

## Case Study

# Rehabilitation nutrition in pressure ulcer management with type 2 diabetes: a case report

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**Background and Objectives:** Severe infection, inadequate food intake, and pressure ulcers in patients with type 2 diabetes can result in malnutrition. We describe a case in which rehabilitation nutrition was effective for treating a pressure ulcer in a malnourished patient with type 2 diabetes. **Methods and Results:** A 58-year-old man with type 2 diabetes was diagnosed with hidradenitis suppurativa on the left buttock and thigh and a severe pressure ulcer on his left kneecap. Malnutrition was related to hypermetabolism caused by chronic hidradenitis suppurativa and inadequate protein-energy intake before admission. We initiated a rehabilitation nutrition intervention to improve physical function and to treat a pressure ulcer by prescribing 2,000 kcal/day of food, including 80 g of protein, and physical rehabilitation for 40 minutes/day. The patient showed good progress in terms of his physical function and healing of the pressure ulcer. After prescribing 2,250 kcal/day of food, including 85 g of protein, and physical rehabilitation for 60 minutes/day, HbA1c levels increased to 7.4%. The energy prescription was decreased to 2,000 kcal/day to improve glycemic levels. Then, the patient's weight decreased and his hand grip strength became weaker. On day 134 and discharge the patient could walk independently with a t-cane and ankle supporter. By day 14 after discharge, the pressure ulcer had epithelialized. **Conclusion:** Rehabilitation nutrition management improved physical function and facilitated pressure ulcer healing in a malnourished patient with type 2 diabetes. Close conjoint management of hyperglycemia was also necessary.

**Key Words:** nutritional intervention, diabetes mellitus, wound healing, malnutrition, physical function

## INTRODUCTION

Malnutrition or dysnutrition occurs with inadequate food intake and is exacerbated with associated acute or chronic inflammation. This circumstance is characterized by unintended weight loss, decreased skeletal muscle mass, and/or physical dysfunction.<sup>1,2</sup> Hyperglycemia associated with diabetes mellitus further enhances the risk of dysnutrition together with that of skin and soft tissue infections,<sup>3</sup> including conditions such as chronic hidradenitis suppurativa.<sup>4</sup> Some type 2 diabetes mellitus patients have an elevated rate of whole-body protein metabolism and a negative nitrogen balance;<sup>5</sup> therefore, severe infection and a reduction in food intake in these patients can result in a vicious cycle of infection and deterioration in nutritional status. Malnutrition accompanied with immobility also increases the risk of pressure ulcers.<sup>6</sup>

Malnutrition itself is a risk factor for pressure ulcer development.<sup>7</sup> Therefore, nutritional support plays an im-

portant role both in the prevention and in the treatment of pressure ulcers.<sup>8</sup> For patients with pressure ulcers who have metabolic diseases such as diabetes as comorbidities, nutritional intervention needs to be part of the management plan.<sup>9</sup> However, there are few reports of nutritional intervention to accelerate wound healing and improve physical function in patients with pressure ulcers and metabolic disease.

In this report, we describe a case where rehabilitation

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nutrition was contributory to the management of pressure ulcer in a malnourished patient with type 2 diabetes.

### PATIENT PROFILE

A 58-year-old man who lived alone presented with swelling in his left thigh and buttocks, present for 3 weeks before admission. At the age of 50 years, he commenced insulin therapy for type 2 diabetes mellitus, but discontinued the treatment of his own accord. He had developed background diabetes retinopathy. Because of increasing difficulty to walk, stand up, get up, and roll over, he had been prone for 2 weeks before presentation. His limited mobility affected his access to food. For 2 weeks, he ate a lunch box containing 800 kcal, or 2 or 3 rice balls containing 300 to 500 kcal, 3 times a week, when his friends visited his home. For the remaining 4 days of the week, he ate nothing, only drinking water.

On admission, he was septic and hyperglycemic (Table 1). Physical examination indicated puffiness of the left buttocks and thigh, and a subcutaneous abscess was detected on computed tomography (CT). Hidradenitis suppurativa was diagnosed. Several pressure ulcers were detected on both elbows, the toes, and the kneecaps. Necrotic tissue with redness, swelling, a feeling of heat, and pain (signs of inflammation) was detected in the pressure ulcer on the left kneecap. The ethics committee of the Japan Community Healthcare Organization Yokohama Central Hospital approved the use of the information contained in this case study and the patient provided informed consent for the publication of his case.

### WOUND EVALUATION (DESIGN-R, FIGURE 2)

The pressure ulcer on the left kneecap was evaluated with the DESIGN-R tool,<sup>10,11</sup> and the score was 27 at admission. The DESIGN-R tool employs seven criteria: depth, exudate, size, inflammation and infection, granulation tissue, necrotic tissue, and pocket (undermining). The DESIGN-R score ranges from 0 (healed) to 66 (most severe), and pressure ulcers are classified into three categories according to the score: slight (total score of  $\leq 9$ ), moderate (10-18), and severe ( $\geq 19$ ). The validity and reliability of DESIGN-R have been established.<sup>10-12</sup>

### INITIAL CLINICAL COURSE

Figure 1 illustrates the course of treatment for hidradenitis suppurativa and the pressure ulcer on the left kneecap and the changes in nutritional intake. *Streptococcus agalactiae* was detected on bacteriological examination of the purulent discharge, and antibiotics were administered intravenously.

### NUTRITIONAL DIAGNOSIS

The patient was ultimately diagnosed with severe malnutrition using the Subjective Global Assessment on day 19.<sup>13</sup> Malnutrition was related to hypermetabolism caused by chronic hidradenitis suppurativa (the inflammatory reaction was strong until intervention) and inadequate protein-energy intake before and after admission, as evidenced by the unintended weight loss ( $>7.5\%$  per 3 months) and loss of subcutaneous fat (% triceps skinfold of 60% compared to the Japanese nationwide reference).<sup>14</sup> Nutritional intervention was recommended for effective management of the pressure ulcers, because previous studies had shown that high energy and protein intakes reduce pressure ulcer size.<sup>15,16</sup>

### METABOLIC AND GENERAL MEDICAL MANAGEMENT

The patient's *diabetes* was treated with oral hypoglycemic medications (dipeptidyl peptidase 4 inhibitor and alpha-glucosidase inhibitor) and insulin from the time of hospital admission. He was provided meals containing 1,600 kcal/day (25 kcal/kg actual body weight [ABW]: 64.6 kg) and 70 g protein (1.1 g/kg ABW). There was no proteinuria and no other evidence of nephropathy obtained, although likely given his retinopathy. Laboratory investigations are shown in Table 1.

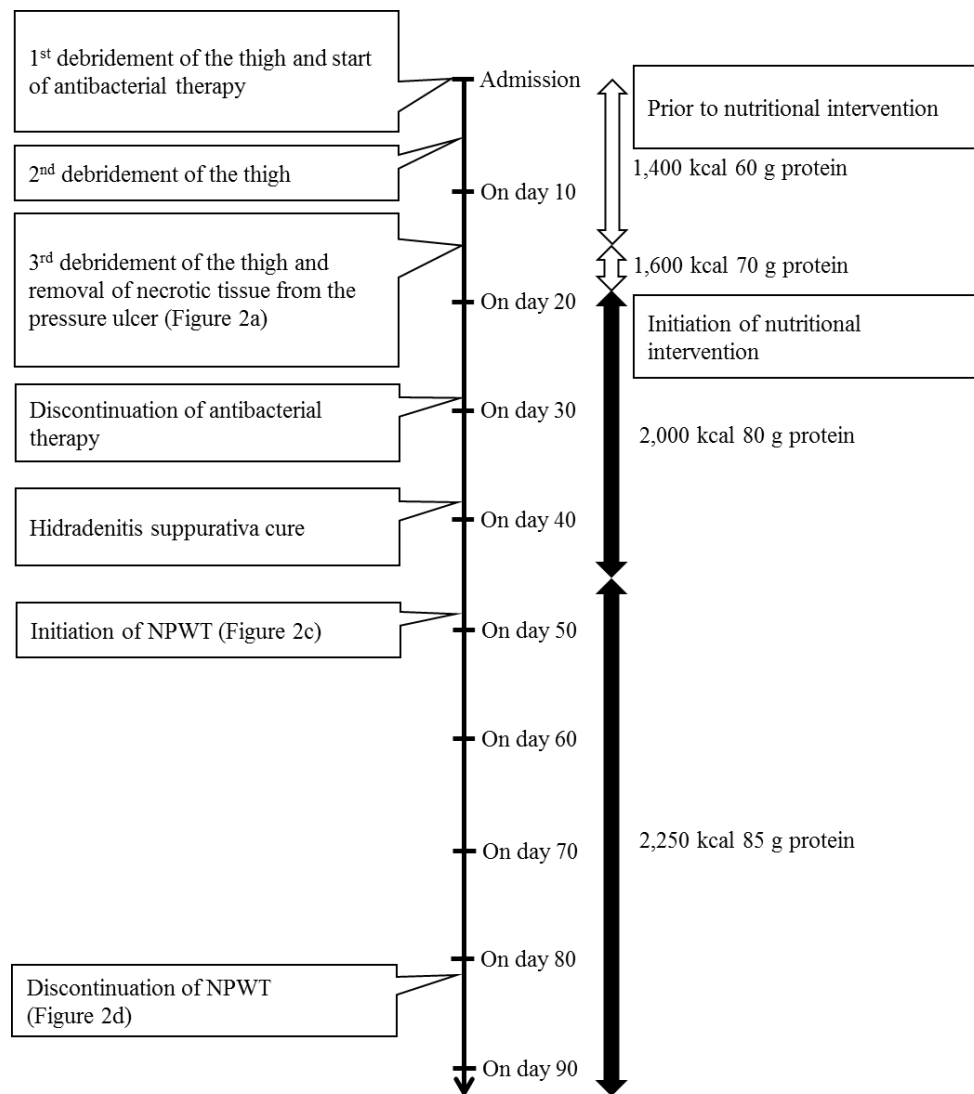
*Anemia* was managed by diet, supplements and with packed red blood cell transfusions on days 1, 2, and 4.

### REHABILITATION NUTRITION INTERVENTION

On day 19, nutritional intervention was initiated by a registered dietitian at the request of the attending physician. The patient's height, usual body weight, ideal body weight, and ABW were 176 cm, 70 kg, 68.1 kg, and 64.4 kg, respectively. Anthropometric data are shown in Table 2.

**Table 1.** Laboratory data from admission to after discharge

Hospital day	1	19	36	57	99	120	-
Intervention day	-	1	18	39	81	102	128
Energy intake (kcal/day)	1400	1600	2000	2250	2250	2000	2000
Protein intake (g/day)	60	70	80	85	85	85	85
Total protein (g/dL)	8.4	7.3	7.8	8.0	7.5	7.7	8.2
Albumin (g/dL)	2.0	2.1	3.1	3.7	3.9	4.0	4.4
Urea nitrogen (mg/dL)	28.1	6.0	11.0	11.0	14.1	13.7	7.0
Creatinine (mg/dL)	0.93	0.46	0.54	0.55	0.62	0.73	0.69
eGFR (mL/min/1.73m <sup>2</sup> )	65.5	142	119	116	102	85.4	90.8
Total cholesterol (mg/dL)	134	-	-	-	-	-	130
Triglycerides (mg/dL)	176	-	-	-	-	-	133
Hemoglobin (g/dL)	11.8	9.8	11.0	10.8	9.7	9.8	11.5
C-reactive protein (mg/dL)	26.5	1.13	0.09	0.02	0.01	0.01	-
White blood cell count (/ $\mu$ L)	$1.89 \times 10^4$	$6.37 \times 10^3$	$6.35 \times 10^3$	$6.12 \times 10^3$	$5.4 \times 10^3$	$5.36 \times 10^3$	$6.57 \times 10^3$
Glycated hemoglobin (%)	11.3	-	6.8	-	7.4	-	6.3
Premeal blood glucose (mg/dL)	366	190	161	194	182	167	134



**Figure 1.** Clinical course of treatment and nutritional intake before and after intervention in a malnourished patient with a pressure ulcer and type 2 diabetes. NPWT: negative pressure wound therapy.

**Table 2.** Change in nutritional intake and anthropometric measurements from nutritional intervention to discharge

Hospital day	19	46	60	91	133
Intervention days	1	28	42	73	115
Energy intake (kcal/day)	1600	2000	2250	2250	2000
Protein intake (g/day)	70	80	85	85	85
Body weight (kg)	64.6	64.4	64.7	65.0	64.3
BMI (kg/m <sup>2</sup> )	20.9	20.8	20.9	21.0	20.8
Calf circumference (cm)					
Right	Not available	34.5	35.5	36.5	37.5
Left	Not available	34.5	35.0	36.0	36.5
Arm circumference (cm)	24.0	27.7	27.8	27.5	28.3
Triceps skinfold(mm)	6	6	6	8	8
Handgrip strength (kg)					
Right	Not available	19.9	18.4	25.9	24.9
Left	Not available	25.4	28.2	32.2	31.3

The modified meal plan comprised up to 2,000 kcal/day (30 kcal/kg ABW), including 80 g of protein (1.2 g/kg ABW, 16% of energy), was initiated to improve physical function and the pressure ulcers in reference to Japanese Treatment Guide for Diabetes.<sup>17</sup> In accordance with the Overview of Dietary Reference Intakes for Japanese (2015)<sup>18</sup> recommendations for micronutrients, the

amounts of vitamins D and C, zinc, and copper were 9.1 µg (adequate intake<sup>18</sup> [AI] 5.5 µg), 140 mg (recommended dietary allowance<sup>18</sup> [RDA] 100 mg), 13 mg (RDA 10 mg), and 1.4 mg (RDA 0.9 mg), respectively. The foods consumed were recorded by a registered dietitian and nurses. The patient consumed all food at each meal; therefore, the patient's actual intake was 2,000 kcal/day.

Treatment of hyperglycemia was continued with oral hypoglycemic medications and insulin. Day 29, physical rehabilitation for 40 minutes/day was started to facilitate walking outside with a t-cane and inside without a cane. The patient was not able to bend his left knee by more than 90 degrees nor was foot dorsiflexion using the tibialis anterior muscle possible because of the severity of the pressure ulcer that had been debrided up to the joint. Therefore, he used an ankle supporter during walking exercise using parallel bars and a walker. Day 38, CT revealed no additional abscesses, and the hidradenitis suppurativa appeared to be cured. Day 49, the DESIGN-R score was 33 (Figure 2c), and Negative Pressure Wound Therapy (NPWT)<sup>19</sup> was initiated to treat the undermining of the pressure ulcer.

Day 55, the patient could perform the walk exercise with a t-cane and he started voluntary training by himself. The energy prescription was increased to 2,250 kcal/day (35 kcal/kg ABW), including 85 g of protein (1.3 g/kg ABW, 15 % of energy), to meet his nutritional needs. Day 81, NPWT was discontinued because the DESIGN-R score had decreased to 17 (Figure 2d) and no undermining was observed. Day 64, the rehabilitation schedule was changed to 60 minutes/day, and stepping exercise was started.

Day 99, the DESIGN-R score was 13 (Figure 2e) and the patient showed good progress; however, the HbA1C level was elevated at 7.4% (Table 1). Accordingly, the energy prescription was decreased to 2,000 kcal/day (30 kcal/kg ABW), including 85 g of protein (1.3 g/kg ABW, 17% of energy), to improve glycemic levels. Day 131, the patient's ferritin level was 21.5 ng/mL, and his serum iron was 24 µg/dL, indicating iron-deficiency anemia. Therefore, an oral iron preparation was prescribed to treat iron-deficiency anemia. Day 133, the patient's nutritional status was improved, as evidenced by improved anthropometric measurements, except for body weight (Table 2). However, the patient's weight decreased, and his hand grip strength became weaker. Day 134, the patient was discharged to home and could walk independently with a t-cane and ankle supporter.

Day 11 after discharge, glycemic control was good and the HbA1C level had decreased to 6.3%. Day 14 after discharge, the pressure ulcer was found to have epithelialized.

## DISCUSSION

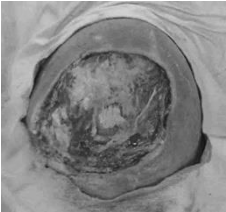

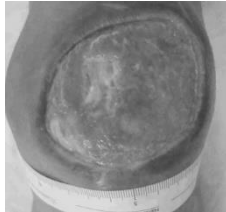
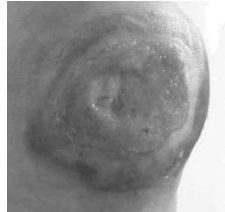
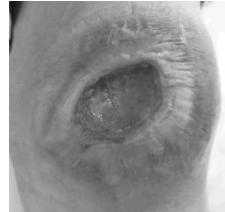
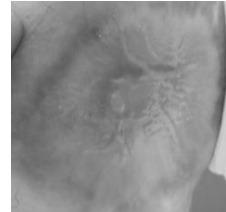
The management of this case highlights two important issues about nutritional intervention. First, organized rehabilitation nutrition intervention may help improve physical function and wound healing in malnourished patients with severe pressure ulcers. For pressure ulcer treatment, the NPUAP/EPUAP guidelines recommend the provisions of 30 to 35 kcal/kg body weight (BW) of energy, including 1.25 to 1.5 g/kg BW protein intake, with energy intake dependent on medical conditions and activity levels in everyone.<sup>9</sup> High energy and high protein intake reduces pressure ulcer size.<sup>15,16</sup> The DESIGN-R score gradually improved and the healing process was good. The effectiveness of NPWT has not been established,<sup>9,20</sup> and Wanner MB et al found no significant difference in time to reach 50 % of the initial pressure ulcer

volume between the NPWT group and the traditional treatment group in patients with spinal injuries.<sup>21</sup> Yet, in this case, the speed of PU reduction during the NPWT period was faster than during the traditional treatment period (Figure 2). Thus, a rehabilitation nutrition intervention with NPWT might promote wound healing. There were concerns regarding fixation of the lower leg and the foot because the pressure ulcer on the left kneecap was debrided around the joint. Intervention with rehabilitation nutrition<sup>22</sup> and monitoring of physical activity and nutritional status was important for the patient to walk again. After intervention, the anthropometric measurements except for weight improved, and the patient could walk outside again with a t-cane. Serum concentrations of urea nitrogen and creatinine were elevated on day 1, but otherwise decreased. The serum creatinine was 0.46 mg/dL on day 19, which was low for a man of his age. These data suggest that renal function was impaired on day 1; however, since serum creatinine concentrations on days 1 and 19 were not elevated, the patient probably had a decrease in muscle mass. Gradual increases in serum creatinine thereafter might have been due to the recovery of muscle mass. Although the total serum protein I did not exhibit marked changes, the serum albumin level increased from 2.0 g/dL to 4.4 g/dL, in association with a marked decrease in globulin due to controlled inflammation. Thus, rehabilitation nutrition intervention was apparently effective in this malnourished patient in improving wound healing and physical activity.

Second, patients with type 2 diabetes who have good glycemic control with insulin therapy may show improved physical function and wound healing with rehabilitation nutrition intervention. Hyperglycemia is associated with an increase in infectious complications and mortality.<sup>3,23,24</sup> For patients in a non-critical care setting, premeal and random blood glucose of less than 140 mg/dL (7.8 mmol/L) and less than 180 mg/dL (10.0 mmol/L), respectively, are recommended.<sup>25-27</sup> In accordance with NPUAP/EPUAP guidelines and the Japanese Treatment Guide for Diabetes,<sup>17</sup> we calculated energy requirements to be 30 to 35 kcal/kg given his level of physical activity and rehabilitation. In this case, premeal glycemic status exceeded 140 mg/dL in hospital despite treatment with noninsulin anti-hyperglycemic agents and insulin. As per activity levels, the energy prescription was revised to 35 kcal/kg ABW, and thereafter, hand grip strength and calf circumference increased, but premeal blood glucose and HbA1C levels were elevated due to inadequate medication. We decreased the energy intake to 30 kcal/kg ABW because the healing process of the pressure ulcer was good, and subsequently, glycemic status improved. However, the patient's body weight decreased and his hand grip strength became weaker. For our patient, sufficient energy intake according to activity levels and continuous insulin therapy may have been necessary, rather than a reduction of energy intake, to improve physical function. If glycemic status is well controlled with medical therapy, rehabilitation nutrition support might help improve the condition of patients with type 2 diabetes.

## Conclusion

Rehabilitation nutrition treatment improved physical

	a	b	c	d	e	f
						
Hospital day	15	19	49	81	99	133
DESIGN-R score	42	37	33	17	13	5
PU classification	severe	severe	severe	moderate	moderate	slight
Depth	5 deep	5 deep	4 deep	4 deep	3 deep	2 superficial
Exudate	6	6	6	3	1	1
Size	9	9	9	8	6	3
Infection	3	1	0	0	0	0
Granulation	6	6	3	3	3	1
Necrotic tissue	6	3	3	3	3	0
Pocket (undermining)	12	12	12	0	0	0
Speed of PU reduction (duration)	-	-	0.265 (hospital day 15-49)	0.5 (hospital day 49-81)	0.222 (hospital day 81-99)	0.235 (hospital day 99-133)

**Figure 2.** Wound appearances and pressure ulcer status as evaluated using the DESIGN-R tool in a malnourished patient with type 2 diabetes. PU: pressure ulcer; Speed of PU reduction: Speed of PU reduction, as calculated using  $\Delta$ DESIGN-R/ $\Delta$ hospital day.

function and pressure ulcer healing in a malnourished patient with type 2 diabetes. With continuous management of hyperglycemia by adequate medical therapy, rehabilitation nutrition intervention was effective in this patient. Further studies should clarify what type of nutritional intervention is most effective in malnourished patients with pressure ulcers and metabolic disease like type 2 diabetes.

#### AUTHOR DISCLOSURES

The authors have no conflicts of interest and funding or support disclosure.

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