

## Case Report



# A Case Study on the Customized Nutrition Intervention for a Patient with Primary Gastrointestinal Non-Hodgkin Lymphoma Underlying Chronic Kidney Disease

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### Conflict of Interest

The authors declare that they have no competing interests.

## ABSTRACT

Non-Hodgkin lymphoma comprises 2.1% of the total number of cancers in South Korea. Among those, diffuse large B cell lymphoma (DLBCL) comprises the largest percentage. Nutrition interventions have been highlighted because nutritional status in non-Hodgkin's lymphoma patients has a significant impact on treatment and prognosis, but relevant studies are inadequate. Therefore, the aim of this study was to share the case of a nutrition intervention for a patient with primary gastrointestinal non-Hodgkin lymphoma underlying chronic kidney disease who was comorbid with tumor lysis syndrome, which was a complication of a specific chemotherapy. The subject is a 76-year-old patient who was diagnosed with DLBCL. He had abdominal pain, constipation, and anorexia. After chemotherapy, he experienced the tumor lysis syndrome. The patient's condition was continuously monitored, and various nutrition interventions, such as nutrition counseling and education, provision of therapeutic diet, oral nutritional supplement, change of meal plans, and parenteral nutrition support were attempted. As a result of the nutrition intervention, oral intake was increased from 27% of the energy requirement to 70% and from 23% of the protein requirement to 77%. Despite the various nutrition interventions during the hospitalization, there were no improvements in weight and nutrition-related biochemical parameters or malnutrition. However, it was meaningful in that the patient was managed to prevent worsening and the planned third chemotherapy could be performed. These results can be used as the basis for establishing guidelines for nutritional interventions customized to patients under the same conditions.

**Keywords:** Lymphoma; Chemotherapy; Nutrition therapy; Malnutrition

## INTRODUCTION

Non-Hodgkin lymphoma is a malignant tumor of lymphatic tissues, excluding Hodgkin lymphoma. According to 2019 annual report of Korea Central Cancer Registry, it was reported that about 94% of the lymphomas in Korea in 2017 were non-Hodgkin lymphomas and that non-Hodgkin lymphomas comprise 2.1% of all cancers [1].

The most common area of non-Hodgkin lymphoma invasion site is the gastrointestinal tract, excluding lymph nodes, with 50%–60% in the stomach, 20%–30% in the small intestine, and 10% in the large intestine. Among the affected sites in the small intestines, the ileum is the most commonly affected. Primary gastrointestinal lymphoma has been on the rise in recent years, and its main symptoms are non-specific, such as abdominal pain, diarrhea and vomiting. Diffuse large B cell lymphoma (DLBCL) which comprises the largest proportion of the non-Hodgkin lymphoma is also known to induce complications such as bleeding, perforation, and intussusception [2].

DLBCL shows aggressive clinical features. Unlike Hodgkin lymphoma, it is treated with mainly chemotherapy. R-CHOP (rituximab, cyclophosphamide, hydroxydaunorubicin, oncovin and prednisone) used in the treatment for chemotherapy regimen of non-Hodgkin lymphoma, which is an integrative chemotherapy that combines a number of drugs with varying functional mechanisms and toxicity levels [2,3].

Unlike other solid cancers, DLBCL has the specific characteristics of the possibility of tumor lysis syndrome as a side effect of chemotherapy. Tumor lysis syndrome is a sign of fast-growing cancer cells releasing intracellular substances into the blood as they die shortly after the chemotherapy, and it can cause acute kidney injury (AKI), cardiac dysrhythmias, and death [4].

The nutritional status of the patient with non-Hodgkin lymphoma can affect the response to the treatment and the prognosis. Yilmaz et al. [5] presented results showing that the 1-year mortality of lymphoma patients with the poor nutritional condition was higher than that of the patients with good nutritional condition. In order to prevent malnutrition and maintain proper nutrition in lymphoma patients undergoing chemotherapy, it is important to ensure that nutrition intervention is customized to the patient's clinical situation [6].

This study aims to introduce a customized nutrition intervention that was performed during an AKI, hemodialysis, and chemotherapy in a patient with primary gastric DLBCL with tumor lysis syndrome as a complication of the first chemotherapy. This study was conducted after obtaining an approval from the institutional review board of the Catholic University of Korea Yeouido St. Mary's Hospital (SC20ZISI0110).

## CASE

The subject was a 76-year-old male with a history of prostate cancer who is undergoing outpatient treatment at the Department of Nephrology for chronic kidney disease (CKD) due to Autosomal Dominant Polycystic Kidney Disease. He reported abdominal pain on March 19, 2020 and was admitted for further evaluation. The results of a computed tomography scan showed terminal ileum circumferential thickening and terminal ileitis was suspected. Thus, he was transferred to the gastroenterology department on March 26. Results of colonoscopy and biopsy led to the final diagnosis of DLBCL. He was transferred to hematology department on April 2 and started chemotherapy. He was hospitalized a total of 4 times from March 19 to June 23. Three cycles of chemotherapy were performed. Various nutrition intervention processes, such as nutrition education and counseling, nutrition provision (changing meal plans and oral nutritional supplement [ONS]), the explanation about therapeutic diet, and parenteral nutrition (PN) support according to the patient's clinical course during this process are presented in **Table 1**.

Table 1. Summary of each nutrition intervention

Variables	Number of admission										
	1st		2nd		3rd		4th				
HOD	#2 (Mar 20, 2020)	#5-7 (Mar 23-25, 2020)	#9-14 (Mar 27, 2020-Apr 1, 2020)	#17-19 (Apr 4, 2020-Apr 6, 2020)	#27 (Apr 14, 2020)	#30 (Apr 17, 2020)	#2 (Apr 29, 2020)	#6-9 (May 3-6, 2020)	#2-11 (May 13-22, 2020)	#2 (Jun 3, 2020)	#21 (Jun 22, 2020)
Clinical course	-	-	-	Diagnosed with DLBCL, first cycle of chemotherapy	ileus	Tumor lysis syndrome	ICU stay, CRRT	IHD start	Second cycle of chemotherapy, grasin administration with ANC reduction	Hold chemotherapy because of fever and pneumonia, third cycle of chemotherapy	-
Symptoms	Abdominal pain, dyspepsia, constipation	Abdominal pain, dyspepsia, constipation	Abdominal pain, abdominal distension, constipation	Abdominal pain, constipation	Abdominal pain, abdominal bowel gas, constipation	General weakness, powerlessness	Abdominal pain, abdominal distension	Anorexia, general weakness, powerlessness	General weakness, powerlessness	Anorexia, general weakness, powerlessness	General weakness, powerlessness
Diet order	CKD diet (Na 2,000 mg)	CKD with light low sodium (Na 4,000 mg)	Low residual diet	High-protein diet	NPO	High-protein diet	NPO	HD diet	Sterilized-HD diet	HD diet	High-protein diet
Energy from oral intake (kcal, % calorie intake by oral diet)	430/27	720/45	260/16	250/15	0/0	475/30	0/0	192/12	473/30	473/30	1,125/70
PN type	-	Smofkabiven Peripheral 3-in-1	Smofkabiven Peripheral 3-in-1	Smofkabiven central	Combiflex	Combiflex	Combiflex	Combiflex	-	-	-
Energy from PN (kcal, % calorie intake by PN)	0/0	662/41	662/41	1,071/67	1,122/70	1,122/70	1,122/59	1,122/70	0/0	0/0	0/0
Total intake (kcal, % calorie intake by oral diet and PN)	430/27	1,382/86	922/58	1,321/83	1,122/70	1,597/100	1,122/59	1,314/82	473/30	473/30	1,125/70
Nutritional interventions	Nutrition counseling	Nutrition provision (parenteral nutrition), education and counseling for management CKD	Nutrition support	Nutrition provision (oral nutrition supplements provided, parenteral nutrition), education and counseling for management CKD	Nutrition support	Nutrition counseling, nutrition support	Nutrition counseling	Nutrition counseling, nutrition support	Nutrition counseling, nutrition provision (oral nutrition supplements provided)	Nutrition counseling, nutrition provision (changing meal plan)	Nutrition counseling

HOD, hospital onset of day; DLBCL, diffuse large B cell lymphoma; CKD, chronic kidney disease; NPO, nothing per oral; ICU, intensive care unit; PN, parenteral nutrition; CRRT, continuous renal replacement therapy; IHD, intermittent hemodialysis; ANC, absolute neutrophil count; HD, hemodialysis.

**Table 2.** Anthropometric & biochemical data

Variables	Normal range	1st		2nd		3rd		4th	
		Admission	Discharge	Admission	Discharge	Admission	Discharge	Admission	Discharge
Weight (kg)		56.9	59.5	53.0	53.3	53.4	53.5	52.4	52.0
PIBW (%)		109.0	114.0	101.5	102.1	102.3	102.5	100.4	95.1
BMI (kg/m <sup>2</sup> )		22.9	23.9	21.3	21.4	21.5	21.5	21.1	20.9
Biochemical data									
Albumin (g/dL)	3.5–5.2	3.41	3.07	2.52	3.04	2.71	2.58	2.60	3.27
Total protein (g/dL)	6.6–8.3	7.6	5.6	4.8	5.6	5.2	4.7	5.0	5.5
Hemoglobin (g/dL)	12.0–16.0	9.6	13.2	11.2	10.9	10.0	9.7	10.5	10.6
WBC count (10 <sup>9</sup> /L)	4.0–10.0	5.77	19.93	17.80	7.02	6.62	10.67	9.06	8.99
RBC count (10 <sup>12</sup> /L)	4.5–5.5	2.82	3.69	3.89	3.63	3.37	3.22	3.55	3.53
Platelet count (10 <sup>9</sup> /L)	150–450	226	294	425	185	186	50	180	89
Blood Urea Nitrogen (mg/dL)	8.0–20.0	48.0	75.1	54.3	39.0	39.6	25.7	19.2	26.8
Creatinine (mg/dL)	0.51–0.95	3.13	7.18	5.16	3.78	3.80	1.80	2.39	2.64
e-GFR (mL/min per 1.73 m <sup>2</sup> )		18.3	6.7	10.9	14.6	14.5	35.8	25.4	22.5
Potassium (mmol/L)	3.5–5.1	5.1	5.1	3.3	4.2	3.8	3.0	3.4	3.9
Phosphorus (mg/dL)	2.5–4.5	4.3	6.8	-	2.7	3.0	2.0	2.5	0.8
Magnesium (mg/dL)	1.9–2.5	2.2	2.8	-	2.2	2.0	1.6	1.5	2.1
ANC (μL)	> 1,000	4,510	4,900	15,630	4,180	3,900	9,600	4,880	7,270

PIBW, predicted ideal body weight; BMI, body mass index; ANC, absolute neutrophil count; WBC, white blood cell; RBC, red blood cell count; e-GFR, estimated glomerular filtration rate.

The patient's anthropometric data and biochemical parameters during the periods of hospitalization are presented in **Table 2**. Weight at the time of the fourth admission was reduced by 4.9 kg (–8.6%/3 months) compared to that at the time of the first admission. Serum albumin levels were lower than the normal range. Hypoalbuminemia possibly related to edema caused by underlying CKD. Serum blood urea nitrogen (BUN) is an indicator that indirectly reflects the protein intake, and 60–80 mg/dL is considered an optimal range for patients undergoing hemodialysis [7]. The patient in this study showed a lower BUN value than the optimal range for patients undergoing hemodialysis. This may be due to insufficient protein intake.

Catholic medical center nutrition risk screening (CMC NRS) and the scored Patient-Generated Subjective Global Assessment (PG-SGA), which is a standard tool to assess the nutritional status of a hospitalized patient, were used. On CMC NRS, he scored 2 points on category of appetite (reduced by more than 1/2 of the usual intake), 3 points on the gastrointestinal discomfort (abdominal pain), 1 point on the defecation disorder (constipation), 1 point on the diet prescription (therapeutic diet), and 1 point on age (≥ 70 year) for a total of 8 points, which identified to be at high risk of malnutrition (CMC NRS score of 4 or higher is nutritionally at risk). The results of assessing the nutrition status using PG-SGA showed that the patient were moderate malnutrition (scored 16 points, SGA-B).

**Table 3** presents the results of the nutrition status assessment at the times of the first through the fourth admissions.

**Table 3.** Nutrition assessment data

Variables	1st		2nd		3rd		4th	
	Admission	Discharge	Admission	Discharge	Admission	Discharge	Admission	Discharge
Total PG-SGA score* (PG-SGA score, subjective global rating)	16, SGA-B	-	28, SGA-B	-	15, SGA-B	-	15, SGA-B	13, SGA-B
CMC NRS score <sup>†</sup>	8		8		6		6	

PG-SGA, Patient-Generated Global Assessment; CMCNRS, Catholic Medical Center nutrition risk screening.

\*PG-SGA scores range from 0–35 with a higher score reflecting a greater risk of malnutrition. SGA-A, well-nourished; SGA-B, moderately malnourished or suspected malnutrition; SGA-C, severely malnourished. <sup>†</sup>CMC NRS score ≥ 4: the patient is nutritionally at-risk.

**1st adm #2 (2020-03-20)**

The patient was classified as a high risk of malnutrition. After an interview with the certified clinical dietitian, nutrition intervention plan was established. In order to calculate the required energy intake and protein intake, the Kidney Disease Outcomes Quality Initiative (K/DOQI) guideline was used considering the patient's overall condition. Energy requirement was approximately 1,600 kcal (with reference to ideal weight, 30 kcal/kg/day) and protein requirement was 44 g (with reference to ideal weight, 0.8 g/kg/day). CKD diet were prescribed and he consumed 430 kcal (27% of the energy requirement) and 10 g of protein (23% of the protein requirement). He was encouraged to increase his intake as his abdominal pains were improved.

**1st adm #5 (2020-03-23)**

Abdominal discomfort and difficulty to adapt to CKD diet caused insufficient oral intake. Therefore, Smofkabiven Peripheral 3-in-1 type was provided via peripheral PN. Approximately 68% of the energy requirement were met through the oral intake and PN. In order to increase oral intake, prescribed diet was changed from low-sodium CKD diet (2,000 mg of sodium) to light-low sodium CKD diet (4,000 mg of sodium). Acceptance of the hospital meal improved to 720 kcal energy intake (45% of the energy requirement) and 18 g of protein intake (41% of the protein requirement) via oral, which represented a 60% increase in the energy intake compared to that before the diet order change.

**1st adm #7 (2020-03-25)**

Nutrition education and counseling for management of CKD were requested. The contents of education were dietary guidelines for sodium, potassium and phosphorus limits, recommended energy intake and proper intake for each food group. ONS for non-dialysis patients, which can be utilized when oral intake is insufficient, was provided and education was provided how to use them.

**1st adm #9 (2020-03-27)**

Terminal ileitis was suspected, and the patient was transferred to gastroenterology department. Low-residual diet was prescribed due to abdominal swelling and discomfort, and the clinical dietitian explained how to restrict intake of fiber and fat. The patient's oral intake was reduced because of the symptoms. The patient orally consumed 260 kcal of energy (16% of the energy requirement) and 14 g of protein (32% of the protein requirement). Through oral intake and 3-in-1 type PPN, approximately 55% of the energy requirement was fulfilled.

**1st adm #14 (2020-04-01)**

Insufficient oral intake continued due to abdominal pain and constipation and PN (SMOF lipid 20%) was provided. Through oral intake and PN, 1,220 kcal of energy (76% of the energy requirement) and 14 g of protein (32% of the protein requirement) were provided. The nutrition support team (NST) requested the recommend change of the 3-in-1 type of PN to provide proper amount of energy and protein.

**1st adm #17 (2020-04-04)**

The patient was given the diagnosis of DLBCL. On April 2, he was transferred to the hematology department. In accordance with the protocol at the hematology department, the prescribed therapeutic diet changed to a high-protein diet. The high-protein diet at this hospital is designed for patients undergoing chemotherapy, taking into account symptoms caused by chemotherapy, reduced appetite, and insufficient oral intake. Three meals are

served with dairy products or fruit, and two snacks a day (bread, potatoes, soup, thin porridge, and eggs, etc.). Considering the renal functions, a prescription of a CKD diet would be appropriate. However, considering of patient's malnutrition status and poor oral intake, High-protein diet was prescribed after a consultation with the medical staff in order to increase intake. On April 3, the first cycle of chemotherapy were administered with R-CHOP (75%).

#### **1st adm #19 (2020-04-06)**

Nutrition education was carried out for the nutritional management of chemotherapy. Contents of nutrition education were recommended dietary intake during chemotherapy, how to cope eating problems caused by side effects. Also, various flavors (coffee, crispy rice crust, and banana flavors) and types (e.g., liquid and jelly) of ONS for cancer patients were provided. The patient was encouraged to use them.

#### **1st adm #27 (2020-04-14)**

The patient continuously reported indigestion, abdominal discomfort, and abdominal pain even after chemotherapy. The results of an X-ray showed ileus. Nothing per oral (NPO) was prescribed. 1,122 kcal of energy (70% of the energy requirement) and 48 g of protein (109% of the protein requirement) were provided by central parenteral nutrition (CPN).

#### **1st adm #30 (2020-04-17)**

Continuous increase in serum BUN and creatinine were observed. Tumor lysis syndrome was suspected. Renal functions worsened due to lack of oral intake for a long period of time, weight loss, and body fluid volume reduction. Co-treatment with the nephrology department recommended encouragement to increase oral intake and hydration. Approximately 30% of the energy requirement and 45% of the protein requirement were covered through the oral intake. NST suggested to provide PN because it would be difficult to reach the required levels via oral intake. Through oral intake and PN, 1,600 kcal of energy (100% of the energy requirement) was fulfilled. The patient was encouraged to use the ONS and snacks (e.g., thin rice gruel and French toast).

#### **2st adm #2 (2020-04-29)**

Outpatient biochemical data revealed worsened renal functions, metabolic abnormality, anuria, and edema. The patient was transferred to intensive care unit and he started Contemporary Nutrition Support Practice - A Clinical guide, Version 3 (CRRT).

According to the results of the CMC NRS, the patient had weight loss in the past 3month, appetite, gastrointestinal discomfort, requiring complete support, prescription diet, and age for a total of 10 points, which were classified malnutrition risk group. The results of the PG-SGA also showed that the patient was moderate malnutrition (scored 28 points, SGA-B). The patient was fasting due to hemodynamic instability and abdominal pain and swelling. During fasting, nutrition support through CPN and consultation to NST were recommended. Considering the increase in the energy and protein requirements for the patients undergoing CRRT, the energy requirement was calculated to be about 1,900 kcal (with reference to ideal body weight, 35 kcal/kg/day) and protein requirement was calculated to be 82 g (with reference to ideal body weight, 1.5 g/kg/day). Through CPN, 1,122 kcal of energy (about 59% of the energy requirement) was provided.



**2st adm #6 (2020-05-03)**

Patient's general condition had been stabilized and gastrointestinal symptoms had been improved. The treatment plan was changed from CRRT to intermittent hemodialysis (IHD), and the clinical dietitian explained the need for hemodialysis (HD) diet, high-quality protein intake to maintain nutritional status, sufficient calorie intake and sodium, phosphorus and potassium restriction.

After changing to IHD, the energy requirement was about 1,600 kcal (with reference to ideal body weight, 30 kcal/kg/day) and the protein requirement was 66 g (with reference to ideal body weight, 1.2 g/kg/day). The oral intake was decreased, so ONS for dialysis patients was recommended.

**3rd adm #2 (2020-05-13)**

For the second cycle of chemotherapy, the patient was readmitted. The results of the CMC NRS showed that he had weight loss in the past 3 months, appetite, therapeutic diet, and age for a total of 6 points, identified to be at high risk of malnutrition. PG-SGA showed that the patient was moderate malnutrition (scored 15 points, SGA-B).

HD diet was prescribed. The reason for providing a therapeutic diet and caution (e.g., dietary restrictions) were explained to the patient. In order to prevent further weight loss and improve nutritional status, the importance of oral intake was emphasized.

**3rd adm #9 (2020-05-20)**

The patient's absolute neutrophil count decreased from 5,460  $\mu$ L to 620  $\mu$ L. Grasin prefilled Injection Jeil (Granulocyte colony-stimulating factor) was administered, Sterilized-HD diet was prescribed for the purposes of reducing the risk of infection from diet. The clinical dietitian explained recommended dietary intake and restricted food list during neutropenia. 475 kcal of energy (30% of the energy requirement) and 19 g of protein (29% of the protein requirement) was consumed via oral intake. To increase intake, ONS for hemodialysis patients was additionally provided. In order to increase immune function, sufficient oral intake was encouraged.

**3rd adm #11 (2020-05-22)**

With continuous encouragement for food consumption and additional provision of ONS for dialysis patients, his oral intake was increased to 1,000 kcal of energy (62% of the energy requirement) and 40 g of protein (61% of the protein requirement) per day.

**4th adm #2 (2020-06-03)**

The patient was hospitalized for the third cycle of chemotherapy. At the time of admission, he had a fever of 38.0°C. Thus, he was started on antibiotic treatment. The results of CMC NRS showed that he had weight loss in the past 3 months, appetite, therapeutic diet, and age for a total of 6 points, which placed the patient at high risk of malnutrition. The results of the PG-SGA showed that the patient was moderate malnutrition (scored 15 points, SGA-B). Hemodialysis diet was prescribed and the patient was encouraged to increase oral intake.

**4th adm #3 (2020-06-04)**

Although the fever subsided, the chemotherapy was postponed due to pneumonia. The energy intake of the patient was 845 kcal/day (53% of the energy requirement) and protein intake was 40 g/day (61% of the protein requirement). Clinical dietitian highlighted that

chemotherapy were withheld due to pneumonia, and explained the importance of increased oral intake to improve nutritional status.

**4th adm #8 (2020-06-09)**

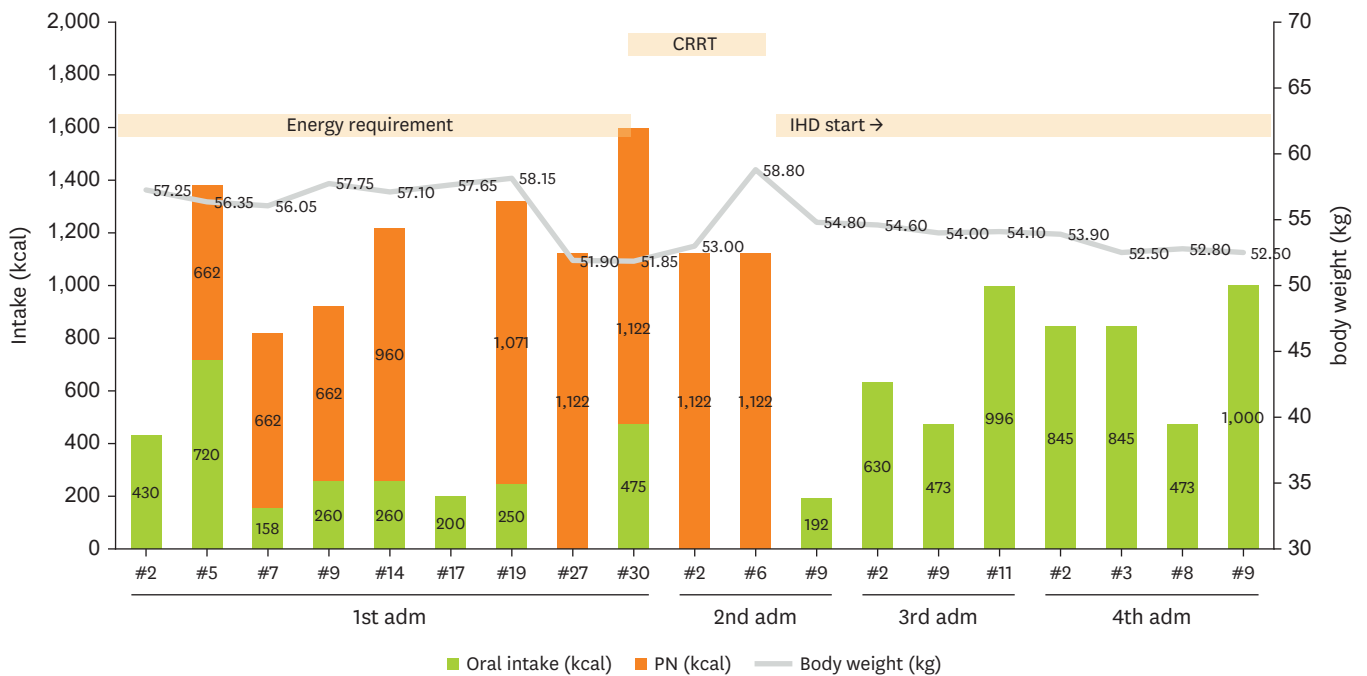
The third cycle chemotherapy was planned as pneumonia improved. However, anorexia worsened and the compliance of hemodialysis diet decreased. The subject experienced specific complications that were greatly related to insufficient oral intake, such as tumor lysis syndrome and neutropenia during the first and the second cycles of chemotherapy. Sufficient nutrition support is needed to prevent malnutrition from being worsened during the third cycle of chemotherapy. Under consultation with the medical staff, it was decided not to restrict the diet until intake recovery while monitoring the blood levels related to renal functions. Also, prescribed diet was changed from hemodialysis to high-protein diet.

**4th adm #9 (2020-06-10)**

It was found that the patient's oral intake increased to 1,000 kcal of energy (63% of the energy requirement) and 45 g of protein (68% of the protein requirement) through continuous nutrition counseling and changing meal plan.

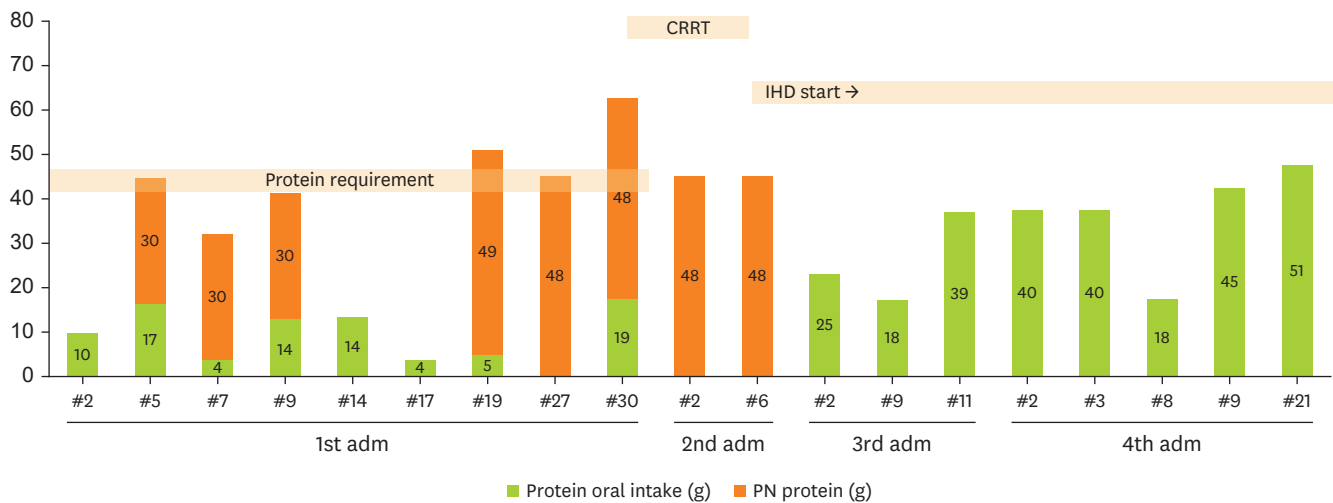
**4th adm #21 (2020-06-22)**

Oral intake increased to 1,125 kcal of energy (70% of the energy requirement) and 50 g of protein (76% of the protein requirement) per day. The patient was given continuous encouragement to consume foods, and was instructed to use nutrient dense snacks (e.g., high-protein jelly and calcium-fortified red bean jelly) and ONS when intake was insufficient. Changes in the weight and food intake over four periods of hospitalizations were presented in **Figures 1** and **2**. It was shown in **Figure 1** that oral intake gradually increased from the third hospitalization compared to the intake during the first and the second hospitalizations.



**Figure 1.** Changes in energy intake through oral and PN. CRRT, continuous renal replacement therapy; IHD, intermittent hemodialysis; PN, parenteral nutrition.





**Figure 2.** Changes in protein intake through oral and PN. CRRT, continuous renal replacement therapy; IHD, intermittent hemodialysis; PN, parenteral nutrition.

Weight also fluctuated greatly in the first and the second hospitalizations due to frequent NPO and edema. However, a relatively stable weight was maintained from the third hospitalization. According to **Figure 2**, protein supplement through PN was necessary due to low levels of protein intakes in the first and the second hospitalizations, but protein supplement through PN was terminated from the third hospitalization due to the gradual increase in the oral protein intake.

## DISCUSSION

The initial nutritional status of the lymphoma patient is assessed as an important prognostic factor of chemotherapy [5]. In particular, improvements in the nutritional status before the treatment are important for patients for whom R-CHOP treatment.[8]. Clinical dietitian's early nutrition intervention for the malnourished patients showed positive results, such as increased oral intake and reduced duration of hospital stays [9]. The systematic review and meta-analysis by Baldwin et al. [10] was reported that patients who received nutrition intervention showed improvements in weight and intake compared to patients who received routine care.

According to the screening by CMC NRS, which is the initial nutrition screening tool at this hospital, and PG-SGA, the subject of this study was malnourished at the time of admission and needed nutrition intervention from the beginning of the hospitalization. Nutrition counseling is the most commonly used nutritional support for malnourished patients, and helps to maintain and improve the nutritional status by managing the symptoms and encouraging oral intake. During nutrition counseling, nutritional problems, goals, and motivations of nutritional recommendations should be given [11]. Despite multiple sessions of nutrition counseling performed for this purpose, the subject diagnosed with primary gastrointestinal non-Hodgkin lymphoma did not show improvements in oral intake or nutritional status due to abdominal pain, constipation, indigestion, lack of appetite, and complication of ileum infection, and did not reach the energy and protein requirement which is the goal of the nutrition intervention. In patients with the same symptoms as the subject in this study, increase in PN support is necessary if oral intake is insufficient [12]. It was

stated that artificial nutrition should be provided to maintain the nutritional status or prevent deterioration of nutrition in patients who are losing weight due to insufficient food intake [11]. Therefore, in order to increase oral intake of the subject, the gastrointestinal symptoms and complications, which are the causes of restriction of intake, should be improved. The NST recommended to simultaneously provide PN at the same time. Despite the increases in energy and protein supplement through parenteral nutrition, the nutritional status of the subject did not improve before the chemotherapy. However, the nutritional status was not worsening.

The subject was classified with a high risk of tumor lysis syndrome as a patient with an underlying CKD. He was 76 years old, corresponding to the age group of above 60 with a high risk of neutropenia [8]. After the first cycle of chemotherapy, oral intake decreased to about 10% of the energy requirement due to severe lack of appetite and indigestion and abdominal pain due to ileus. Due to contraindications to oral intake, he was prescribed NPO. Ultimately, the patient was observed with continuously increased BUN/ Cr and metabolic abnormalities. AKI on CKD occurred. At the time of 14 days from chemotherapy, he was comorbid with a tumor lysis syndrome. When a tumor lysis syndrome occurs, the chemotherapy was postponed or temporarily halted and conservative therapy, such as appropriate fluid therapy and diuretic and allopurinol administration, is performed [4]. Metabolic abnormalities were also corrected in this subject after the conservative therapy. However, the patients needed to intensive care and CRRT due to worsening renal function and hemodynamic unstable.

With the stabilization of the subject's condition, his treatment plan was changed from CRRT to IHD. According to the previous research by Naalweh et al. [13], only 24%–40% of the dialysis patients usually follow the therapeutic diet. In particular, it was reported that the adherence to the diet was low in the old-age patients because it was difficult to change the dietary habits that have been maintained for a long time. This subject also showed difficulty to adapt to the HD diet during the hospital stay, and the intake was even lower due to the generalized weakness and loss of appetite because of chemotherapy. In particular, after the second cycle of chemotherapy, the prescription changed to sterilized-HD diet and the list of restricted food items increased due to neutropenia, making it difficult to increase the intake. Lee et al. [14] stated that continuous, rather than one-time, monitoring was important for dialysis patients who have difficulties in eating. In this study, the clinical dietitian continuously visited the patient to emphasize importance of maintain the nutritional status of patients and encourage active increase in intake, which resulted in a temporary improvement in intake. However, despite the continuous nutrition intervention, the patient could not reach the energy and protein requirements for an anticancer patient on dialysis. This was similar to the results by Akbulut [11], who conducted a 2-year randomized controlled trial reported that nutrition counseling on old patients ( $\geq 70$  year) with a risk of malnourishment during chemotherapy had a positive impact on the increase in nutritional intake but more than half of the patients did not reach the energy and protein requirements.

In hemodialysis patients whose diets are a part of the treatment, insufficient energy and protein intake due to excessive dietary restrictions was criticized as a problem [15]. Therefore, rather than strictly restricting diets, it may be more helpful to provide multi-perspective individualized nutrition interventions for improving patient's nutritional status considering overall condition, treatment directions and diet adaptation.

In conclusion, in order to prevent additional worsening of nutritional condition due to chemotherapy and allow the planned chemotherapy in a primary gastrointestinal non-

Hodgkin lymphoma patient with CKD, customized nutrition intervention for each situation, such as tumor lysis syndrome and dialysis which can occur during treatment through continuous monitoring, may be necessary. This study was on a lymphoma patient with comorbidities undergoing a chemotherapy, and there are limitations in the analysis of the factor that reduced the oral intake. Therefore, a research that analyzes the obstacles to oral intake in lymphoma patients may be necessary in the future based on this study.

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