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Original article

The impact of sarcopenia on the results of lumbar spinal surgery

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ABSTRACT

Objectives: As the population ages, the number of lumbar spinal surgeries performed on sarcopenic patients will increase. The purpose of this study was to investigate the prevalence of sarcopenia and evaluated its impact on the results of lumbar spinal surgery.

Methods: This study included 2 groups: One group consisted of patients who underwent whole-body dual-energy X-ray absorptiometry (DXA) scanning before the option of undergoing surgery for lumbar spinal disease (LSD group) and a second group consisted of patients underwent DXA scanning for osteoporosis screening under hospital watch at the geriatric medicine department (control group). In order to evaluate the impact of sarcopenia on the clinical outcome of lumbar spinal surgery, the Japanese Orthopedic Association (JOA) score, the recovery rate based on the JOA score, and visual analogue scale (VAS) scores for lower back pain, lower extremity pain, and lower extremity numbness were compared within the LSD group.

Results: The prevalence of sarcopenia showed no statistical difference between groups (control group, 50.7%; LSD group, 46.5%). In the LSD group, while the changes in VAS scores showed no statistical difference between the nonsarcopenia subgroup and sarcopenia subgroup, the sarcopenia subgroup demonstrated inferior JOA scores and recovery rates at the final follow-up when compared with the nonsarcopenia subgroup ($P < 0.05$).

Conclusions: This study demonstrated a high prevalence of sarcopenia among the elderly populations in Japan and a negative impact of sarcopenia on clinical outcomes after lumbar spinal surgery.

1. Introduction

In Japan, people over 65 years old already account for more than a quarter of the total population, and the proportion of aging people in the total population is increasing rapidly. Frailty is a common clinical syndrome in older adults that carries an increased risk for poor health outcomes [1] and is also an independent predictor of postoperative complications, mortality, and reoperation in patients undergoing surgery for adult spinal deformity [2]. Recently, frailty screening of preoperative patients significantly improved surgical outcomes in major surgery [3]. A major component of frailty is sarcopenia, a progressive geriatric syndrome, which was first defined in 1989 by Rosenberg as loss of muscle mass, strength, and function related to ageing [4].

Lumbar spinal diseases such as lumbar canal stenosis cause lower back pain, lower extremity pain, lower extremity numbness, lower muscle weakness, and gait disturbance, resulting in decreased physical function. Moreover, degenerative lumbar spinal diseases cause paraspinal/lower extremity muscular atrophy and fatty change due to muscle denervation and/or disuse [5]. Thus, it appears that lumbar spinal disorders might have a potent influence on the development of sarcopenia. As the Japanese population ages, the number of lumbar spinal surgeries performed on sarcopenic patients will likely increase. However, the precise prevalence of sarcopenia in patients with lumbar spinal disease has not been fully investigated. Presently, since spine surgeons do not yet fully understand the relationship between sarcopenia and lumbar spinal diseases, the effectiveness of spinal surgery on patients with sarcopenia in unknown. Our hypothesis is that patients with lumbar spinal disease have a higher rate of sarcopenia and the effectiveness of spinal surgery in patients with sarcopenia is lower than in

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patients without. The purpose of this study was to investigate the prevalence of sarcopenia in those with lumbar spinal disease and to evaluate the impact of sarcopenia on the results of lumbar spinal surgery.

2. Methods

Our institutional research ethics committee approved this study (approval number: M2016-299) and informed consent was waived since it was a retrospective, anonymized study. We performed a retrospective chart review to identify all patients over 65 years old who underwent whole-body dual-energy X-ray absorptiometry (DXA) (GE Healthcare, Buckinghamshire, UK) at our institution from January 1, 2014 through December 31, 2015.

This study included 2 groups. One group consisted of patients with lumbar spinal disease who underwent DXA scanning for the evaluation of skeletal muscle mass before the option of undergoing surgery (LSD group). The second group consisted of patients underwent DXA scanning for osteoporosis screening at the same period under regular hospital watch at the geriatric medicine department (control group) (Table 1).

The exclusion criteria for both groups included: previous spinal instrumentation surgery with pedicle screws, previous joint surgery with prosthesis, and concurrent serious medical conditions, such as sepsis and terminal malignancy or missing data.

Then, the impact of sarcopenia on spinal surgery results was evaluated within the LSD group. The overall LSD group consisted of patients with lumbar spinal disease who underwent preoperative DXA, the subgroup evaluated were patients that followed through with lumbar spinal surgery.

As for surgery, we performed conventional wide fenestration for lumbar canal stenosis without instability, posterior interbody fusion for lumbar canal stenosis with instability, vertebral column resection for sagittal deformity cases by lumbar compression fracture, and pedicle subtraction osteotomies for lumbar degenerative kyphosis.

Postoperatively, patients with lumbar canal stenosis and lumbar compression fracture received a soft brace for 3 months, patients with lumbar degenerative kyphosis received a hard brace for 6 months. The necessity for postoperative rehabilitation is evaluated based on their postoperative status, such as muscle weakness of lower limbs and/or disabilities in activities of daily living, such as standing, walking, and stair climbing. Rehabilitation methods included leg muscle functional strengthening and endurance, walking exercise, and advice on how to function in daily life.

2.1. Appendicular skeletal muscle mass index

Whole body DXA scans provided total lean body mass, total fat mass, and total body bone mineral content. Appendicular skeletal muscle mass (ASM) was determined by combining the lean tissue mass of arms and legs. ASM index was defined as ASM/height^2 (kg/m^2) [6].

2.2. Definition of sarcopenia

Sarcopenia was diagnosed when the ASM index by DXA was $\leq$7.0 kg/m^2 for male patients and $\leq$5.4 kg/m^2 for female patients, according to the recommended definition of sarcopenia proposed by the Asian Working Group for Sarcopenia [7].

2.3. Clinical outcomes

Clinical outcome was assessed by means of the scoring system proposed by the Japanese Orthopedic Association (JOA). The recovery rate based on the JOA score was calculated according to the following formula: recovery rate = [(postoperative score − preoperative score)/(29 − preoperative score)] × 100% [8]. In addition, a visual analogue scale (VAS) score was used to evaluate the degree of lower back pain, lower extremity pain, and lower extremity numbness.

2.4. Matching technique

The matching technique applied in this study was based on the variables age and sex. One control per LSD case was randomly selected and matched for age and sex from the control population.

2.5. Statistical analysis

We used Fisher exact test with regard to gender, type of lumbar spinal disease, and surgical procedure. The Mann-Whitney *U* test was used to analyze other data. JMP ver. 12 (SAS Institute, Cary, NC, USA) was used for statistical analysis, and p-values less than 0.05 were considered statistically significant.

3. Results

A total of 243 patients were enrolled in this study. The mean age was 78.0 years in the control group and 73.8 years in the LSD group. While 93 (61.2%) were diagnosed with sarcopenia in the control group, 39 (42.9%) were diagnosed with sarcopenia in the LSD group (Table 1). Thus, the prevalence of sarcopenia was higher in the control group ($P < 0.01$); however, the mean age was also higher in the control group ($P = 0.01$). To investigate the influence of lumbar spinal disease on the development of sarcopenia, controlling for age and sex, matching was performed on control and LSD groups. As a result, 71 matched pairs without residual significant differences were created. While 36 (50.7%) were diagnosed with sarcopenia in the matched control group, 33 (46.5%) were diagnosed with sarcopenia in the matched LSD group (Table 2). Thus, there was no difference in the prevalence of sarcopenia in lumbar spinal disease versus geriatric medicine patients.

Next, the impact of sarcopenia on spinal surgery results was evaluated within the LSD group. The overall LSD group consisted of

Table 1
Demographic data of 243 patients.

Characteristic	Control (n = 152)	LSD (n = 91)	P-value
Age, yr	78.0 ± 0.6	73.8 ± 0.7	<0.01*
Sex			0.09
Male	76	35	
Femlae	76	56	
Sarcopenia	93	39	0.01*

Values are presented as mean ± standard deviation or number.
LSD, Lumbar spinal disease.
*P < 0.05, statistically significant differences.

Table 2
Demographic data of matched patients.

Characteristic	Matched control (n = 71)	Matched LSD (n = 71)	P-value
Age, yr	74.6 ± 0.7	74.9 ± 0.6	0.71
Sex			0.73
Male	29	26	
Femlae	42	45	
Sarcopenia	36	33	0.74

Values are presented as mean ± standard deviation or number.
LSD, Lumbar spinal disease.