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Importance of Nutrition Support Team in Pressure Ulcer Control: Examination at One Long-term Care Hospital in Yamaguchi Prefecture

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Abstract Background: Recently, the importance of nutritional management in pressure ulcer control has been pointed out. In this study, we analyzed the relationship between nutritional indicators and the presence or absence of pressure ulcers in order to reveal the importance of nutritional management in pressure ulcer control. **Method:** We investigated 407 inpatients for blood tests, height, weight, BMI, the Ohura-Hotta (OH) scale, nutrition method, living independence, and the presence or absence of pressure ulcers. **Results:** In the comparison of patients with and without pressure ulcer, significant differences were found in gender, nutrition method, serum total protein, serum albumin, hemoglobin concentration, and the OH scales. Multiple logistic regression analysis showed that gender, intravenous nutrition, serum albumin levels, and the OH scale were associated with the presence or absence of pressure ulcers. The results suggest that not only the OH scale, but the nutritional support was also important in the prediction of the pressure ulcer. It was suggested that shifting from intravenous feeding to tube feeding or oral feeding is important. **Conclusion:** we found that pressure ulcer was related to gender, intravenous nutrition, serum albumin level and the OH scale. The importance of nutritional management for pressure ulcer prevention was confirmed.

Key words: pressure ulcers, nutrition, nutrition support team, albumin, OH scale

Introduction

Pressure ulcer is defined as “a localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear,”¹ which arises from impaired blood flow in the capillaries due to continuous pressure, resulting in tissue necrosis from tissue ischemia.² It is often chronic, refractory, and takes a long time to heal because the healing process is interrupted.³ In particular, deep pressure ulcers require concentrated and long-term treatment.⁴ For pressure ulcer

development, many intervening and exacerbating factors are also associated, but the importance of these factors remains unclear.

In a previous study, Nomura et al.⁵ investigated the degree of nutritional disorders by nutritional evaluation, nutritional management methods, and the treatment responsiveness after nutritional therapy was performed in 18 elderly patients with pressure ulcer. As a result of nutritional management by nutrition support team, a therapeutic effect was observed in 12 of 18 cases, and it was reported that this therapeutic response was more common in the oral and tube nutrition groups. As

a previous study using multivariate analysis, Nishizaki et al.⁶ analyzed predictive risk factors for pressure ulcers in end-stage cancer patients undergoing home care, and predicted three factors: joint contracture, hyperactive delirium, and Hb. In addition, Børsting et al. reported in a study of elderly inpatients in Norway that by multiple logistic regression pressure ulcer was related to age, leanness, diabetes, Braden score and length of stay.⁷

As described above, there are few studies that analyze the factors of pressure ulcer development in detail in Japan, so in this study, a large-scale case number of 407 people with consent was obtained at a long-term care hospital consisting of 435 beds in Yamaguchi Prefecture. The purpose of this study was to find out the role of the nutrition support team (NST) by analyzing the factors of pressure ulcer development by multivariate analysis.

Methods

Research design

This study is a single-center, cross-sectional observational study at a long-term care hospital in Yamaguchi Prefecture.

Research subjects

We collected data from medical records including the records by pressure ulcer control team and nutrition support team of elderly people who were hospitalized in our hospital in 2005.

Research method

Height, body weight and BMI were obtained from the medical record. Total protein (TP, g / dL), serum albumin (Alb, g / dL), blood pigment amount (Hb, g / dL), serum creatinine (Cre), mg / dL) and blood urea nitrogen (BUN, mg / dL) were also obtained from the blood tests within 3 months. Ohura-Hotta (OH) scales⁸ was confirmed by the pressure ulcer control team record. We investigated whether the nutrition method at the time of study registration was oral administration, tube administration, or intravenous administration. The degree of independence in daily life was classified according to J, A, B, and C using the same criteria for determining the degree of living independence as the certification for long-term care (Table 1).⁹ Regarding the presence or absence of pressure ulcers, we investigated and confirmed the records by doctors of the pressure ulcer control team.

Table 1 Criteria of the degree of independence in daily life of the elderly with disabilities (degree of bedridden)

Rank J	Although he has some kind of disability, his daily life is almost independent and he goes out on his own. 1. Go out using transportation etc. 2. Go out to the neighborhood
Rank A	Living indoors is largely self-sufficient, but does not go out without assistance 1. Go out with caregiving and live almost out of bed during the day 2. Do not go out often, and sleep and wake up during the day.
Rank B	Living indoors requires some kind of assistance, and mainly lives on the bed during the day, but keeps a sitting position. 1. Transfer to a wheelchair and eat and excrete away from bed 2. Transfer to a wheelchair with assistance
Rank C	Spend all day in bed and need assistance in excretion, eating and changing clothes 1. Turn over on his own 2. Can't turn over on his own

From ref. 9

Statistical analysis

Descriptive statistics were calculated for each item. In the two-group comparison with and without pressure ulcers, the F-test was performed for continuous variables, and the student's t-test was performed for homoscedastic ones. Mann-Whitney's U test was performed for continuous variables with unequal dispersion and discrete variables. For categorical variables, a χ^2 test was performed. For multivariate analysis, multiple logistic regression analysis was performed with the presence or absence of pressure ulcer as the objective variable. At this time, as the nutrition method, dummy variables were created for each of tube administration and intravenous administration with reference to oral administration. The degree of living independence was converted into a discrete variable with J and A as 1, B as 2 and C as 3. First, linearity of the variables was examined, and multiple logistic regression analysis was done with hierarchical backward elimination method. StatFlex ver6.0 was used for the statistical analysis. $P < 0.05$ was considered significant.

Ethical considerations

This study was carried out in accordance

with the Declaration of Helsinki (2013 Fortaleza Amendment) of the World Medical Association and "Ethical Guidelines for Medical Research for Humans" (2014 Ministry of Education, Culture, Sports, Science and Technology / Ministry of Health, Labor and Welfare Notification No. 3). Although this research has not obtained a consent form from the research subjects, the research subjects were guaranteed to have an opportunity to refuse (opt-out) becoming a subject of the study by disclosing the information about the research posted on the hospital homepage. We guaranteed the opportunity (opt-out) to be possible. This study was conducted after an ethical review at Ube Rehabilitation Hospital (approval number E-6) and Yamaguchi University School of Medicine, Department of Health Sciences (approval number 701-1).

Results

Overview of target patients

Table 2 outlines the basic attributes of 407 target patients. The female ratio was 67.8% and the age was 79.3 ± 10.9 years. The nutritional administration method was oral feeding in 84.5%, tube feeding in 14%, and intravenous feeding in 1.5%. The rank B or C

Table 2 Patient basic characteristics (n=407)

	mean \pm SD (numbers for category variables)	median
gender	female:276, male:131	
age	79.3 ± 10.9	81.0
nutrition method	oral:344, tube:57, venous:6	
living independence	J:11, A:72, B:183, C:141	
Height	149.65 ± 11.72	150.0
Weight	42.52 ± 8.29	42.0
BMI	19.05 ± 3.45	18.9
TP	6.12 ± 0.69	6.10
Alb	3.50 ± 0.50	3.50
Hb	11.76 ± 1.70	11.80
Cre	0.73 ± 0.47	0.60
BUN	18.4 ± 9.1	16.6
OH scale	2.69 ± 2.67	3.00

SD: standard deviation, BMI: body mass index, TP: serum total protein, Alb: serum albumin, Hb: hemoglobin, Cre: serum creatinine, BUN: blood urea nitrogen

living independence is 79.6%, which is a characteristic of a long-term care type hospital like our hospital. The mean values of TP, Alb, Hb, Cre, and BUN were all within the standard range, but in Cre and BUN, some cases were significantly out of the standard range. Pressure ulcers were found in 20 cases (4.9%).

Comparison with and without pressure ulcers

Table 3 shows a comparison of the two groups according to the presence or absence of pressure ulcers. When a significant difference test was performed between the two groups, significant differences were found in gender, nutritional administration method, TP, Alb, Hb, and the OH scales. For items for which a significant difference was found, the band graph of the ratio is shown for the category variable, and the distribution of each group is shown for the continuous or discrete variable (Fig. 1). In the group with pressure ulcers, the proportion of males was significantly higher, oral administration was lower, TP and Alb were lower, and Hb was also lower. In addition, the OH scale was

predominantly higher in the group with pressure ulcers.

Multivariate analysis of pressure ulcer development factors

Multiple logistic regression analysis was performed with the presence or absence of pressure ulcer as the objective variable and 14 variables were put as explanatory variables. Then, as shown in Table 4, gender, intravenous administration, Alb, and the OH scales were selected as significantly associated variables as a result of backward elimination. It was found that male patients with parenteral nutrition, low Alb, and high OH scale tend to have pressure ulcers. The absolute value of Z is almost same for the selected four variables, suggesting an equivalent significance of the four variables. Figure 2 shows the odds ratio of the four variables and their 95% confidence intervals. The AUC using the remaining 4 variables was 0.755, suggesting that with these four variables we can satisfactorily predict the pressure ulcer development.

Table 3 Comparison between with and without pressure ulcer

	PU + (n=20)	PU - (n=387)	p-value	statistical method
	mean \pm SD (numbers for category variables)			
gender	female:8, male:12	female: 268, male: 118	0.0059	χ^2 test
age	81.5 \pm 9.3	79.2 \pm 10.9	0.3642	Student's t test
nutrition method	oral:15, tube:2, venous:3	oral:329, tube:55, venous:3	<0.0001	χ^2 test
living independence	J:0, A:0, B:10, C:10	J:11, A:72, B:183, C:141	0.1412	χ^2 test
height	154.10 \pm 12.27	149.42 \pm 11.66	0.0818	Student's t test
weight	42.50 \pm 8.27	43.00 \pm 8.81	0.7918	Student's t test
BMI	18.12 \pm 3.25	19.10 \pm 3.45	0.2169	Student's t test
TP	5.76 \pm 0.56	6.13 \pm 0.69	0.0155	Student's t test
Alb	3.14 \pm 0.51	3.51 \pm 0.49	0.0013	Student's t test
Hb	10.91 \pm 1.82	11.80 \pm 1.68	0.0214	Student's t test
Cre	0.67 \pm 0.45	0.73 \pm 0.47	0.5809	Student's t test
BUN	19.83 \pm 10.96	18.32 \pm 8.97	0.4705	Student's t test
OH scale	4.10 \pm 2.24	2.61 \pm 2.25	0.0065	M-W U test

PU: pressure ulcer, SD: standard deviation, BMI: body mass index, TP: serum total protein, Alb: serum albumin, Hb: hemoglobin, Cre: serum creatinine, BUN: blood urea nitrogen

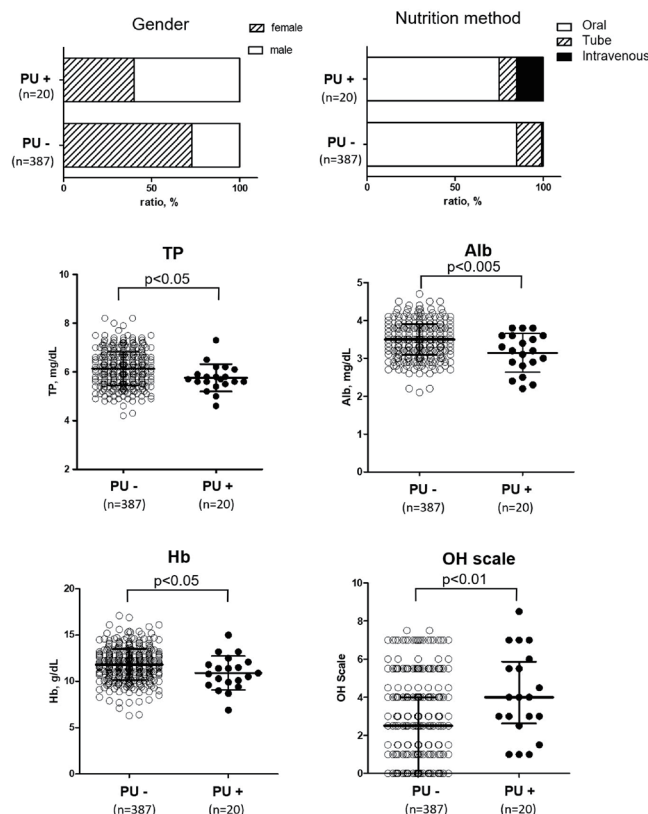


Fig. 1 Graph of items that showed significant difference in univariate analysis
 Gender and nutrition methods show a graph of proportions. Others show a graph of distribution. TP, Alb, and Hb have bars with mean ± SD, and the OH scales have bars with median and quartile deviation.
 PU: pressure ulcer, TP: serum total protein, Alb: serum albumin, Hb: hemoglobin

Table 4 Result of the multiple regression analysis

Objective valuable: pressure ulcer

	model 1 (all valuables included)						model 2 (after elimination)					
	B	SE	Z	P	Odds ratio	95%CI	B	SE	Z	P	Odds ratio	95%CI
0	-5.863	11.16					0.99146	2.11919				
1 gender	-1.437	0.6837	-2.101	0.03561	0.238	0.062-0.908	-1.2218	0.49859	-2.44769	0.0143	0.295	0.111 - 0.783
2 age	0.03929	0.0314	1.251	0.21087	1.04	0.978-1.106						
3 tube	-1.404	0.8779	-1.599	0.10983	0.246	0.044-1.373						
4 venous	2.103	1.288	1.632	0.10267	8.188	0.655-102.293	2.02502	1.01539	1.99433	0.0461	7.576	1.036 - 55.431
5 TP	-0.3224	0.4751	-0.679	0.4974	0.724	0.285-1.838						
6 Alb	-0.087	0.9826	-0.089	0.92945	0.917	0.134-6.290	-1.2616	0.60688	-2.07875	0.0376	0.283	0.086 - 0.930
7 Hb	-0.2608	0.1951	-1.336	0.18141	0.77	0.526-1.129						
8 BUN	0.03909	0.03574	1.094	0.27417	1.04	0.970-1.115						
9 Cre	-1.757	1.156	-1.52	0.12849	0.173	0.018-1.663						
10 height	0.02298	0.06678	0.344	0.73077	1.023	0.898-1.166						
11 weight	0.04274	0.1407	0.304	0.76125	1.044	0.792-1.375						
12 BMI	-0.03543	0.344	-0.103	0.91796	0.965	0.492-1.894						
13 OH scale	0.2584	0.1459	1.772	0.07646	1.295	0.973-1.723	0.25270	0.11786	2.14408	0.0320	1.288	1.022 - 1.622
14 living independence	0.3309	0.5331	0.621	0.53488	1.392	0.490-3.958						

tube: tube nutrition, venous: intravenous nutrition, BMI: body mass index, TP: serum total protein, Alb: serum albumin, Hb: hemoglobin, Cre: serum creatinine, BUN: blood urea nitrogen, CI: confidence interval

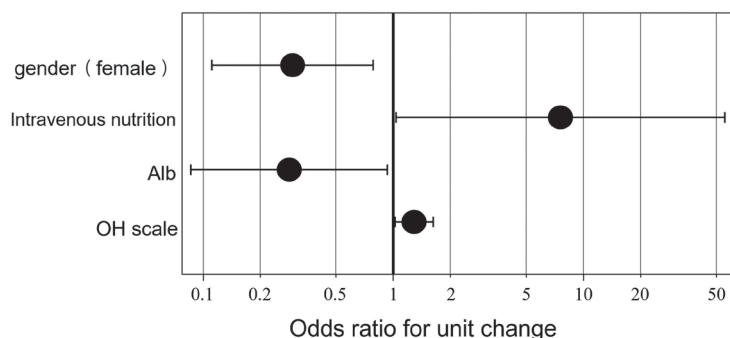


Fig. 2 Odds ratio by multiple logistic regression analysis

The presence or absence of pressure ulcer was used as the objective variable, and all variables were input and analyzed. Gender, intravenous nutrition, Alb, and the OH scales were significantly associated with pressure ulcers. Higher odds (right) are more likely to cause pressure ulcers, and lower odds (left) are less likely to cause pressure ulcers.

Alb: serum albumin

Discussion

In this study, as a result of multiple logistic regression analysis of 407 patients, the OH scale, which has been said to be important so far, Alb and intravenous administration, which are blood tests that sensitively show nutritional status, and gender are the factors that may cause pressure ulcer development. Among these, it is very interesting that only intravenous administration was related to the pressure ulcer, using oral administration as a reference variable. This is valuable evidence showing the importance of shifting from venous nutrition to tube nutrition, and from tube feeding to oral nutrition. Furthermore, it has not been pointed out in previous studies that men are more likely to develop pressure ulcers than women, which is a new finding of this study.

Although the importance of nutritional management in the development and treatment of pressure ulcers is being widely recognized, its scientific basis is by no means sufficient. In 2013, Oura et al.¹⁰ conducted a multicenter, randomized, parallel-group comparative study of the effects of nutritional interventions on nutritional status and pressure ulcer healing, and found that nutritional interventions have a direct effect on reducing pressure ulcer size. Although the study by Oura et al. was a small number of 50 cases, it is a valuable evidence-creating study in Japan

because it was randomly assigned. According to the 2007-2010 “National Survey on NST Activity Status and Operational Effects in Japan” by Higashiguchi et al.,¹¹ the improvement rate of pressure ulcers by NST intervention was 40-50%, and the incidence of new pressure ulcers was 0.5-0.6%. It was reported and suggested the effect of NST.

In Japan, which has entered a super-aging society, pressure ulcer control is an extremely important measure. It is very important to continue to accumulate evidence regarding nutritional management and pressure ulcer development or treatment. We hope that this study will help clarify the causes of pressure ulcers in Japan.

Conclusion

Analysis of the relationship between the various measurement including nutritional indicators and the presence or absence of pressure ulcers revealed a significant relationship with sex, intravenous nutrition, serum albumin level and the OH scale. The association between intravenous nutrition and serum albumin levels suggested the importance of nutritional management and NST intervention for pressure ulcer prevention.

Limitations

Because this is the study using past medical

record of our hospital, only the OH scale was available, while the Braden scale is widely used in these days. However, ability for the prediction of pressure ulcer by the Braden scale and by the OH scale are similar (AUC=0.814 for the Braden score, AUC=0.794 for the OH score).¹²

Conflict of Interest

The authors declare no conflict of interest.

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