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Case Report

Improvement of glucose variability by continuation of Low-Carbo meal

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Abstract

Background: For years, there have been various discussion of Calorie Restriction (CR) and low carbohydrate diet (LCD). We have continued clinical research of CR and LCD so far.

Patient and Method: The patient was 72-year-old female with type 2 diabetes mellitus (T2DM). At first visit, she showed BMI 29.5, postprandial 120 min of blood glucose 548 mg/dl, HbA1c 18.0%, Hb 11.4 g/dL, GOT 29 IU/mL, r-GTP 36 IU/mL, Cre 1.0 mg/dL, TG 194 mg/dL, LDL 161 mg/dL. Serum C-peptide radioimmunoactivity (CPR) 5.4 ng/mL, urinary protein 24 mg/dL.

Results: We have treated her by standard LCD meal, including 26% of carbohydrate with 1400kcal per day. She could continue LCD successfully and showed the decreased data as follows: HbA1c 18.0% to 7.8%, blood glucose 548 mg/dL to 154 mg/dL, proteinuria 24 mg/dL to 3 mg/dL, weight 72 kg to 65 kg for some months.

Discussion and Conclusion: LCD showed clinical efficacy in several biomarkers. Patient applied standard-LCD method, including 26% of carbohydrate with 1400 kcal per day, which would bring decreased HbA1c, glucose, proteinuria and weight to the actual degree. These data would become basal reference and would bring further research development in the future.

Key Words

Glucose variability; Type 2 diabetes mellitus (T2DM); Low-Carbo; standard-low carbohydrate diet (standard-LCD); Calorie Restriction (CR),

Introduction

Recently, there has been serious medical and social problems worldwide. It is acute increase of type 2 diabetes mellitus (T2DM). The number of T2DM was approximately 385 million in 2014, and will increase to 592 million by 2035 [1,2]. Consequently, effective and successful treatment for T2DM has been in discussion for years, including diet therapy, exercise therapy, anti-diabetic agents and insulin therapy [3].

In response to diabetic problems, diabetic societies in several countries have summarized their guidelines so far. Some

changes of the guideline were found about the goal of the therapy for the diabetes. There was a proposal of joint algorithm from the European Diabetes Society (EASD) 2012 [4]. After that, the official comment was presented from the American College of Physicians (ACP) in 2017 [5]. It included a new interpretation for the standard level of the goal for HbA1c [6]. The important difference was the value for HbA1c in most T2DM patients, which was to be 7% or more and less than 8%. It showed a large impact for other diabetic societies, because of the discrepancy of ideal value as before. This impact was so large to influence much for several diabetic societies. Against the presentation of ACP, ADA announced an objection at once [3]. Consequently, diabetic management has been in discussion with some diabetic guidelines.

On the other hand, there have been discussion of nutritional therapy for years. They include the comparison with Calorie restriction (CR) and Low Carbohydrate Diet (LCD). Originally, Bernstein and Atkins started LCD in 1990' in Western and European countries [7,8]. After that, LCD has been gradually known and popular, and clinical efficacy of LCD for weight reduction and normalizing glucose variability has been reported so far. Then, LCD has revealed rather predominant effect in comparison with low fat diet and Mediterranean diet from the Dietary Intervention Randomized Controlled Trial (DIRECT) study [9,10]. There are continuing discussion about CR and LCD, and the latter would be shown in the light of various predominant efficacy in the clinical several situations [11,12].

In Japan, the authors and colleagues have initiated LCD through various opportunities [13]. We have continued to develop LCD movement using simple method of LCD in 3 types, which are super LCD, moderate LCD and petite LCD meals [14,15].

In this report, we would present clinical situation of the severe degree of T2DM, and the clinical application of LCD for the patient. The response of LCD would be shown by the decreasing value of HbA1c, blood glucose variability and weight reduction during several months.

Case Report

The patient was 72-year-old female who has been formerly diagnosed as type 2 diabetes mellitus (T2DM) at the age of 65. At that time, she was explained to have diabetic tendency with the necessary treatment of diet therapy, and with no need to start anti-diabetic agent.

After that, she has not have remarkable health problems. In November of the year 201x, she developed symptoms of upper respiratory infection and visited near ambulatory clinic. By blood glucose rapid measurement kit, she was proved to have diabetic states due to extremely elevated blood glucose level. Then, she was transferred to our diabetic specialty clinic for further evaluation and treatment.

On physical examination, she showed 156 cm in height, 72 kg in weight, BMI 29.5 at first visit. Her vitals and consciousness are normal, and lung, heart, abdomen and neurological findings were unremarkable. Chest X-P and EKG showed no remarkable changes. She showed moderate fatty liver by the examination of abdominal CT scan.

Laboratory data showed the following data: postprandial glucose-120 min 548 mg/dl, HbA1c was 18.0%, Hb 11.4 g/dL, GOT 29 IU/mL, GPT 28 IU/mL, r-GTP 36 IU/mL, BUN 19 mg/dL, Cre 1.0 mg/dL, TG 194 mg/dL, LDL 161 mg/dL. Serum C-peptide radioimmunoactivity (CPR) was 5.4 ng/mL (0.8 – 2.5). There was elevated value of urinary protein as 24 mg/dL (< 10).

From these data above, the patient was diagnosed to have severe type 2 diabetes mellitus, obesity and fatty liver. We consulted about the diabetic treatment such as diet therapy, exercise and anti-diabetic agents. She has been working in the restaurant for years, and her life style has been regular. For the proposal of treatment of LCD, she judged that LCD can be successfully continued for several months with her strong mind to be relieved from diabetic states.

The practical method of the diet therapy was standard LCD method. It has 26% of carbohydrate from the calorie ratio and 1400kcal per day. In other word, it has 364 kcal (1400 x 0.26 = 364) per day, and equals to 91g (364/4 =91) of carbohydrate intake a day.

Clinical course of the case is shown in in (Figure 1). Just after the diagnosis of severe diabetic state with extremely elevated HbA1c and blood glucose, we start the diet therapy of LCD. She had continued LCD for several weeks successfully. HbA1c value was decreased from 18.0% to 7.8% in 4 months. Similarly, blood glucose was decreased from 548 mg/dL to 154 mg/dL in 2 months. As to proteinuria, its concentration in urine was decreased from 24 mg/dL to 3

mg/dL in 8 months. Regarding the body weight, she showed 7 kg of weight reduction from 72 kg to 65 kg for 4 months.

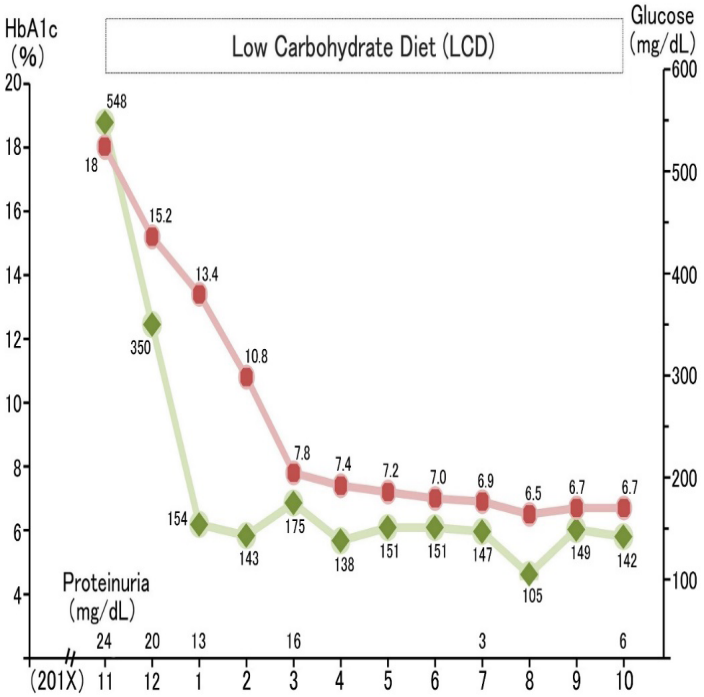

Figure 1: Clinical progress course of the case (72-year-old female with T2DM).

Ethical considerations

This report was conducted in compliance with the ethical principles of the Declaration of Helsinki. Moreover, it was also with Japan's Act on the Protection of Personal Information along with the Ministerial Ordinance on Good Clinical Practice (GCP) for Drug (Ordinance of Ministry of Health and Welfare No. 28 of March 27, 1997).

As for current research, we made an ethical committee in the Yoshinogawa Hospital including the president, the vice-president, the head-nurse of the nursing department, director of the Pharmaceutical department, director of the administration and expert in the mmedical and legal specialty. We discussed about this report and concluded that this is valid and agreed with all members without any problems. Further, informed consents and written paper agreements have been obtained from the subject.

Discussion

The author and colleague researchers have continued clinical experience and research of CR and LCD for years. We have established Japanese LCD promotion association (JLCDPA) and developed LCD in Japan by various seminars, lectures, textbooks, presentation of medical congress [15].

In our previous report, there were clinical experience for LCD with almost 2700 cases [14,16]. We found the weight reduction degree that more than 10% was observed in 26% of subjects, and that more than 2.5% was observed in 79% of subjects, suggesting clinical effect of LCD for reducing body weight.

The beneficial and characteristic methods include the following three pattern of LCD as follows [15,17]: 1) super-LCD: strictly limited in 3 meals, 2) standard-LCD: limited in 2 meals a day, 3) petit-LCD: limited in 1 meal a day. In these three methods, the carbohydrate ratio in the light of calorie calculation is 12%, 26%, 40%, respectively [15,17].

As to the definition of LCD, Feinman and Bernstein have classified nutrition therapy into several categories. [18] They are

i) Very low-carbohydrate ketogenic diet (VLCKD): Carbohydrate, 20–50 g/d or < 10% of the 2000 kcal/d diet.

ii) Low-carbohydrate diet: < 130 g/d or < 26 % total energy.

iii) Moderate-Carbohydrate Diet: 26 % – 45 %.

iv) High-Carbohydrate Diet: > 45 % - 201)

Super-LCD is included in the group of VLCKD. It contains 12 % of carbohydrate, and 42g of carbohydrate intake with 168 kcal, when the total calorie is standard 1400 kcal a day. On contrast, standard-LCD contains 26% of carbohydrate, and 91g of carbohydrate a day.

Continuing Super-LCD usually makes the patient elevated ketone bodies and significant weight reduction [14,16]. Continuing ketogenic diet seems to be necessary to obtain enough weight reduction [19,20]. On contrast, standard-LCD does not usually produce ketone bodies so much [14]. The reason is that carbohydrate intake a day would not be so limited, and that there are various responses of generating ketone bodies due to the predisposition of each patient.

In this report, the case has several characteristics about clinical manifestation. She showed extremely high HbA1c value and hyperglycemia. However, she has not complained of well-known symptoms, such as thirsty, weight loss, fa-

tigue and so on, which are usually observed in severe degree of diabetes [21].

The reason for this may be related to the lifestyle of daily work in the patient. She has always walked a lot, worked hard and carried relatively heavy things every day, in which she has stimulated the muscle during work on a daily basis. Furthermore, she applied not super-LCD method, but standard-LCD, where the rate of decrease of HbA1c and weight loss was observed about to this moderate degree.

As blood glucose variability became rather normal range, proteinuria representing renal impairment has decreased. We have investigated the relationship between LCD and renal function [22]. Then, further research development would be expected in the future.

In summary, the case in this study showed that LCD would be useful for improvement of HbA1c and blood glucose, indicating glucose variability. Furthermore, she showed enough weight reduction and decreased proteinuria. These data would become basal reference data in this area of research and would bring further research development in the future.

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