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Beneficial Analysis for Glucose Variability by Continuous Glucose Monitoring (CGM)

Sanae Mima[1], Hiroshi Bando[1,2iD*], Akemi Tamura[1], Yukari Okino[1], Takumi Yamada[1], Yoshiyuki Abe[1]
[1]*Komatsushima Hospital, Komatsushima city, Tokushima, Japan*
[2]*Medical Research/Tokushima University, Tokushima, Japan*

Corresponding Author: **Hiroshi Bando** ORCID iD
Address: Tokushima University /Medical Research, Nakashowa 1-61, Tokushima 770-0943, Japan. Tel: +81 9031872485; Email:pianomed@bronze.ocn.ne.jp
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Abstract

A continuous glucose monitoring (CGM) system was applied using FreeStyle Libre 3 to evaluate glucose variability in response to various food intakes and exercise. The subject was a 45-year-old registered nurse with a BMI of 17.9. When she drank 500 cc of a carbonated beverage containing 23.5 g of sugar, her blood glucose increased acutely. She then exercised by jumping for 3 minutes, after which her glucose levels decreased shortly thereafter. Consumption of pound cake, pork bowl, and corn soup caused a rapid rise in blood glucose. She consistently follows a standard low-carbohydrate diet (LCD) and consumes only 15 g of nuts and soybeans for lunch, during which her blood glucose does not increase. Appropriate CGM application significantly contributes to overall well-being.

Keywords

Continuous Glucose Monitoring, Freestyle Libre 3 System, Low Carbohydrate Diet, Soybeans

Abbreviations

CGM: Continuous Glucose Monitoring; LCD: Low Carbohydrate Diet

Introduction

Concerning the detailed study of glucose variability, the continuous glucose monitoring (CGM) method has been prevalent using the FreeStyle Libre CGM system [1]. Some types have been applied for patients with type 1 and type 2 diabetes (T1D, T2D) [2]. Several investigations for CGM have shown the satisfaction of quality of life associated with metabolic control [3]. From various studies on CGM, the ideal glucose situation has been in discussion compared with SMBG [4]. They included the differences in time in range (TIR), time above range (TAR), time below range (TBR), and mean difference (MD) [5]. Such application has provided more usefulness and benefits in clinical practice [6].

The authors and collaborators have continued practice and research for various patients with diabetes and atherosclerotic cardiovascular disease (ASCVD) [7]. Among them, several benefits of CGM have been reported for controlling glucose variability [8]. Currently, our team has an impressive opportunity to apply the CGM method using FreeStyle Libre 3. As per the protocol, an excellent registered nurse can use Libre

3 for 1 week, in which she can try to take various foods of carbohydrate, protein, fat, drinks, cakes, and so on. The detailed situation can be obtained from both glucose variability every 1 minute and actual food intake, exercise, and other daily activities. The results and related perspectives are described in this article.

Case Presentation

Case and Method:

The current case is a 45-year-old female registered nurse. She did not have any special diseases or health problems. She has been working at the outpatient clinic of a large general hospital. She has had normal physical examination and laboratory data so far. Her physique showed height 153 cm, weight 42 kg, and BMI 17.9 kg/m^2. Her daily habit has included the continuation of a standard low carbohydrate diet (LCD), where she has mildly restricted carbohydrate intake for a long time. The reason would be that she feels better when she limits intake of carbohydrate to some degree.

The method included the application of FreeStyle Libre 3 for 1 week in June 2025. She could use the apparatus voluntarily for the actual application of Libre 3. She fit the apparatus smoothly, and no remarkable problems were found.

Results

CGM measurement was successful from June 24 to 30, 2025. The result of the former 3 days is shown in **(Fig-1)**. When she drank 500 cc of a beverage with 23.5 g of sugar, her blood glucose showed acute hyperglycemia. Just after that, she tried to exercise for 3 minutes, which was of intense degree with continuous jumping without rest on the floor. By this exercise, blood glucose decreased rapidly. For the sugary beverage, the detailed content is shown in **(Table-1)**. It includes 4.7 g of sugar per 100 mL, associated with several kinds of vitamins.

Table-1: Nutrients in the Beverage

Energy	19 kcal
Protein	0 g
Fat	0 g
Carbohydrate	4.7 g
Salt	0.1 g
Vitamin C	12-48 mg
niacin	1.5 mg
vitamin B6	0.15 mg
caffeine	5.0 mg
arginine	2.5 mg
alanine	2.5 mg
glycine	2.5 mg
leucine	2.5 mg
isoleucine	1.2 mg
valine	1.2 mg
1) The data is per 100mL.	
2) The case drank 500mL.	

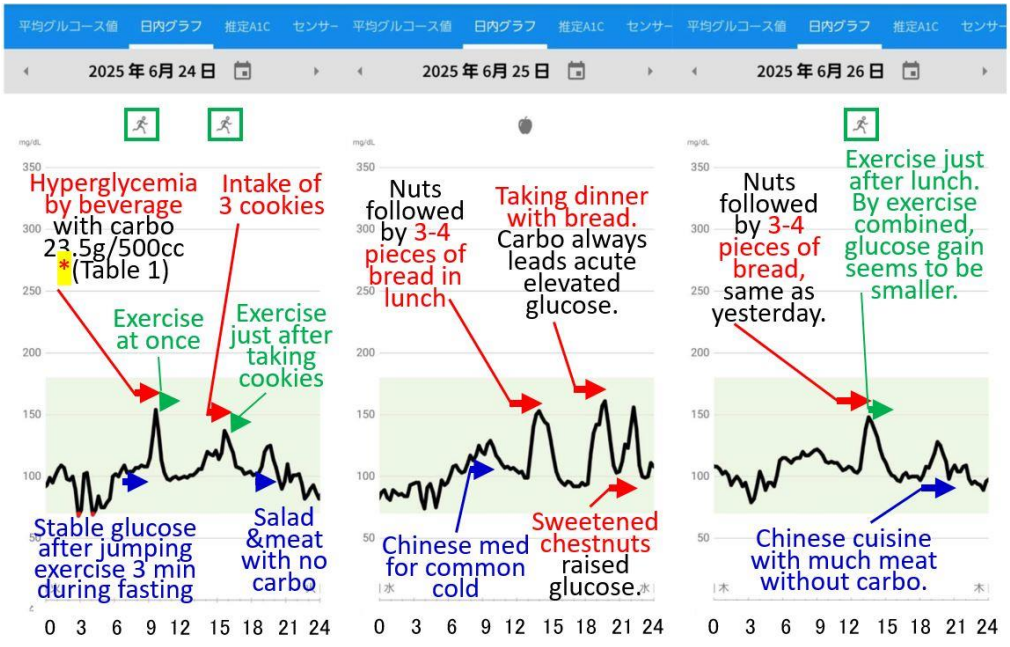

Fig-1: CGM results for various trials-1

Case Report

On June 25 and 26, she had a comparative experiment with the same food at lunch. The intake of nuts and 3–4 pieces of bread was the same. In contrast, jumping exercise for 3 minutes was conducted only on June 26. When comparing glucose response between the 25th and 26th, the latter showed acute glucose decrease just after starting the exercise.

The result of the latter 4 days is shown in **(Fig-2)**. When she took pound cake and café au lait for breakfast, her glucose showed acute elevation and acute decrease. Taking low carbohydrate cereal granules seemed to influence her blood glucose. A pork bowl with 100 g of rice elevated blood glucose, and successive intake of cakes for hours showed intermittent glucose elevation. Furthermore, corn soup, a vitamin-rich beverage, and ice cream brought glucose elevation. On June 30, she had her usual daily food intake. She always takes only black coffee for breakfast, where blood glucose remains stable. For lunch, she takes 15 g of nuts and black soybeans, and then glucose does not increase **(Table-2, Fig-3)**. She always takes a large amount of salad and meat at supper, where a small elevation of blood glucose is observed.

Table-2: Nutrients in Soybeans

Energy	415 kcal
Protein	32.8 g
Fat	18.0 g
Carbohydrate	16.9 g
Fiber	17.8 g
Salt	0.02 mg
Data are calculated from 100 g.	

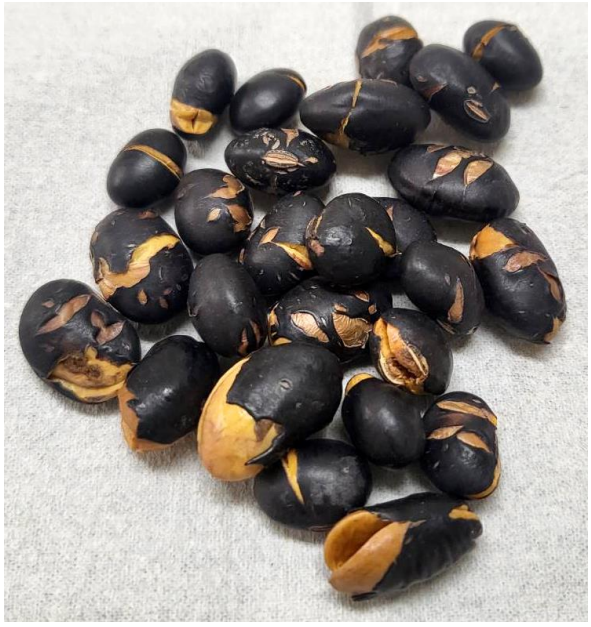

Fig-3: Black soybeans

Discussion

The US Food and Drug Administration (FDA) has recognized FreeStyle Libre 3 real-time CGM, and clinical application has been developed with the support of the American Diabetes Association (ADA) [9,10]. Furthermore, several investigations have been conducted for the precision of the data obtained from CGM [11,12]. In this study, real-time and precise fluctuation of blood glucose has been captured, and such benefits provide impressive and meaningful perspectives to diabetic patients and care providers with satisfactory treatment.

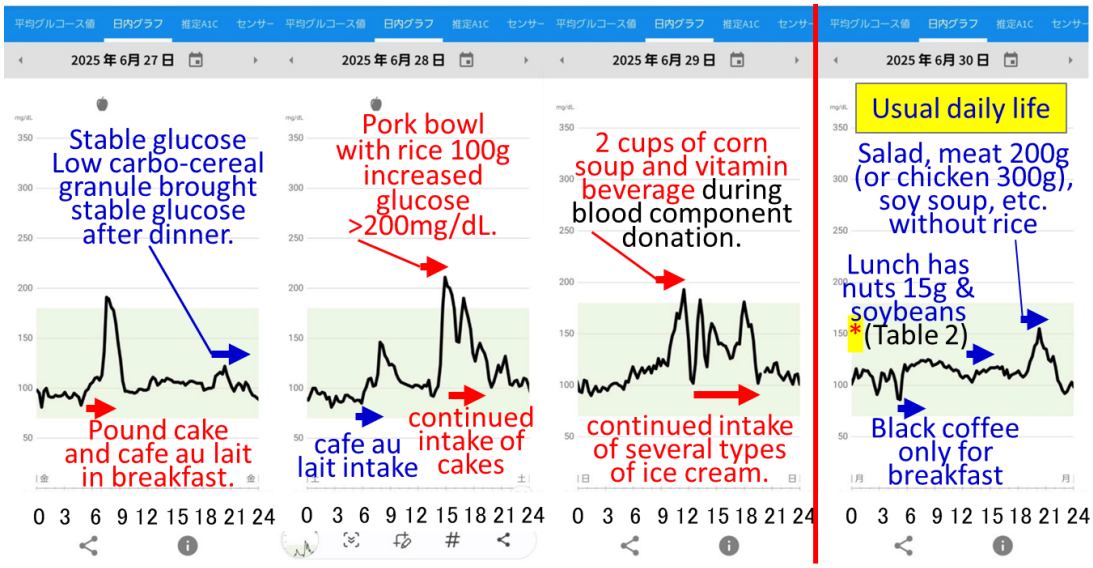

Fig-2: CGM results for various trials-2

From the obtained results, several aspects can be discussed. When she drank a sugary beverage with 23.5 g sugar in 500 cc, her blood glucose elevated by 40 mg/dL. As a general rule, 1 g of carbohydrate can elevate blood glucose by 1 mg/dL, 3 mg/dL, and 5 mg/dL for healthy subjects, T2D, and T1D, respectively [13]. Possible reasons for the exaggerated elevation may include: i) rapid absorption, ii) carbonated beverage, iii) influence of vitamins, such as caffeine and others, and iv) rare intake of sugary drinks by the case.

She usually restricts carbohydrate-rich foods and takes only nuts and soybeans for lunch. Since postprandial glucose elevation was not found, soybeans seem to be beneficial due to their higher protein and lower carbohydrate content.

Some limitations exist in this report. CGM has been evaluated as a practical and useful procedure so far [14,15]. However, it is not enough to merely examine the data; intensive monitoring and behavioral response to every glucose change are recommended for the patient.

In summary, CGM contributes significantly with adequate testing and reflection. As part of the historical progress of CGM, future development is expected toward more precise data, greater convenience, and improved feedback, leading to enhanced well-being for each individual.

Conflict of Interest

The authors have read and approved the final version of the manuscript. The authors have no conflicts of interest to declare.

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