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Renal Replacement Therapy

CASE REPORT

Rehabilitation nutrition support for a hemodialysis patient with protein-energy wasting and sarcopenic dysphagia: a case report

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Abstract

Background: Patients with end-stage renal failure may exhibit sarcopenia and protein-energy wasting (PEW). We report a case of improvement in physical function, muscle mass, and muscle strength by management of rehabilitation nutrition in a maintenance hemodialysis patient with PEW and sarcopenia.

Case presentation: A 60-year-old man with an 8-year history of dialysis was admitted for pneumococcal meningitis. When he was transferred for rehabilitation 36 days following the onset, he was transferred to our hospital for rehabilitation and hemodialysis. On admission, energy intake was 1200 kcal/day, via a nasogastric tube, due to sarcopenic dysphagia. He was diagnosed with PEW, based on results from a biochemical examination, physical examination, and his low dietary intake. His height, dry weight, body mass index, Mini Nutritional Assessment-Short Form, albumin, C-reactive protein, and Geriatric Nutritional Risk Index were 166 cm, 46.5 kg, 16.9 kg/m^2, 1 point, 2.1 g/dL, 0.22 mg/dL, and 63, respectively, indicating malnutrition. He was also diagnosed with sarcopenia because of low muscle mass, muscle strength, and physical function. Functional Independence Measure (FIM) was 58 points (motor 27, cognition 31). He was improved by a combination of rehabilitation including activities of daily living training, swallowing training, and nutrition management. Nutritional requirement was 1752 kcal/day of energy and 55.5 g/day (1.2 g/kg/day) of protein. Energy intake was added energy accumulation (300 kcal/day) to improve muscle mass and strength. On day 108, he was discharged to go home, he could walk outdoors, and his sarcopenic dysphagia improved.

Conclusion: Aggressive management of rehabilitation nutrition to increase dry weight may improve PEW and sarcopenic dysphagia in patients undergoing maintenance hemodialysis.

Keywords: Chronic kidney disease, Dry weight, Meningitis, Physical function, Sarcopenia

Background

Hemodialysis patients often have renal anemia, protein-energy wasting (PEW), skeletal muscle loss, muscle weakness, skeletal muscle dysfunction, exercise intolerance, fatigue, decreased activity of daily living, and ultimately, declined quality of life (QOL) [1]. In addition to these consequences, hemodialysis patients tend to decrease their dietary intake, which causes sarcopenia [2]. Furthermore, metabolic and endocrine abnormalities (such as nonspecific inflammation; catabolism; metabolic acidosis; insulin resistance; and loss of amino acids, water-soluble vitamins, and trace elements associated with dialysis treatment) can lead to sarcopenia. It has been shown that declining physical function and malnutrition in dialysis patients are risk factors for cardiovascular events and poor prognosis. Sarcopenic dysphagia is caused by muscle mass reduction and muscle weakness of swallow-related muscles accompanying sarcopenia in the whole body. There is no obvious disease causing swallowing disorder, and it is thought that swallowing disorder while eating is caused by the addition of elements

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Table 1 Studies regarding nutritional interventions in hemodialysis patients with protein-energy wasting

Case number	Author	Reported year	Reference	Subjects	Design	Period	Results and clinical nutrition significance
1	Fouque et al.	2008	[4]	86 HD patients	Randomized controlled trial: ONS vs control groups	90 days	↑ DEI, DPI, SGA, QOL
2	Scott et al.	2009	[5]	88 HD patients	Randomized controlled trial: ONS vs control groups	90 days	↑ albumin, QOL
3	Moretti et al.	2009	[6]	49 HD patients	Randomized controlled trial: ONS vs control groups	1- year	↑ nPCR, albumin
4	Malgorzewia et al.	2011	[7]	55 HD patients: PEW (30) Control (25)	Randomized controlled trial: ONS vs control groups	90 days	↑ albumin, prealbumin in 30 PEW patients ↓ CRP, levels in both group
5	Magnard J et al.	2013	[8]	50 HD patients	Randomized controlled trial: exercise vs control group (energy intake 30–40 kcal/kg of ideal weight/day, and protein intake > 1.1 g/kg of ideal weight/day)	180 days	↑ walk function, albumin and prealbumin, body composition (LTI, FTI), muscle strength, postural stability, QOL (SF-36)
6	Ravel VA et al.	2013	[9]	98,489 HD patients	Prospective cohort study: reference level (60 to < 70 g/d), low protein nitrogen appearance (PNA) levels	8-years	↑ risk of death
7	Rattanasompattikul M et al.	2013	[10]	84 HD patients	Pilot-feasibility, double-blind, randomized, placebo-controlled trial: ONS、PTX、ONS + PTX、control groups	16 weeks	↑ albumin (ONS、PTX、ONS + PTX groups)
8	Pasian C et al.	2014	[11]	48 HD patients	Means of a dietetic intervention	28 days	↑ prealbumin, physical autonomy, grip strength
9	Mpio I et al.	2015	[12]	49 HD patients	Prospective study: optimization of protein and energy intake in the daily meals	1- year	↑ QOL ↓ mortality
10	Hristea D et al.	2016	[13]	21 HD patients	Pilot randomized controlled trial: nutrition-exercise group vs Nutrition group	6 months	↑ physical function (6MWT, balance), QOL(SF-36) No change albumin, prealbumin, CRP, BMI, lean- and fat-tissue index, or quadriceps force. Not to have the potential to reverse PEW.
11	Sohrabi Z et al.	2016	[14]	92 HD patients	A randomized, controlled, nonblinded, parallel trial: vitamin E–fortified Whey beverage vs whey beverage vs vitamin E vs control	8 weeks	Whey protein in the form of a new fermented whey beverage and vitamin E supplementation may improve SGA score and MIS in the short term.
12	Martin-Alemañy G et al.	2016	[15]	36 HD patients	Randomized controlled trial: ONS + resistance exercise (RE) vs control groups	90 days	↑ BW, BMI, AMC, TSF, fat mass percentage, grip strength, phase angle and albumin in both group ↓ prevalence of PEW
13	Jo IY et al.	2017	[16]	42 HD patients	Intervention study: personalized nutritional counseling	1- year	↑ DPI, albumin, and cholesterol levels ↓ body cell mass, fat free mass
14	Hajira B et al.	2017	[17]	100 HD patients	Intervention study: dietary counseling	60 days	↑ DEI, DPI, AC, TSF, cholesterol
15	Hosojima M et al.	2017	[18]	50 HD patients	Randomized, double-blind, crossover pilot trial: endosperm protein vs soy and casein proteins	4 weeks	↑ nPCR

Abbreviations: *AC* arm circumference, *AMC* midarm muscle circumference, *BCM* body cell mass, *BMI* body mass index, *CRP* C-reactive protein, *DEI* dietary energy intake, *DPI* dietary protein intake, *FFM* fat free mass, *HD* hemodialysis, *MIS* malnutrition-inflammation score, *nPCR* normalized protein catabolic rate, *ONS* oral nutritional supplements, *PEW* protein-energy wasting, *PTX* pentoxifylline, *QOL* quality of life, *SF-36* 36-Item Short-Form Health Survey, *SGA* subject global assessment, *TSF* triceps skinfold thickness, *6MWT* 6-min walk test

Table 2 Summary of previous reports regarding protein-energy wasting and sarcopenic dysphagia

Case number	Author	Reported year	Reference	Age	Sex	Primary disease	Description of nutrition therapy	Evaluation of sarcopenia
1	Mamo Y et al.	2003	[19]	18 years	Man	Fibrocalcific pancreatic diabetes	Unknown	None
2	Kalantar-Zadeh K et al.	2009	[20]	54 years	Man	Type 2 diabetes and CKD	Unknown	None
3	Ikizler TA et al.	2013	[21]	74 years	Woman	Gastrointestinal viral disease, type 2 diabetes and CKD	Intravenous fluids and renal specific oral nutritional supplement	None
4	Wakabayashi et al.	2016	[22]	71 years	Man	Lung cancer	Rehabilitation nutrition	Yes
5	Maeda et al.	2016	[23]	80 years	Woman	Age-related functional decline	Rehabilitation nutrition	Yes
6	Hashida et al.	2017	[24]	76 years	Woman	Tongue cancer	Rehabilitation nutrition	Yes

Abbreviations: *CKD* chronic kidney disease

that accelerate sarcopenia, such as malnutrition, invasion, and waste for Elder of Flail [3]. Therefore, evaluation and treatment of PEW and sarcopenic dysphagia are very important issues in maintenance hemodialysis patients.

Nutritional therapies such as enteral nutrition, parenteral nutrition, and oral nutritional supplementation can be used to treat PEW [1]. A list of these studies, along with their reported nutritional outcomes, is provided in Table 1 [4–18]. The studies designed to establish the benefits of nutritional supplementation on the long-term improvements in overall nutritional status in hemodialysis patients with PEW have yielded encouraging results. The types of oral supplementations included regular meals, oral supplementation taken at home or during dialysis, and oral amino acid tablets. The duration of the treatment ranged from 1 month to over a year. The nutritional effects of these supplements are reported to improve nutritional indicators and body composition. In addition, reduction of mortality and improvement of PEW, physical function, and QOL have been reported. Also, exercise interventions for dialysis patients are recommended because they improve exercise tolerance and ameliorate PEW, increase skeletal muscle mass and muscle strength, suppress protein catabolism, and, therefore, increase QOL. Previous studies have reported that PEW and sarcopenic dysphagia, which is characterized by a loss of swallowing function and generalized muscle mass, could be improved by rehabilitation and nutritional support. However, to our knowledge, there are few case reports on rehabilitation nutrition management for hemodialysis patients with PEW and sarcopenic dysphagia. The case reports of PEW and sarcopenic dysphagia to date are listed in Table 2 [19–24]. It is unknown whether rehabilitation nutrition management is effective in improving sarcopenic dysphagia in hemodialysis patients with PEW and sarcopenia.

We report a case of a maintenance hemodialysis patient with PEW and sarcopenic dysphagia, showing improvement in physical function, muscle mass, and strength as a result of rehabilitation nutrition management [25].

Table 3 Hospitalization present condition

Hospitalization present condition		Sarcopenia index		Nutrition index	
Body height	166 cm	Physical function	Walking was impossible	MNA-SF	1 point
Dry weight	46.5 kg	CC	28 cm	GNRI	63
BMI	16.9 kg/m^2	Grip strength	Right 15 kg	MIS	21 points
HDS-R	27/30		Left 18 kg	Biochemical test	
MMSE	25/30	Swallowing function		Potassium	3.5 mEq/L
Dialysis condition		MWST	2 points	Phosphorus	3.3 mg/dL
Dialysis therapy	Hemodialysis	RSST	2/30 s	Blood urea nitrogen	41.6 mg/dL
Dialysis time	4 h	FILS	3	Creatinine	7.38 mg/dL
Dialyzer	VPS-18HA	Body function		CRP	0.22 mg/dL
Blood flow rate	200 ml/min	FIM	58 points	Albumin	2.1 g/dL

Abbreviations: *CC* calf circumference, *CRP* C-reactive protein, *FIM* Functional Independence Measure, *FILS* Food Intake LEVEL Scale, *GNRI* Geriatric Nutritional Risk Index, *MIS* malnutrition-inflammation score, *MMSE* Mini Mental State Examination, *MWST* modified water swallow test Nutritional Risk Index, *MNA-SF* Mini Nutritional Assessment Short Form, *RSST* repetitive saliva swallowing test

Case presentation

A 60-year-old man with an 8-year dialysis history as a result of immunoglobulin A nephropathy was admitted to an acute care hospital for generalized seizures due to pneumococcal meningitis and required mechanical ventilation. Before admission, he independently performed basic activities of daily living (ADL) and had neither central nervous system disease nor dysphagia. He was treated with antibiotic agents and was extubated after 10 days. After 36 days following the onset of symptoms, he was transferred to a long-term care hospital for rehabilitation and hemodialysis.

Nutrition and physical assessment

The condition observed at admission is shown in Table 3. Anthropometric measurement revealed the following: the body height was 166 cm, dry body weight was 46.5 kg, and body mass index (BMI) was 16.9 kg/m^2. The dry weight before onset was 49.5 kg, with a weight loss of 6.1%/month. He had severe dysphagia, and Food Intake Level Scale (FILS) [26] was level 3 (swallowing training using a small quantity of food was performed). His score on the Mini Nutritional Assessment Short Form (MNA-SF) was 1-point, Geriatric Nutritional Risk Index (GNRI) was 63, malnutrition-inflammation score was 21 points, and laboratory tests showed an albumin of 2.1 g/dL, C-reactive protein of 0.22 mg/dL; these indicated malnutrition. He was diagnosed with PEW based [27] on the results of a biochemical examination, physical examination, and his low dietary intake. Invasion caused by inflammation of meningitis, insufficient nutritional intake, and complications owing to chronic renal failure were the main causes of malnutrition.

He was diagnosed with severe sarcopenia because of decreased muscle mass (calf circumference 28 cm), muscle strength (grip strength: right 15 kg, left 18 kg), and physical function (walking was impossible) [28]. The causes of sarcopenia were considered to result from bed rest, invasion by meningitis, chronic renal failure, and low nutritional intake. Paralysis and decline of cognitive function were not observed. However, edema and pleural effusion were observed. He also received a diagnosis of possible sarcopenic dysphagia according to the relevant consensus diagnostic criteria because he presented with dysphagia and generalized sarcopenia. There was no obvious lesion suspected to be an organic disorder of the brain and because there was no history of paralysis and dementia (Mini Mental State Examination: 25 points), the cause of dysphagia was thought to be sarcopenia [29]. Functional Independence Measure (FIM) score was 58 points (motor domain score of 27, cognitive domain score of 31). Figure 1 shows the pathology-related figure of this case.

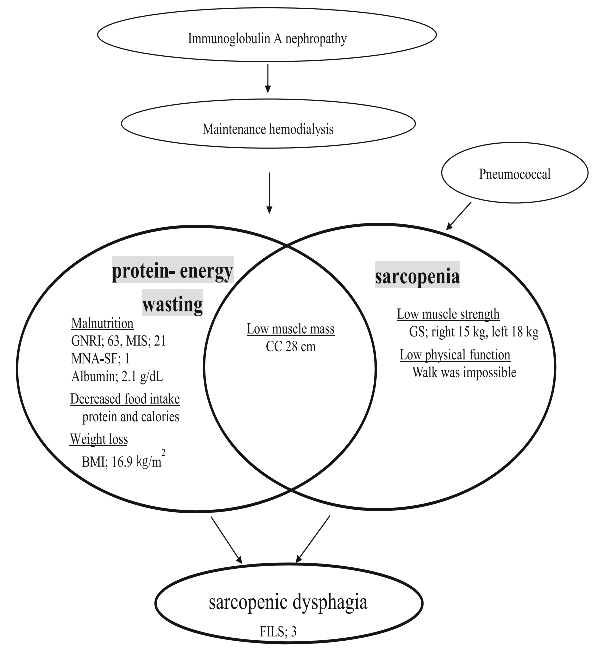

Fig. 1 Disease-related diagram of this case. Protein-energy wasting caused by dysphagia of sarcopenia, with meningitis, lack of activity, and sarcopenia due to low nutrition. Abbreviations: body mass index (BMI), calf circumference (CC), Food Intake Level Scale (FILS), Geriatric Nutritional Risk Index (GNRI), grip strength (GS), malnutrition-inflammation score (MIS), Mini Nutritional Assessment-Short Form (MNA-SF), protein-energy wasting (PEW)

Nutrition care management and outcome

He wished to resume oral intake and be discharged home despite having severe dysphagia. Therefore, a multi-disciplinary team approach—including doctors, nurses, physiotherapists, a speech-language-hearing therapist, and registered dietitians—was used to improve ADL, aid in the transition to oral intake of food, and accelerate discharge. The clinical course and intervention timeline are shown in Table 4.

The energy requirement was set to 1752 kcal/day as per the nutrition management plan during hospitalization. It was calculated using the Harris-Benedict equation [30], multiplied by the activity factor 1.2 and the stress factor 1.1, added to the daily energy accumulation (300 kcal/day), to improve muscle mass and strength. Protein requirement was set at 55.8 g of protein (1.2 g/kg dry weight). Similar to the previous hospital, 1200 kcal/day was administered from the nasogastric tube. The provided energy was gradually increased to 1500 kcal on day 2. On the 5th day, the provided nutrition reached 1800 kcal, 58.8 g of protein and 918 mL of water. After admission to our hospital, dry weight gradually decreased and reached 45.8 kg on the 15th day. Thereafter, dialysis treatment was continued without significant decrease in blood pressure.

Table 4 Trends in nutrition management and physical and mental functions

Hospital day		Admission	On day 7	On day 15	On day 29	On day 42	On day 64	On day 78	On day 92	Discharge On day 108
Nutrition management	Nutrition route	NG	NG and oral nutrition			Oral nutrition				
	Nutrition menu	Nutrient for renal failure	Nutrient for renal failure + Pureed	Nutrient for renal failure + Pureed	Pureed + ONS	Rice porridge and soft food + ONS	Diet for dialysis (soft and bite-sized)	Diet for dialysis (soft and bite-sized)	Diet for dialysis	Diet for dialysis
	Energy (kcal)	1200	1500 + 300	1500 + 300	1400 + 300	1400 + 300	1800	1800	2000	2000
	Protein (g)	42.0	53.2	53.2	66.7	66.7	60.0	60.0	65.0	65.0
Nutrition index	GNRI	63	–	–	70	–	75	–	77	79
	MNA-SF (point)	1	–	–	–	–	–	–	–	10
	nPCR (g/kg/day)	0.5	–	–	0.69	–	0.8	–	0.86	0.89
	%CGR	71	–	–	76	–	87	–	95	95
Biochemical examination	Albumin (g/dL)	2.1	–	2.3	2.6	2.9	2.9	2.9	3.0	3.1
	CRP (mg/dL)	0.22	–	–	0.30	–	0.24	–	0.20	0.26
	Potassium (mg/dL)	3.5	–	3.8	4.1	4.2	4.5	4.8	4.7	5.0
	Phosphorus (mg/dL)	3.3	–	3.6	4.2	4.0	4.5	4.9	4.8	5.1
	Sodium (mEq/L)	140	–	141	140	140	139	140	142	140
	Blood urea nitrogen (mg/dL)	41.6	–	42.8	43.9	49.8	57.5	62.5	62.2	70.5
	Creatinine (mg/dL)	7.38	–	7.41	7.51	8.30	8.45	8.55	9.22	9.50
	Cardiothoracic ratio (%)	56.8	–	–	51.5	–	50.5	–	51.5	–
Physical assessment	FIM (point)	58	–	–	–	–	82	–	115	–
	Grip strength; right (kg)	15	–	–	15	–	16	–	18	–
	Grip strength; left (kg)	18	–	–	17	–	18	–	20	–
	FILS	3	–	–	4	–	7	9	10	–
	Dry weight (kg)	46.5	46.0	45.8	–	46.0	46.5	–	47.0	47.5
	CC (cm)	28.0	–	–	28.2	28.4	–	–	28.8	29.1

Abbreviations: *CC* calf circumference, *CRP* C-reactive protein, *FIM* Functional Independence Measure, *FILS* Food Intake Level Scale, *GNRI* Geriatric Nutritional Risk Index, *MNA-SF* Mini Nutritional Assessment Short-Form, *NG* nasogastric tube, *nPCR* normalized protein catabolic rate, *ONS* oral nutritional supplements, *%CGR* % creatinine generation rate

On day 2, exercise training, physical activity training by physical therapist (PT), and swallowing training by the speech therapist (ST) began (PT: 20 min/day, ST: 20 min/day). On day 3, videoendoscopic examination (VE) of swallowing revealed disorders of bolus formation and transport. In addition, delayed swallowing reflex, a large amount of residuals in the epiglottic vallecula and pyriforms, and laryngeal penetration were also observed.

On day 7, ingestion of pudding (300 kcal) and thickened water began. On day 14, pureed food began to be offered only for one meal a day; from the 20th day, three meals were offered daily (1400 kcal + dietary supplement, 300 kcal). We continued physiotherapy, mainly focusing on lower limb muscular strength training and orthostatic exercises, and indirect swallowing training. The amount of enteral nutrition was modified based on physical activity and oral intake.

On day 42, the nasogastric tube was removed and rice porridge and soft food (combined with oral nutritional supplement) were started. VE on the 55th day showed no obvious larynx penetration and aspiration and improved throat clearance.

On day 81, in addition to PT—including walking training and stair ambulation—voluntary training was actively carried out. Therefore, we increased the provided energy to 2000 kcal and 65 g protein.

On day 108, he was discharged to go home, and he was able to walk outdoors. Dry weight increased to 47.5 kg, and the MNA-SF increased to 10 points, while GNRI was 79, indicating severe nutritional risk. The FIM score increased to 115 (+ 57) points (motor domain score of 81 [+ 54], cognitive domain score of 34 [+ 3]), and bilateral handgrip strength improved (right 18 [+ 3] kg, left 20 [+ 2] kg). His FILS level was 10, without developing pneumonia; sarcopenic dysphagia improved. He was no longer diagnosed with PEW because his dietary intake improved, although biochemical examination and physical examination did not show improvements. Walking ability improved, and handgrip strength showed a mild increase, although sarcopenia remains.

Ten months after discharge, he visits our hospital three times a week for maintenance dialysis.

Discussion

This case highlights two important issues with respect to nutritional intervention and management. Firstly, rehabilitation nutrition management aimed at increasing the dry weight, towards improving PEW in hemodialysis patients, may lead to improvement in physical function. Secondly, rehabilitation nutrition management may be useful in improving sarcopenic dysphagia in hemodialysis patients with PEW and sarcopenia.

Rehabilitation nutrition management aimed at increasing the dry weight in improving PEW in hemodialysis patients may lead to improvement in physical function. PEW is difficult to improve by nutritional supplementation alone because factors such as hyper catabolism accompanying dialysis, inflammation, loss of amino acids, insulin resistance, and endocrine abnormality may interfere with the treatment regimen [27]. Potential sources of sarcopenia, frailty, and protein-energy wasting in hemodialysis patients are shown in Fig. 2. The catabolism of protein and energy promotes not only fat loss but also protein loss, thus resulting in sarcopenia. Rehabilitation nutrition management evaluating sarcopenia is considered effective for improving physical functions. It is effective to raise awareness of sarcopenia, and early diagnosis and intervention are desired. Rehabilitation nutrition management improved physical function and facilitated the healing of pressure ulcers in a malnourished patient with type 2 diabetes. Based on this study, it may be useful to simultaneously perform nutritional support and rehabilitation for hemodialysis patients with PEW. We instituted nutrition control and rehabilitation by administering 38 kcal/dry weight/day for energy and 1.2 g/dry weight/day for protein [3]. By sharing

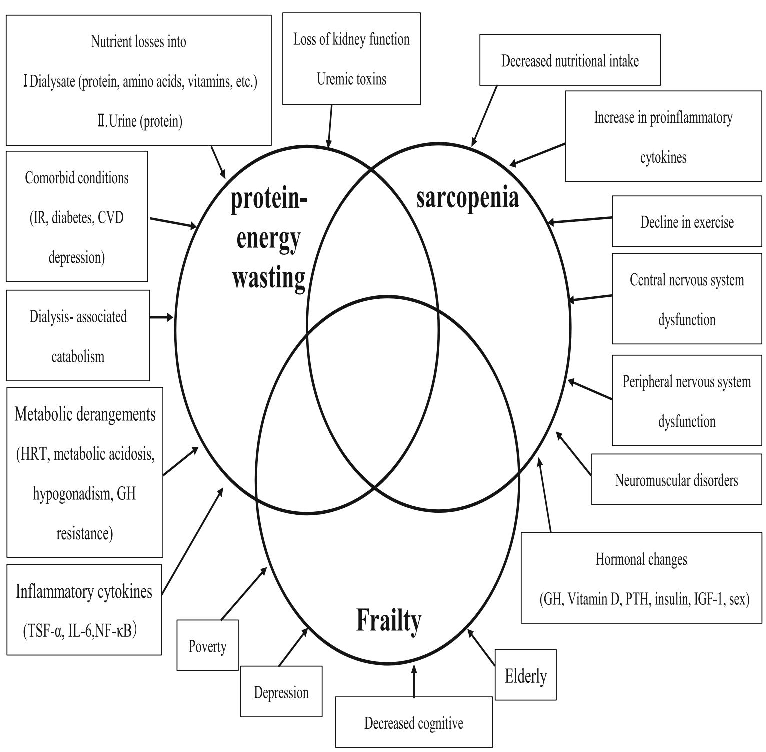

Fig. 2 Potential causes of sarcopenia, frailty, and protein-energy wasting in a hemodialysis patient. There are many factors in sarcopenia, frailty, and protein-energy wasting in hemodialysis patients, and these three factors often overlap. Abbreviations: cardiovascular disease (CVD), growth hormone (GH), hyperparathyroidism (HPT), insulin-like growth factor-1 (IGF-1), interleukin-6 (IL-6), insulin resistance (IR), nuclear factor-kappa B (NF-κB), parathyroid hormone (PTH), tumor necrosis factor-α (TSF-α)

information on momentum and swallowing function, we carried out nutrition management considering the energy requirement for functional improvement. This resulted in improvement in nutritional status and physical function, which resulted in the patient's ability to orally ingest food and to walk outdoors.

Rehabilitation nutrition management may be useful in improving sarcopenic dysphagia in hemodialysis patients with PEW and sarcopenia. There is a correlation between sarcopenia and swallowing dysphagia [31]. Sarcopenic dysphagia is caused by muscle mass reduction and muscle weakness of whole body and swallowing [3]. In this case, sarcopenia was found in the whole body due to increased bed rest, parenteral nutrition intake, nutritional deficiency, and infiltration by meningitis, despite oral ingestion before artificial respiration. The patient in this case had risk factors for sarcopenic dysphagia, such as decreased skeletal muscle index, low independence of ADL, and low BMI [32]. Skeletal muscle loss is related to swallowing function and that sarcopenia and reconstructed tongue may cause sarcopenic dysphagia. In this case, the swallowing function was improved mainly by resistance training, food training, and nutrition improvement, and so, it was considered to be affected by sarcopenic dysphagia. Improvement in swallowing function was observed by carrying out nutrition management aimed at dry weight increase in maintenance dialysis patients and mainly based on resistance training.

Conclusion

Rehabilitation nutrition management aimed at increasing the dry weight in improving PEW, and sarcopenia in maintenance hemodialysis patients may lead to improvement in physical function and sarcopenic dysphagia. Further investigations are necessary to verify the effect of rehabilitation nutrition approach on maintenance dialysis patients with PEW and sarcopenia.

Abbreviations

ADL: Activities of daily living; BMI: Body mass index; FILS: Food Intake Level Scale; FIM: Functional Independence Measure; GNRI: Geriatric Nutritional Risk Index; MNA-SF: Mini Nutritional Assessment Short Form; PEW: Protein-energy wasting; PT: Physical therapist; QOL: Quality of life; ST: Speech therapist; VE: Videoendoscopic examination

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Availability of data and materials

The data and materials were all included in the manuscript.

Authors' contributions

All the authors have approved the manuscript and agree with submission to the esteemed journal. CU has participated in conception and design, acquisition of data, interpretation of data, drafting or revision of the manuscript, and approval of the final version of the manuscript. HW, KM, and SN have participated in conception and design, interpretation of data, drafting or revision of the manuscript, and approval of the final version of the manuscript.

Ethics approval and consent to participate

Written informed consent was obtained from the patient after a detailed explanation of the objectives of the study. The patient requested strongly that the report be published to rehabilitation nutrition management in dialysis patients. The patient provided informed consent for publication of this study, and the patient anonymity should be preserved.

Consent for publication

For publication of this case report, written agreement was obtained from the patient.

Competing interests

The authors declare that they have no competing interests.

Publisher's Note

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