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Clinical effects of low body mass index on geriatric status in elderly patients

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ABSTRACT

Background: There is limited information on the relationship of low body mass index (BMI) to the geriatric conditions in elderly patients.
Objective: The objective of this study is to investigate whether low BMI associates with geriatric status in elderly patients by calculating suitable cut-off point of BMI for assessment of geriatric conditions.
Method: A total of 1223 elderly patients was enrolled (male/female: N = 472/751), and cut-off point of the BMI values to assess the geriatric status such as aspiration pneumonia, cognitive impairment was determined by receiver operating characteristic (ROC) analyses. Logistic regression analyses were performed to examine the association between several geriatric status and low BMI. Of these patients, 262 patients (male/female: 101/161) had received standard rehabilitation treatment. Functional Independence Measure (FIM) scores were measured both at admission and discharge to calculate FIM gain and efficiency, and retrospective cohort study was performed.
Results: Cut-off point of BMI value to assess the geriatric status was determined (19.0 kg/m^2). Significant associations of low BMI to several geriatric factors such as loss of posterior occlusion, cognitive impairment were observed in both male and female. FIM scores in above cut-off point group were significantly higher than in below cut-off point group in female (FIM gain, P = 0.0005; FIM efficiency, P = 0.0025, Mann-Whitney *U* test). On the other hand, there were no significant differences between low and above BMI cut-off point in FIM scores of male patients.
Conclusion: Low BMI might be a useful parameter to evaluate the geriatric status, and the viewpoint would contribute to decide the care plan for the good end-of-life of elderly.

1. Introduction

Elderly people are considered vulnerable members of society with regard to health, and the number of hospitalized elderly patients has been steadily increasing in worldwide (Arai et al., 2012). An increase of elderly patients, therefore, may force changes in the framework of social welfare such as medical expenses. Aspiration pneumonia is an important cause of death among hospitalized elderly patients (Bosch et al., 2012). In order to assess the diseases activity, blood, urine and sputum samples of elderly patients admitted to the hospital have been collected clinically, and the patients are treated by physicians carefully according to the biochemical diagnosis, resulting in high medical expenses. Whereas family care is considered to be effective for managing several geriatric diseases. Suitable daily care may be performed in their home, if several risk factors of geriatric conditions are found earlier by the caregivers including their families for prevention of the occurrence of geriatric disease such as aspiration pneumonia.

In elderly patients, the frailty such as weight loss, poor physical activity and impaired cognitive activity should be significant risk of geriatric diseases (Marzetti et al., 2017). Deschamps reported previously that weight loss of elderly people appears to be associated with severity of cognitive impairment, and the malnutrition should be one of major problems of cognitive impairment (Deschamps et al., 2002). Nutritional evaluation might be an important first step to screen the elderly people who are malnourished or are at risk of geriatric diseases. Despite the extensive diagnostic testing, however, the precise evaluation for the geriatric risk of elderly patients remains problematic because of the complicated and multiple procedures. Although early detection of relevant symptoms of geriatric diseases by the family is very significant clinically for the prevention of serious conditions, a rapid and easy way to identify the geriatric risk is not fully understood.

The body mass index (BMI) is a clinical measure defined by a person's weight in relation to the height (García-Ptacek et al., 2014). It is well-known that both low and high BMI have been associated with

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Table 1
Subjects characteristics.

Subject	N	Age (yr ± SD)	P-value	BMI (kg/m^2 ± SD)	P-value
Total	1223				
Male	472	82.6 ± 6.4	< 0.0001*	19.5 ± 3.9	< 0.0001*
Female	751	85.3 ± 6.6		19.6 ± 3.7	

Statistical analyses between male and female were performed using Mann-Whitney *U* test. SD, standard deviation.
* P < 0.05.

progression of several diseases. High BMI is associated with increased risk of diabetes, vascular disease and hypertension in mid-life (Singh et al., 2010), whereas low BMI may be an early event in cognitive decline in later-life (Mathys et al., 2017). We also showed previously that BMI of elderly patients with either cognitive impairment or aspiration pneumonia were significantly lower (Naruishi et al., 2014). Therefore, we paid attention to the clinical significance of BMI again because of the convenience clinically, although both a mini nutritional assessment (MNA) and measurement of serum albumin levels may be better methods to evaluate the nutritional status of elderly people (Dent et al., 2012).

In the present study, we defined the BMI cut-off point in order to evaluate the risk of geriatric status, and investigated the clinical associations between low BMI and several geriatric status. Our approach will contribute to make a good care plan for elderly people by checking their physical status during daily care using BMI values.

2. Materials and methods

2.1. Subjects and evaluation

A total of 1223 elderly patients with various geriatric disorders such as pneumonia, cerebrovascular disorder and senile dementia, etc. admitted to Tottori Municipal Hospital or Naruto Seagull Hospital between 2012 and 2016 were enrolled (male/female: N = 472/751). Aspiration pneumonia was diagnosed by specialists in internal medicine based on the guideline of Japanese Respiratory Society (Kohno et al., 2013). Cerebrovascular disorder was diagnosed by specialists in neurosurgery. With or without of cognitive impairment of elderly patients was evaluated using the clinical dementia rating scale (CDR) (Moyle et al., 2013). CDR is a well-known test to distinguish unambiguously among elderly people with a wide range of cognitive function. The score is classified as follow: 0, 0.5, 1, 2, 3, and it is defined as score: 0 is “normal”. BMI value of each patient was calculated based on description of medical records in our hospital. The oral conditions of the elderly patients including loss of posterior occlusion, opened lips at all time, nonfunctional tongue movements and presence or absence of remaining/mobile teeth were evaluated by dentists. When the loss/stable of posterior occlusion was assessed, it was defined as “stable” posterior occlusion even if the case of denture wearing. All examinations were performed when the elderly patients were in a stable condition after receiving acute medical care.

Of 1223 patients, the physical ability of 262 elderly patients (male/female: 101/161, average age: male, 83.2 ± 6.6 yr, female, 85.9 ± 6.0 yr) was evaluated at admission and again at discharge using Functional Independence Measure (FIM) motor scale (Frankenthal et al., 2014). The 262 elderly patients had received standard rehabilitation treatment by attending physicians including range-of-motion exercises, resistance training, physical restoration, movement exercises, and ambulation exercises during their hospital stay. FIM gain was calculated as the change in FIM score at hospital discharge. FIM efficiency was calculated by subtracting FIM at admission from FIM at discharge and then dividing by the length of stay in days.

All examiners were trained, and the all examinations were performed using the same evaluation standards in order to lessen the inter-examiner error. The exclusion criteria of this study are as follows: 1. patients without an agreement to the oral examination, 2. death cases within 2 weeks after hospitalization, 3. isolated patients for several medical reasons. This study was conducted according to the guidelines described in Declaration of Helsinki, and was approved by the ethics committee of Tottori Municipal Hospital (No. 1153) and Naruto Seagull Hospital (No. 16-0001).

2.2. Statistical analysis

Cut-off points of BMI to evaluate the geriatric status were analyzed with receiver operating characteristic (ROC) curve and their respective areas under the curve (AUC), in which sensitivity is plotted as a function of 1-specificity. The odds ratio (OR) and 95% confidence interval (CI) were calculated using a logistic regression model. To examine the changes of physical ability by rehabilitation during hospitalization, retrospective studies were performed. Differences of FIM scores between each group were analyzed by the Mann-Whitney *U* test, because the data were not normally distributed. Statistical analyses were performed by using JMP® 8 ver. 8.0.2 (SAS Institute Japan, Tokyo), and P values of < 0.05 were considered statistically significant.

3. Results

3.1. Statistical differences of characteristics between male and female

There was significant difference between male and female patients in average age (male, 82.6 ± 6.4 yr, N = 472; female, 85.3 ± 6.6 yr, N = 751, P < 0.0001, Mann-Whitney *U* test) (Table 1). On the other hand, there was no significant difference between male and female in BMI (male, 19.5 ± 3.9 kg/m^2, N = 472; female, 19.6 ± 3.7 kg/m^2, N = 751, P = 0.62, Mann-Whitney *U* test).

3.2. ROC analyses for determining cut-off points of BMI to evaluate the geriatric status

Fig. 1 shows that ROC curves determining BMI cut-off point to evaluate the geriatric status as follows: aspiration pneumonia, cerebrovascular disease and cognitive impairment. The most appropriate cut-off point of BMI was 18.7 kg/m^2 (sensitivity: 0.70, specificity: 0.65), 19.1 kg/m^2 (sensitivity: 0.55, specificity: 0.57) and 19.0 kg/m^2 (sensitivity: 0.57, specificity: 0.68) to identify the incidence of aspiration pneumonia, cerebrovascular disease and cognitive impairment, respectively. The AUCs were 0.70, 0.56 and 0.65 for aspiration pneumonia, cerebrovascular disease, and cognitive impairment, respectively.

3.3. Statistical differences of characteristics between above and below 19.0 kg/m^2 of BMI

Based on the ROC analyses as shown in Fig. 1, we defined comprehensively that the most appropriate cut-off point of BMI to evaluate the incidence of geriatric status is 19.0 kg/m^2. Table 2 shows the statistical differences of characteristics between above and below cut-off