

## Clinical Effect of Low Carbohydrate Diet (LCD): Case Report

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### Abstract

**Background:** The discussion concerning calorie restriction (CR) and low carbohydrate diet (LCD) has been continued for long years. As to LCD, we have reported lots of experience and research for glucose variability and ketone bodies.

**Subjects and methods:** Three cases with type 2 diabetes mellitus (T2DM) were on LCD and studied. Methods included 3 patterns of LCD meal which are super, standard and petit LCD, with including carbohydrate ratio 12%, 26% and 40%, respectively. Case 1 (61, M) showed hyperglycemia about 150 mg/dL to 300 mg/dL in daily profile with 12.5% in HbA1c. Starting super LCD therapy, the glucose profile decreased to less than 150 mg/dL and HbA1c decreased to 6.7% in 3 months. Case 2 (53, M) revealed HbA1c 8.3%, weight 110 kg and body mass index 34.5. By super LCD, his weight was decreased 17 kg in 5 months, with normalized HbA1c and elevated serum 3-hydroxybutyric acid (3-OHBA). Case 3 (72, M) had always extremely elevated fasting triglyceride for 5 years. Starting petit LCD for 2 years, triglyceride and weight were decreased moderately. Successively, changing to standard LCD for 1 year, weight was decreased 6 kg, and triglyceride was normalized.

**Discussion and conclusion:** Each case suggests the characteristic beneficial effect of LCD. From our clinical experience and research, super LCD method, which is one of the very low-carbohydrate ketogenic diet (VLCKD), has evident efficacy of weight reduction. Super-LCD is characterized by strictly limitation for carbohydrate. Standard-LCD and petit-LCD method can be useful and applicable in response to the status of the patients. Thus, LCD treatment have beneficial effects for patients with various status.

**Keywords:** Low carbohydrate diet; Calorie restriction; Type 2 diabetes mellitus; Hypertriglyceridemia; Hyperglycemia; Weight reduction; Petit-low carbohydrate diet (petit-LCD); Standard-low carbohydrate diet (standard-LCD); Super-low carbohydrate diet (super-LCD); 3-hydroxybutyric acid (3-OHBA)

**Abbreviation:** LCD: Low-Carbohydrate Diet; CR: Calorie Restriction; T2DM: Type 2 Diabetes Mellitus; VLCKD: Very Low-Carbohydrate Ketogenic Diet

### Introduction

The discussion about Calorie Restriction (CR) and low carbohydrate diet (LCD) has been continued for long years. There has been evidence of the effect of LCD in several studies [1-7]. In Japan, the author and co-workers firstly reported LCD and developed the usefulness of LCD with thousands of patients with type 2 diabetes mellitus (T2DM) [8,9]. We also reported the clinical significance of ketone body in the axis of pregnant mother-fetus-newborn [10].

In this study, 3 cases with significant effect and specific characteristic through LCD treatment are shown, with the discussion of efficacy for LCD.

### Methods and Case Report

Each case with T2DM was treated with LCD for several months, and revealed specific and significant effect. Three cases with type 2 diabetes mellitus (T2DM) were on LCD and studied. Methods included 3 patterns of LCD meal which are super, standard and petit LCD, with including carbohydrate ratio 12%, 26% and 40%, respectively [8].

#### Case 1

61-year-old man with past history of T2DM had no treatment for

more than 1 year. On first contact, he showed hyperglycemia about 150 mg/dL to 300 mg/dL in daily profile, with 12.5% of HbA1c. We advised him to start super LCD, and glucose profile decreased to less than 150 mg/dL with decreased HbA1c from 12.5% to 6.7% in 3 months (Figure 1).

#### Case 2

53-year-old man visited our clinic with HbA1c 8.3%, body weight 110 kg and body mass index 34.5. After starting super LCD, he continued successfully with elevated serum 3-hydroxybutyric acid (3OHBA). After that, his HbA1c level was normalized and body weight was decreased 17 kg in 5 months (Figure 2).

#### Case 3

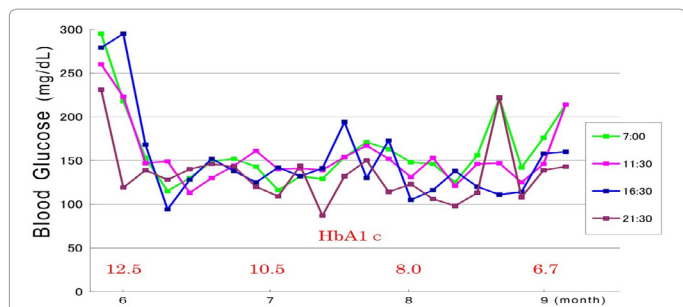
72-year-old man had always extremely elevated triglyceride level for 5 years, even if blood sampling was perfectly after 13 hours night fasting. He started light petit LCD for 2 years, and triglyceride decreased moderately and body weight decreased 2 kg. After that, he started standard LCD for 1 year, then his body weight was decreased 6kg, triglyceride was normalized and HDL was elevated (Figure 3).

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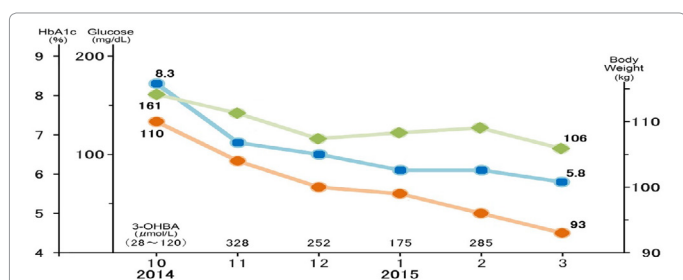
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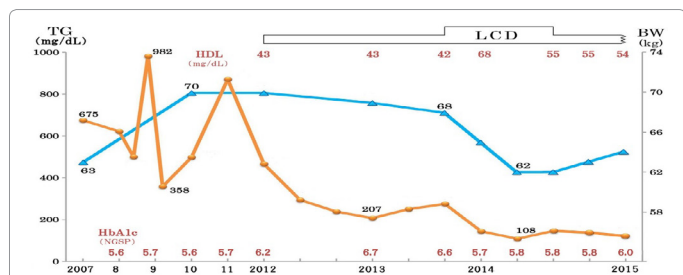
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**Figure 1:** Clinical course of case 1 (61 yrs. Male) starting super-LCD, glucose profile decreased to less than 150 mg/dL and HbA1c decreased from 12.5% to 6.7% in 3 months.



**Figure 2:** Clinical course of case 2 (53 yrs. Male) by continuing super-LCD, body weight decreased 17 kg in 5 months, with persistent elevation of serum 3-OHBA.



**Figure 3:** Clinical course of case 3 (72 yrs. Male) Petit LCD resulted in decreased triglyceride, and standard LCD resulted in moderate weight reduction and normalized triglyceride.

## Discussion

This case report describes the clinical presentation of 3 cases, in which each progress had shown characteristic beneficial point of LCD.

In our previous study, we reported clinical experience for LCD with 2699 cases [9,11]. Weight reduction of more than 10% was observed in 25.6% of subjects, and more than 2.5% was observed in 78.8% of subjects, indicating the efficacy of LCD.

We had continued nutritional LCD movement in Japan for years medically and socially with 3 patterns of LCD as follows [8]: 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, which include carbohydrate ratio in 12%, 26% and 40%, respectively.

Feinman and Bernstein classified nutrition diet into several categories: 1) Very low-carbohydrate ketogenic diet (VLCKD): Carbohydrate, 20 g/d to 50 g/d or <10% of the 2000 kcal/d diet, 2) Low-carbohydrate diet: <130 g/d or <26% total energy, 3) Moderate-Carbohydrate Diet: 26% to 45%, 4) High-Carbohydrate diet: >45% to 201%) [12].

Super LCD is one of VLCKD, which contains 12% of carbohydrate, and 42 g of carbohydrate intake with 168 kcal, when the total calorie is standard 1400 kcal a day. Continuing super LCD usually results in elevated ketone bodies and significant weight reduction [9,11,12]. Continuing ketogenic diet seems to be necessary to obtain enough weight reduction [13,14].

The changes of triglyceride and weight in case 3 would be the efficacy of LCD for hypertriglyceridemia in petit and standard LCD, which should be informed broadly in the future.

## Conclusion

LCD is useful for treatment for T2DM and for weight reduction. For clinical practice, it is helpful to select the adequate method in 3 degrees of LCD, which are petit, standard and super LCD. The elevation of ketone body is always observed during super LCD (VLCKD), and is characteristic phenomenon for beneficial effect of LCD.

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## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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