

CASE REPORT

Weight Loss Intervention before Cord Blood Transplantation in an Obese Patient with Acute Myeloid Leukemia: A Case Study

Ryuichi Kasahara, RPT ^{a,b} Takaaki Fujita, OTR, PhD ^c Ryohei Jinbo, RPT ^a Tatsuyuki Kai, MD, PhD ^d
Yuichi Yamamoto, RPT ^a Shinichiro Morishita, RPT, PhD ^e Miki Furukawa, MD, PhD ^d
Yutaka Shiga, MD, PhD ^d Hideo Kimura, MD, PhD ^d Masahiko Fukatsu, MD, PhD ^b
Kayo Harada, MD, PhD ^b Satoshi Kimura, MD, PhD ^b and Takayuki Ikezoe, MD, PhD ^b

Background: A severely obese woman (39.8 kg/m²) with relapsed acute myeloid leukemia was admitted to our hospital to undergo salvage chemotherapy followed by cord blood transplantation (CBT). **Case:** During the salvage chemotherapy period, a 70-day weight loss program addressing diet and exercise was administered. After the 70-day intervention, the patient's body weight and body fat mass had decreased (8.6% and 15.0%, respectively) without any adverse events. The number of available cord blood units with total nucleated cells per body weight greater than $2 \times 10^7/\text{kg}$ was zero at admission and two after weight loss; therefore, CBT could be performed. **Discussion:** Considering this case, we suggest that a weight loss program combining exercise and nutrition therapy may help patients scheduled for hematopoietic stem cell transplantation by focusing on risk management.

Key Words: cord blood transplantation (CBT); exercise; obesity; weight loss

INTRODUCTION

In patients undergoing hematopoietic stem cell transplantation (HSCT), pre-transplantation obesity is associated with an increased risk of graft-versus-host disease, non-recurrence mortality, and decreased overall survival.^{1,2)} For cord blood transplantation (CBT), the patient's body weight and human leukocyte antigen (HLA) compatibility are important in determining the selection of cord blood units containing a target number of CD34-positive cells and total nucleated cells. Although it is important to optimize the weight of patients at the time of transplantation, weight loss programs for obese patients scheduled for CBT have not been reported and their feasibility remains unclear. We herein present the

case of a severely obese hospitalized patient who successfully underwent CBT following a weight loss program that combined diet and exercise.

CASE

A 57-year-old woman presented with headache, sore throat, and malaise. She was referred to the hematology department of our hospital because of leukocytosis, anemia, and thrombocytopenia. Laboratory data showed a white blood cell (WBC) count of 17,710/ μl , a hemoglobin count of 7.2 g/dl, and a platelet count of 26,000/ μl . Bone marrow examination revealed hypercellular marrow with 89.8% myeloblasts. The patient was diagnosed with acute myeloid

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^a Department of Rehabilitation, Kita-Fukushima Medical Center, Fukushima, Japan

^b Department of Hematology, Fukushima Medical University, Fukushima, Japan

^c Preparing Section for New Faculty of Medical Science, Fukushima Medical University, Fukushima, Japan

^d Department of Hematology, Kita-Fukushima Medical Center, Fukushima, Japan

^e Department of Rehabilitation, Niigata University Health and Welfare, Niigata, Japan

Correspondence: Ryuichi Kasahara, RPT, 23-1 Aza-higashi, Hakozaiki, Date-shi, Fukushima, Japan, E-mail: reha-ryu@jinsenkai.or.jp

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leukemia (AML) (FAB classification M1 due to the absence of disease-specific chromosomal or genetic abnormalities). Complete remission was achieved after induction therapy with idarubicin and cytarabine, and complete remission was maintained by four courses of consolidation therapy. Two years later, pancytopenia was noted, and bone marrow examination found an increase in the number of blasts with bone marrow hypoplasia with a nucleated cell count of $1.5 \times 10^4/\mu\text{l}$. The patient was diagnosed with relapsed AML and readmitted for salvage chemotherapy.

The patient had no relatives who were potential donors for HSCT, so she was scheduled to start unrelated donor coordination in parallel with salvage chemotherapy. Rehabilitation was also started for the purpose of weight loss and to improve physical function before HSCT. At the time of admission, the patient was 156.4 cm tall and weighed 97.4 kg (severe obesity; body mass index 39.8 kg/m^2). The patient was independent in activities of daily living with an Eastern Cooperative Oncology Group Performance Status of 0; however, she did not engage in any routine exercise. The patient gave written informed consent for the publication of this case report.

METHODS

Physical Therapy Intervention

Based on the Guidelines for the Management of Obesity Disease 2016,³⁾ exercise therapy involves four factors: (1) frequency: ideally almost every day, more than 5 days per week; (2) intensity: initially low to medium intensity; (3) duration: 30–60 min per day, 150–300 min per week; and (4) activities: mainly aerobic exercise, resistance exercise, stretching, and various conditioning exercises. During rehabilitation, the current patient exercised for 20–40 min, one to three times per day (20–100 min total), 6 days per week.

In cancer patients, the exercise intensity is generally based on a Borg Scale of Perceived Exertion rating of 13 (somewhat hard).^{4–6)} However, taking into consideration the current patient's physical condition, blood pressure, and pulse each day, an intensity up to Borg 17 (very hard) was allowed. The exercises included aerobic training, such as walking and bicycling, and resistance exercise. During the cytopenia phase after chemotherapy, there were times when the blood test results were lower than the "criteria for discontinuing rehabilitation in cancer patients"^{7,8)}; however, exercise therapy was continued after further evaluation of the patient's physical condition. As a countermeasure against infection, if the patient's WBC count was $2000/\mu\text{l}$ or less, the same exercises

were performed in the ward.

Diet Therapy Intervention

Basal energy expenditure (BEE) was calculated using the Harris–Benedict equation, and the total energy expenditure was calculated by multiplying the BEE by the activity factor and stress factor. The calory intake of meals was 1700 kcal on day 1, and this was decreased to 1500 kcal on day 4 and thereafter.

Assessment

Physical function assessment included muscle strength (grip strength and knee extensor strength), exercise capacity, body weight, and body composition. Handgrip strength, as an index of upper limb strength, was measured using a standard adjustable-handle dynamometer (TAKEI Scientific Instruments; GRIP D). Knee extensor strength, as an index of lower limb strength, was measured using hand-held dynamometers (ANIMA; $\mu\text{-tas F1}$). The knee extension force was tested with the patient sitting with the knee flexed at approximately 90° . The dynamometer was applied proximal to the malleoli. For both measurements, the values were divided by the bodyweight to calculate the bodyweight ratios. Exercise capacity was measured using the 6-minute walk test. Assessments were performed at the time of admission (day 0) and at discharge (day 70). For bodyweight and body composition (body fat mass and skeletal muscle mass), the rate of decrease from admission (day 0) to discharge (day 70) was calculated using a body composition analyzer (In Body; In Body S10). Measurements were performed once a week, and feedback to the patient was provided frequently. Activities of daily living (ADL) were assessed using the Barthel Index.

RESULTS

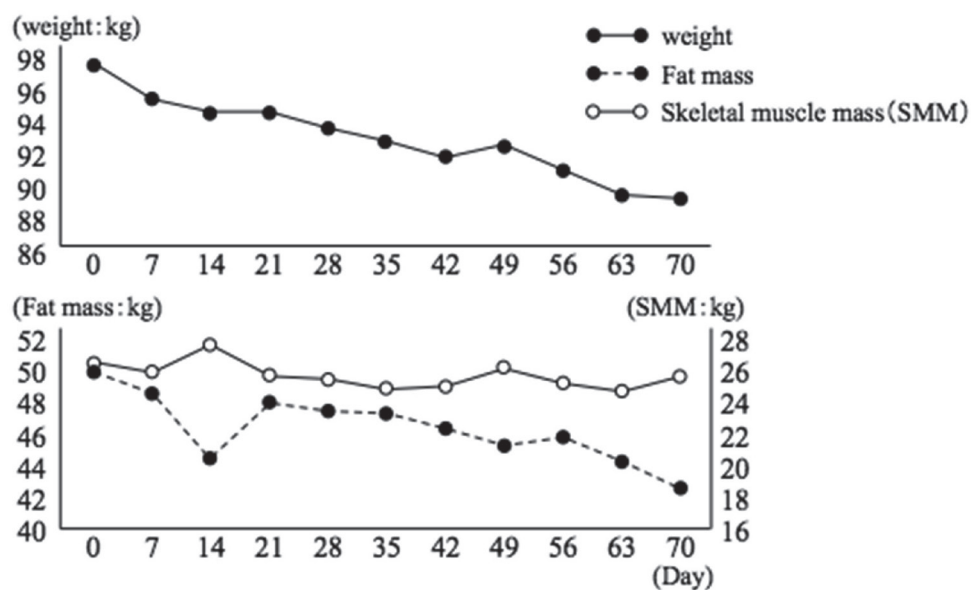
Adherence to exercise therapy was 95.2% (59/62 sessions). The reasons for discontinuation were low back pain (once), headache (once), and fever (once). No adverse events resulting from exercise therapy were observed during or after exercise. The average number of exercises per day was 2.0 ± 0.5 (mean \pm standard deviation). The average exercise duration was 60.0 ± 21.7 min per day and 413.3 ± 52.9 min per week.

Table 1 shows the results of the patient's physical function and ADL assessments. Muscle strength, exercise capacity, and the Barthel Index were unchanged from the time of admission to discharge. **Figure 1** shows the changes in body weight, body fat mass, and skeletal muscle mass from admis-

Table 1. Physical function at admission and discharge

	Admission (day 0)	Discharge (day 70)
Grip strength		
Right	33.4 kg (34.2%)	32.8 kg (36.8%)
Left	28.6 kg (29.3%)	27.4 kg (30.7%)
Knee extensor strength		
Right	34.4 kg (35.3%)	32.9 kg (36.9%)
Left	35.0 kg (35.9%)	32.7 kg (36.7%)
Six-minute walk test	490 m	512 m
Barthel Index	100 points	100 points

Numbers in parentheses show the bodyweight ratio.

**Fig. 1.** Changes in body composition from admission to discharge.

sion to discharge. The patient's body weight was 97.4 kg at admission and 89.0 kg at discharge, which was a decrease of 8.6%. The patient's body fat mass decreased by 15.0%, from 49.7 kg at admission to 42.4 kg at discharge. The skeletal muscle mass was mostly maintained (26.3 kg at admission to 25.5 kg at discharge). At discharge, the physical therapist instructed the patient to perform a home-based exercise program that included walking and bodyweight training for 30–40 min per session (150 min per week). Furthermore, the patient participated in outpatient rehabilitation for 60–90 min a day, three days per week.

When the patient was admitted, no cord blood unit with a sufficient number of total nucleated cells was found, but after bodyweight reduction, two compatible cord blood units were available in the cord blood bank. The patient's body weight

just before transplantation had further reduced to 85.0 kg, and the number of compatible cord blood units had increased to four; she was therefore able to undergo CBT.

DISCUSSION

By participating in a bodyweight loss program, the current severely obese patient with relapsed AML was able to effectively reduce her weight in a short period of time without any adverse events. As a result, suitable cord blood units with a sufficient number of mononuclear cells could be found in the cord blood bank. Exercise therapy for patients with blood cancer requires careful calculation of exercise intensity with consideration of nausea and malaise caused by chemotherapy and the risk of infection and bleeding as a

result of severe cytopenia.

Moderate-intensity physical activity of >250 min per week is reportedly associated with clinically significant weight loss.⁹⁾ In weight loss programs for patients with blood cancer, it is important to set the exercise intensity as high as possible while still ensuring safety. Lønbro et al.¹⁰⁾ reported that exercise therapy at a Borg Scale rating of 14–18 for patients with cancer (mainly breast cancer) undergoing chemotherapy resulted in no adverse events. A Borg scale rating of 10–13 has been used previously in patients undergoing HSCT.^{11–13)} Wiskemann et al.¹⁴⁾ reported exercise therapy at a Borg Scale rating of 12–16 in patients who underwent allogeneic HSCT. They observed a high compliance rate and improvements in cancer-related fatigue, physical function, pain levels, and emotional state. While monitoring vital signs and blood test values, we provided exercise therapy up to a Borg Scale rating of 17 to a patient in need of weight loss. At this intensity level, effective weight loss could be achieved without adverse events. A combination of resistance training with aerobic training is most effective for body weight and fat loss, resulting in greater lean body mass.⁹⁾ In the current patient, the combined use of aerobic exercise and resistance training resulted in a minimal loss of skeletal muscle mass while maintaining physical function.

Rehabilitation for patients undergoing HSCT is generally aimed at preventing the deterioration of physical function and improving the quality of life.¹⁵⁾ A recent study¹⁶⁾ reported the feasibility and safety of combined exercise training and nutritional support before HSCT in patients with hematologic malignancies. The present case suggested that combined exercise training and nutritional support aimed at weight loss could be feasible and safe in patients with hematologic malignancies. Weight loss in patients with obesity undergoing HSCT may lead to an increase in the number of available units of compatible cord blood, as occurred in the current case, and is considered to be an important factor for improving prognosis. Our patient experienced a second period of complete remission after CBT, but the association between transplant results and weight loss is unclear. Further consideration will be needed to determine whether this weight loss program can be applied in other patients and to investigate its effects on transplantation results.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest with any individuals or companies.

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