

Clinical Report

# The Role of Nutrition in Pressure Ulcer Healing

— the survey of hospitalized elderly patients with pressure ulcers —

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## 褥瘡治療における栄養管理の役割について

— 高齢者褥瘡患者の解析を通して —

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### SUMMARY

With the recent advance of aging society in Japan, the number of the patients with pressure ulcers has been increasing over 10% of two million elderly who are bedridden.

The primary cause of pressure ulcer is the disintegration of skin and subcutaneous tissue for pressure due to voluntary immobility of the patients. Moreover there are other risk factors for development of pressure ulcers, which are the old age and malnutrition. The purpose of this study is to survey the relevance of hospitalized aged patients with pressure ulcers and the role of nutrition therapy in the treatment.

Eighteen elderly patients with pressure ulcer(s) were entered in this study, and their nutritional assessment, nutritional management, and the healing of the wound were investigated. All patients had moderate to severe malnutrition, and over the half of them had suffered from severe pressure ulcers. In our study, there was strong correlation between the healing of pressure ulcer and nutritional management.

The patients with pressure ulcers have mostly been malnourished and needed not only the local wound treatment but the systemic nutritional care via physiological enteral route under the management by the interprofessional team.

Key words : pressure ulcer, malnutrition, elderly patients, interprofessional team medicine  
(nutritional support team :NST)

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## 要 旨

近年の社会の高齢化に伴い、寝たきり患者数は200万人を超え、その10%以上に褥瘡の発生を見る。褥瘡の発生・増悪は直達力の他に、二次的なリスク因子が存在し、加齢に加え、栄養障害が強く相関している。

この論文は、高齢者褥瘡患者についての臨床症例を通して、栄養と褥瘡治療の関連性について検討することである。今回、18名の高齢者褥瘡患者を対象に、栄養評価による栄養障害の程度、栄養管理法、および栄養療法を施行した後の褥瘡の治療反応性について検討した。その結果、対象患者は全例中等度～高度の栄養障害を有し、その半数以上に高度の褥瘡を認めた。チーム医療による栄養管理を行った結果、18例中12例に治療効果を認め、この治療反応性は、経口摂取群、経腸栄養投与群に多く見られた。

以上より、褥瘡患者では栄養障害が存在するため、創傷の局所管理に加えて、チーム医療による全身的な栄養管理をより生理的な栄養投与ルートを紹介して行うことが必要であると考えられた。

キーワード：褥瘡、栄養不良、高齢患者、栄養サポートチーム

## Introduction

Pressure ulcers are defined as a localized damage of the skin and underlying tissue, which develop from continuous pressure that impedes or obstructs capillary blood flow, resulting in tissue ischemia and necrosis. They are chronic and often refractory conditions, in which the healing process is disrupted and takes long-term for cure. Therefore they have been regarded as serious and costly problems within the hospital and the aged care facilities.

Estimates of the prevalence and incidence of pressure ulcers vary, depending on the regions and nations, but it is recognized that high prevalence can be observed in bedridden elderly with malnutrition. In Japan, the study of home care patients over 65 years old by Iizuka et al<sup>1)</sup> showed that the rate of malnutrition with pressure ulcers was higher than that of those without them in 58.7% versus 32.6%.

Nutrition plays an important role in preserving skin and soft tissue viability and in supporting tissue repair processes for pressure ulcer healing. The majority of research investigating the relationship between nutrition and wound healing has focused on the management of pressure ulcers.

In this paper the role of nutrition in pressure ulcer treatment was investigated and discussed our clinical experiences of hospitalized elderly patients suffering from pressure ulcers with reviewing the current literatures of nutrition and pressure ulcers.

## Patients and Methods

### Patients

A total of 18 elderly patients (68 to 101 years old, 4 male and 14 female) with pressure ulcer(s), admitted in Myodani Hospital in Kobe city, were entered in this study. They were selected at random regardless of their primary diseases. Among them six patients could eat orally (Per Os) by themselves (O

group), and four patients received enteral feeding (E group), and five and the rest were nourished with total and peripheral parenteral nutrition (T group, and P group), respectively. They were all bedridden without any voluntary movement. We had obtained all patients' or their families' informed consent to the registration of this study. The profile of the enrolled patients were shown in table 1, in which the patients were categorized into four groups of O, E, T, and P group according to their nutritional management modalities.

**Nutritional assessment**

Every patient received the nutritional assessment of anthropometric measurement with height and body weight, triceps skinfold thickness (TSF) of easy bed-side index of fat mass, and arm circumference (AC) for systemic muscular mass. Fat body mass and fat body percentile of each patient were calculated with bio-impedance analysis (BIA) machine (hand-gripping type of OMURON ; HBF-306). On biochemical nutritional analyses of protein and lipid metabolism, serum total protein (TP), albumin (Alb), total cholesterol (TC) and triglyceride (TG) were examined. Moreover the measurement of rapid turnover proteins (RTP) including retinol binding protein (RBP), pre-albumin, and transferrin were also added for the precise indicators of visceral protein status due to their short half-life (0.5 to 5 days). As essential trace elements serum zinc (Zn), ferrum (Fe), and copper (Cu) level were also monitored.

The intake calories of each patient were calculated with the amount of food intake, administered volume of enteral or parenteral pharmaceutical products described on the patients' chart record.

**Pressure ulcers**

The site and the stage of pressure ulcers of the patients at the entry and the clinical outcome are listed in Table 2. Most of the pressure ulcers had been located in sacral lesion besides two cases of heel, and one each of coccyx and buttock. Three patients (Case 8, 13, and 14) had pressure ulcers in two different portions. The grade of the pressure ulcers were diagnosed according to the classification of the National and European Pressure Ulcer Advisor Panel (NPUAP and EPUAP) (Fig. 1)<sup>2)3)</sup> at the entry (initial stage) and the following three months during the treatment. The treatments were performed by the interprofessional team of NST (nutritional support team) and WCT (wound control team) of Myodani Hospital (Picture 1).

Nutritional way	Patient	Age / Sex	Disease
<b>Oral : O group</b>	1.	82. / female	Myocardial Infarction
	2.	89. / male	Ileus
	3.	101. / female	Pneumonia
	4.	81. / female	Lumbar canal stenosis (LCS)
	5.	80. / male	Spinal cord injury
	6.	86. / female	Osteoporosis
<b>Enteral : E group</b>	7.	84. / female	Cerebral infarction
	8.	88. / female	Diabetes mellitus (DM)
	9.	94. / female	Cerebral hemorrhage
	10.	83. / male	Cerebral infarction
<b>Parenteral (TPN) : T group</b>	11.	77. / male	Pneumonia
	12.	86. / female	Pneumonia, Dementia
	13.	86. / female	Cardiac failure
	14.	94. / female	Ileus, Dehydration
	15.	83. / female	Parkinson's disease, Pneumonia
<b>Parenteral (PPN) : P group</b>	16.	83. / female	Subdural hemorrhage
	17.	92. / female	Cardiac failure, disuse syn.
	18.	88. / female	Cerebral infarction

Table 1 Profile of the entered 18 patients categorized in four groups by way of their

Nutritional way	Patient	Site / Initial stage (state)	Clinical outcome
<b>Oral : O group</b>	1.	sacrum / III (necrosis)	Improved
	2.	sacrum / II (erosion)	Improved
	3.	sacrum / II (skin defect)	Improved
	4.	sacrum / III (ulceration)	Improved
	5.	coccyx / I (redness)	Improved
	6.	sacrum / II (skin defect)	Improved
<b>Enteral : E group</b>	7.	sacrum / III (skin defect)	Improved
	8.	heel / III, sacrum / II (necrosis)	Improved
	9.	sacrum / IV (pocket formation)	Improved
	10.	hips / II (erosion)	Improved
<b>Parenteral (TPN) : T group</b>	11.	sacrum / III (necrosis)	Improved
	12.	sacrum / II (skin defect)	Improved
	13.	heel / III, sacrum / II (necrosis)	Not changed
	14.	sacrum / III, heel / II (ulceration)	Deteriorated
	15.	sacrum / II (subcutaneous defect)	Not changed
<b>Parenteral (PPN) : P group</b>	16.	sacrum / III (necrosis)	Not changed
	17.	sacrum / II (blister formation)	Improved
	18.	sacrum / III (ulceration)	Deteriorated

Table 2 A list of pressure ulcers of the patients (their site, initial staging and outcome)

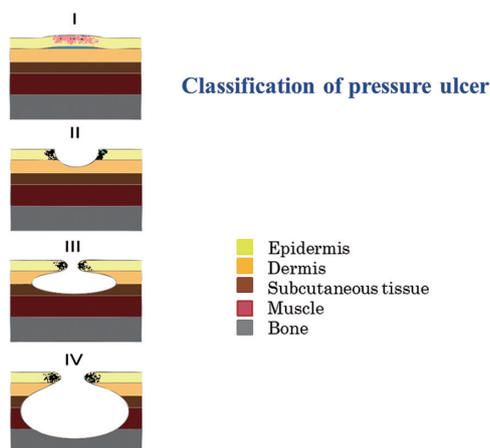


Figure 1 Pressure ulcer classification by the National and European Pressure Ulcer Advisor Panel (NPUAP and EPUAP)<sup>2)3)</sup>

Interprofessional team (NST, WCT) round



Picture 1 Interprofessional team (NST : nutritional support team, WCT : wound Control team) round at Myodani Hospital

Results

Administered calorie and nutrients

Daily intake calories of each nourished group at the entry of the study, which were calculated with the data collected from patient’s medical record audit, was 875 ± 102 kcal in O group, 1094 ± 126 kcal in E group, 832 ± 99 kcal in T group, and 239 ± 78 kcal in P group, respectively. All patients in four groups were beneath the optimal nutrient intake at the beginning, especially quite lower in P group. Enteral and parenteral feeding were forced to be administered regularly, but the patients in O group could eat orally at will, whose calorie intake was somewhat fluctuated depending on their daily appetite.

Anthropometric Date

Anthropometric measurements of the body were shown in Table 3. Mean body mass index (BMI), which is calculated based on height and body weight, of all groups were less than twenty, showing highly emaciation. In O, E, and T group the fat body mass and percentile ratio of it to the body, and TSF (Triceps skin fold) did not be lower so much, compared with those of corresponding aged healthy people, while AC (Arm circumference) was considerably lower than normal. It means that the emaciation is due to the lack of systemic skeletal muscle volume, which is so-called “sarcopenia syndrome”. In P group, in which administered calorie was less than 300 kcal, was significantly lower than other three groups. O and E group showed relatively higher anthropometric data compared with other two parenteral nutrition groups (T and P group).

Biochemical Data

In nutritional objective data assessment (ODA) biochemical blood data of total protein, albumin, total cholesterol, rapid turnover protein (RTP) and serum essential trace elements (Zn, Fe, Cu) were

Anthropometric measurement					
	mean ± SD (n=18)				
Nutritional way	BMI	Fat body mass (kg)	Fat body Percent (%)	TSF (mm)	AC(cm)
Per Os (n=6)	19.8 ± 2.0	12.1 ± 1.0	25.6 ± 3.7	13.8 ± 1.5	21.2 ± 2.9
Enteral (n=4)	18.3 ± 1.9	17.8 ± 0.9	36.6 ± 4.9	19.0 ± 2.3	22.1 ± 3.2
Parenteral (TPN) (n=5)	19.0 ± 1.2	15.1 ± 2.3	29.5 ± 3.5	10.3 ± 1.6	17.1 ± 2.7
Parenteral (PPN) (n=3)	15.5 ± 2.2	7.3 ± 1.8	22.2 ± 2.4	9.5 ± 0.9	13.0 ± 1.8

Table 3 Anthropometric data (BMI:body mass index, TSF:triceps skinfold, AC:arm circumference)

shown graphically in Fig. 2, 3 and 4. But the data of RTP and essential trace elements in P group were not available. The nutritional parameters of TP, Alb, TC, and TG of O & E group are higher than those of T & P group (Fig 2). Protein-based values of TP and Alb of all groups were below the normal range, but lipid-based ones of TC and TG were within normal limits. Among four groups, the nutritional parameters in E group were the highest, which was caused by regular formulated enteral feeding via percutaneous endoscopic gastrostomy (PEG).

TP and Alb, which have historically been used widely in nutritional parameter, however, are poor indicators due to the long half-life and being susceptible to inflammation, and other factors. In place of them, RTPs have recently well used as more precise parameter of nutrition<sup>4)</sup>. The patients' RTP data in Fig 3 were rather lower compared with normal standard, but those of E group kept rather higher value than the other two groups. As shown in Fig 4, the same tendency was found in serum essential trace elements except of higher Zn and Cu in T group in which multi-minerals were administered regularly as the pharmaceutical product (Minerarin<sup>®</sup>).

**Pressure ulcers healing**

As listed in Table 2, initial stage and the status of the pressure ulcers were not different among the groups, but the clinical outcome after three months' treatment were significantly different between O & E and T & P group. Improvement of the stage and status of the pressure ulcers could be obtained all patients in O, E group and two patients of T group. But no change and deterioration were seen in the rest of T and P group. It resulted that the patients with oral, enteral feeding (O, E group) were better responded to the treatment than those in T & P group.

**Case study**

Case 9 is presented here as a typical clinical case showing great improvement of the pressure ulcer with the treatment. The patient was a 94 year-old female with a stage IV pressure ulcer on sacral portion. She fell in the sudden onset of cerebral hemorrhage five years ago and came to be suffering

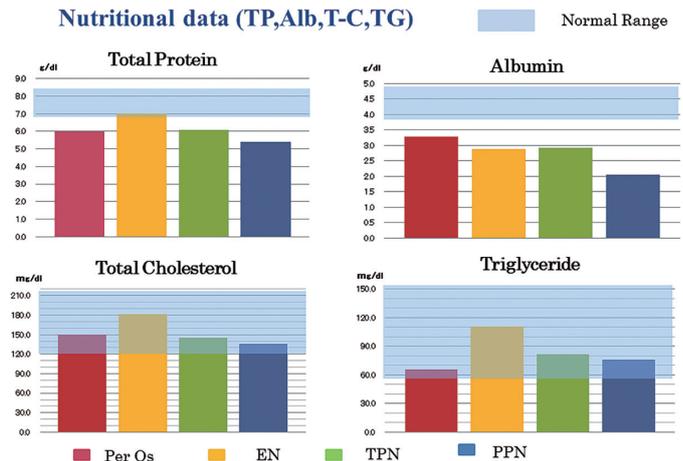


Figure 2 Biochemical data concerning nutritional parameters

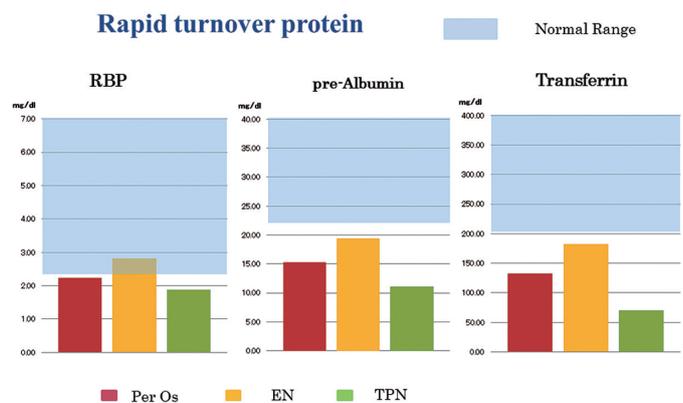


Figure 3 Biochemical data of RTPs (rapid turnover proteins)

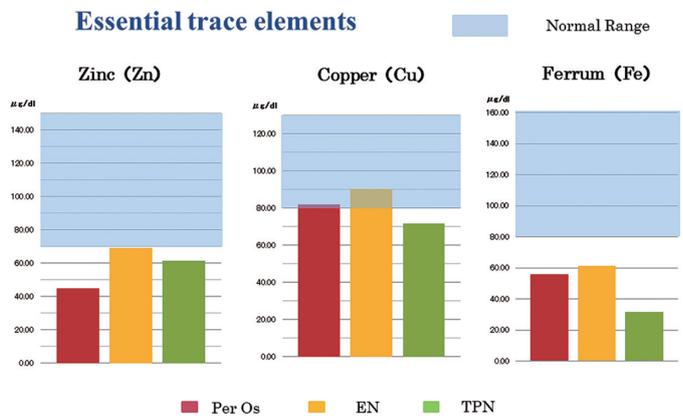


Figure 4 Biochemical data of serum trace minerals

from systemic paresis without any voluntary movement. She has been fed with enteral nutrition via percutaneous gastrostomy. Despite of 1,000 kcal of feeding per day, she had the high nutritional disturbance with low proteinemia of 5.6 g/dl of serum total protein and 2.4 g/dl of albumin. Three packs of special enteral feeding with enriched arginine, glutamine, and trace elements of zinc, copper, and ferrum (Isocal Arginate<sup>®</sup>) were added a day. After the three months' treatment by NST and WCT, her stage IV pressure ulcer with deep concaved pocket formation was improved to stage III. The deep pocket had been lessened in the course of treatment. The healing process of the pressure ulcer was shown chronologically in Picture 2.



Picture 2 Chronological healing process of sacral pressure ulcer in case 9

## Discussion

Although the elderly, particularly with poor nutritional status, have long been recognized to have higher risk for the development of pressure ulcers, the role of nutrition in their management has not been elucidated well until some systematic reviews<sup>5)(6)(7)(8)</sup> published. Recently the standard White Paper “Pressure Ulcer Prevention and Treatment Clinical Practice Guideline” has been released in the collaboration among the National Pressure Ulcer Advisory Panel, the European Pressure Ulcer Advisory Panel and the Pan Pacific Pressure Ulcer Advisory Panel in 2014<sup>9)</sup>. In this paper, the roles of nutrition in the prevention and treatment of the pressure ulcer are clearly remarked.

The brief summary of this White paper is as follows : It consists of Overview of Pressure Ulcer : Prevalence, Incidence, Cost of Nutrition, Recommendations for Practice Nutritional Considerations in Pressure Ulcer Prevention, Nutrition Screening and Assessment, Macronutrients and Micronutrients Related to Pressure Ulcer Treatment, and Current Recommendations for Medical Nutrition Therapy for Pressure Ulcer Treatment. The goal of the White paper is stipulated to develop evidence-based recommendations for the prevention and treatment of pressure ulcers that could be used by healthcare professionals globally.

The prevalence of pressure ulcer is estimated that 1 to 3 million people in the US develop pressure ulcer each year, and more than 2.5 million patients in acute-care facilities suffer from pressure ulcers, and 60,000 die from them each year. Incidence rates ranged from 0.4 to 38 % in general acute care, 2.2 to 23.9 % in long-term care, and 0 to 7 % in home care patients.

Although limited evidence-based research is available, the general consensus indicates that nutrition is an important aspect of a comprehensive care plan for prevention and treatment of pressure ulcers, and it is essential to address nutrition in every individual with pressure ulcers. Adequate calories, protein, fluids, vitamins, and minerals are required for the body to maintain tissue integrity and prevent tissue breakdown. A large cohort study has documented that pressure ulcer incidence increased with advanced

age, frailty, severity of illness, and nutritional problems of significant weight loss and eating difficulties<sup>10)</sup>. For pressure ulcer prevention and treatment certain macro- and micronutrients are needed. Energy are provided through the macronutrients; carbohydrates, fats, and proteins. Energy is essential for pressure ulcer healing. Providing adequate calories promotes anabolism, collagen synthesis and wound healing.

Protein, which is the basis of the human body structure, is also essential to promote positive nitrogen balance. Increased protein levels have been linked to improved healing rates<sup>11)</sup>. Dietary protein is especially important in the older adult due to body composition changes occurring with aging. These changes may include sarcopenia and decreased immune function, which can lead to impaired wound healing and compromised immunity. Recent studies indicate the basic requirement for exogenous protein in older adults is minimum of 1.0 gram per kilogram body weight, which is more than 0.8 gram for healthy adults<sup>12)</sup>. Among amino acids, which are the building blocks of protein, certain amino acids such as branched chain amino acids (BCAAs), arginine and glutamine become conditionally essential during periods of severe stress of trauma, sepsis and pressure ulcer. BCAAs are main sources of muscle protein, and arginine promotes the transport of amino acids into tissue cells and supports the formation of protein in the cell, and glutamine has the role of a fuel source for fibroblasts and epithelial cells in the pressure ulcer healing.

The administration of fluids as the solvent for macronutrients of glucose, proteins, and for minerals and vitamins is needed for proper wound healing. Micronutrients such as ascorbic acid (vitamin C), zinc, copper, and iron are also essential for each stage in pressure ulcer healing. Ascorbic acid is a cofactor with iron for the production of collagen, and zinc is a mineral for an antioxidant, and copper is associated with collagen formation of cross-linking.

Finally in the White paper nutritional care for pressure ulcer is recommended to be performed by the interprofessional team including a physician, nurse practitioner, nurse, clinical nutritionist, pharmacist, speech therapist, occupational therapist, physical therapist, and dentist.

In our study, investigated aged patients had all developed moderate to severe malnutrition in anthropometric assessment and biochemical analysis, and over half of them had gotten stage III to IV pressure ulcers. They were managed nutritionally in orally, enterally, and parenterally, but the administered calories, protein, and minerals of each group were below the adequate levels at the entry of the study, especially in peripheral parenteral group (P group).

The healing of the pressure ulcers after three months' treatment by nutritional support team (NST) with BCAA, arginine, glutamine, and trace minerals and local wound treatment and redistribution of pressure by wound control team (WCT) could improve the wound in 13 patients (71.7 %), most of whom were in the oral or enteral feeding group. On the contrary, in parenteral feeding group, 5 patients (62.5 %) showed no change or deterioration of the lesion. When compared with O & E group and T group, we found the significant difference in the levels of wound healing after three months' treatment. As the administered nutritional calorie, and nutrients were almost comparable among three groups, the difference in outcome is attributed to the nutritional route, oral and enteral is more physiological and desirable than parenteral way. From our survey it may be safely said that there was strong correlation

between pressure ulcer and nutritional management, especially route of administration of nutrients, that is to say, physiological enteral route.

With much more research still to be done in this area, nutritional support will be recognized as more efficacious approach to the treatment of pressure ulcers.

## Conclusion

Pressure ulcers, which are the localized ischemic injury by the pressure applied to skin and soft tissue, could threaten to reduce overall quality of life of the patients due to pain, bleeding, infection, and increased length of hospitalized stay, and may also contribute to mortality in some patients. A primary objective for healthcare professionals is to recognize to be crucial the pressure ulcers control in the course of health and medical care.

High incidence of weight loss, malnutrition and poor visceral protein status are reported to be associated with pressure ulcer development in long-term care elderly patients. For the prevention and the treatment of pressure ulcers, not only the local management but the systemic nutritional care for the aged patients in compromised nutritional status is strongly recommended.

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