treatment has not been established [13,14]. On the other hand, there is no objection on the importance of the rehabilitation during the acute phase and after the acute phase in conservative treatment of OVF [15,16].

In the present study, osteoporosis was found to affect the outcome of conservative treatment of OVF (JOA at the first visit, the Barthel index at before hospitalization, the first visit, discharge, and after 1 year). However, osteoporosis did not affect the living place at discharge and after 1 year. Dhillon et al. [17] reported that the QoL of patients with osteoporosis is significantly lower than patients without osteoporosis. Osteoporosis itself may contribute to pain [18]. There are some reports that pain was improved by drugs for the treatment of osteoporosis [19,20]. The drugs for the treatment of osteoporosis are effective for prevention of secondary fractures, but the treatment rate in Japan is low [21]. If the treatment rate of osteoporosis improves, a better outcome would be obtained.

Sarcopenia also affects ADL and QoL of elderly people as well [1]. In the present study, age-related decrease in SMI affects short-term outcome of conservative treatment of OVF. Short-term outcome (Barthel index at discharge) and sarcopenia also affected living place at discharge and after 1 year.

To improve the outcome of OVF treatment, it is necessary to

Table 1
Patient characteristics.

Variable	Total (n = 396)	Male (n = 111)	Female (n = 285)	P-value
Age, yr	81.93 ± 7.15	81.81 ± 7.42	82.24 ± 7.0	0.574
Body mass index, kg/m^2	21.32 ± 3.92	20.65 ± 3.72	21.41 ± 4.0	0.069
Skeletal mass index, kg/m^2	5.37 ± 0.92	5.73 ± 0.93	5.23 ± 0.88	<0.0001
L2–4, T-score < −2.5, %	74.13 ± 19.26	82.28 ± 21.27	70.80 ± 17.44	<0.0001
Femoral neck, T-score < −2.5, %	67.19 ± 14.08	73.0 ± 15.06	64.75 ± 13.02	<0.0001
Sarcopenia, %	277 (69.9)	102 (91.9)	175 (61.40)	<0.0001
Osteoporosis, %	272 (68.7)	61 (55.0)	211 (74.0)	<0.0001
Fracture type (stable/unstable)	295 : 101	85 : 26	210 : 75	0.553

Values are presented as mean ± standard deviation or number (%).

Table 2
Comparison between patients with and without sarcopenia.

Variable	Sarcopenia (n = 277)	Without sarcopenia (n = 119)	P-value
Age, yr	82.39 ± 7.26	80.87 ± 0.63	0.053
Sex, male:female	102 : 175	9 : 110	<0.0001
JOA score			
First visit	11.37 ± 3.15	11.79 ± 3.08	0.221
Discharge	17.75 ± 4.71	18.29 ± 4.31	0.079
After 1 yr	20.21 ± 6.08	20.35 ± 5.57	0.848
Barthel index			
Before hospitalization	82.39 ± 20.98	85.0 ± 22.80	0.272
First visit	32.74 ± 26.03	45.67 ± 29.95	<0.000 1
Discharge	65.82 ± 27.16	73.27 ± 27.47	<0.05
After 1 yr	75.83 ± 26.57	78.48 ± 26.61	0.411
Living place (home/nursing home)			
Before hospitalization	257 : 20	112 : 7	0.628
Discharge	86 : 191	55 : 64	<0.005
After 1 yr	164 : 87	66 : 19	<0.05

Values are presented as mean ± standard deviation.
Japanese Orthopaedic Association (JOA) score for back pain (0–29) and Barthel index (0–100) for evaluation of the patient's pain and activity level.

Table 3
Comparison between patients with and without osteoporosis.

Variable	Osteoporosis (n = 275)	Without osteoporosis (n = 121)	P-value
Age, yr	82.32 ± 7.2	81.05 ± 7.0	0.103
Sex, male:female	64 : 211	47 : 74	0.001
JOA score			
First visit	11.26 ± 3.17	12.02 ± 3.0	<0.05
Discharge	17.48 ± 4.74	18.09 ± 4.27	0.226
After 1 yr	19.86 ± 6.07	21.16 ± 5.47	0.068
Barthel index			
Before hospitalization	80.68 ± 23.16	88.80 ± 16.09	<0.01
First visit	34.67 ± 26.93	41.07 ± 29.53	<0.05
Discharge	65.42 ± 25.35	74.5 ± 24.09	<0.005
After 1 yr	74.14 ± 28.03	82.1 ± 22.28	<0.05
Living place (home/nursing home)			
Before hospitalization	253 : 22	116 : 5	0.16
Discharge	94 : 181	47 : 74	0.372
After 1 yr	169 : 64	82 : 21	0.169

Values are presented as mean ± standard deviation.
Japanese Orthopaedic Association (JOA) score for back pain (0–29) and Barthel index (0–100) for evaluation of patient's pain and activity level.

Table 4
Multivariable analysis of factors for predicting life at nursing home after 1 year.

Variable	B	Odds ratio	95% CI	P-value
Age	0.015	1.015	0.976–1.056	0.463
Sex	−0.1	0.905	0.479–1.709	0.759
Barthel index (at discharge)	−0.04	0.96	0.95–0.971	<0.0001
Osteoporosis	0.039	1.040	0.553–1.957	0.903
Sarcopenia	−0.807	0.461	0.231–0.918	<0.05

consider treatment of sarcopenia. Some medications, such as vitamin D and bisphosphonate, for the treatment of osteoporosis had been reported to have a positive effect on muscle volume [22,23]. Elderly female patients have the opportunity to undergo treatment of osteoporosis, which could have potential benefits in improvement of muscle conditions and ADLs. Thus, treatment of osteoporosis including vitamin D administration should be essential for improvement of ADLs in sarcopenic patients with OVF.

Age-related decrease of SMI seems to have considerable impact on the outcomes of locomotor disorders. However, there are few reports on influence of sarcopenia on musculoskeletal disorders. This is the first report regarding influence of sarcopenia on the treatment of OVF. The pathogenesis of sarcopenia mainly includes selective atrophy of type II fibers and decrease in number of myofibers due to decreased muscle regeneration ability [24]. Sarcopenia is a complex disease caused by age-related changes in muscle tissue, malnutrition, deterioration of hormonal environment, and waste atrophy. The development of a specific treatment for sarcopenia remains unresolved. Therapeutic properties for sarcopenia include exercise therapy, nutritional approach, and pharmacological treatment, the most important and well investigated of which are resistance trainings [25]. However, these approaches seem to be difficult for elderly people in the acute phase of fractures. The findings in the present study that sarcopnic patients with OVF had poor outcomes in their ADLs support the importance of rehabilitation programs placed on emphasis on resistance training or aggressive muscle strengthening following acute stage of VCF.

The present study has several limitations, sarcopenia was evaluated in terms of muscle mass but not muscle function. Moreover, walking speed and hand grip strength could not be evaluated in patients with vertebral fractures because they could not carry out relevant tests at admission because of pain.

5. Conclusions

Sarcopenia and osteoporosis affected the outcome of conservative treatment of OVF.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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