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Case Report

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Satisfactory Effect by Low Carbohydrate Diet (LCD) And Imeglimin (Twymeeg) for Diabetic Case with Fatty Liver and Lumbar Spinal Stenosis (LSS)

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Abstract

The patient was a 56-year-old male with obesity, lumbar spinal stenosis (LSS), and type 2 diabetes (T2D). He was diagnosed with T2D in September 2025, with an HbA1c of 12.7% and a BMI of 34.4 kg/m^2. He began treatment with a low-carbohydrate diet (LCD), imeglimin (Twymeeg), and empagliflozin. HbA1c decreased to 6.4% within 5 months, accompanied by a 7-kg weight reduction and relief of low back pain (LBP). Blood biochemistry revealed remarkable improvements in AST, ALT, and GGT levels, with no gastrointestinal adverse effects (GI-AEs) associated with imeglimin. The satisfactory clinical improvement appeared to be attributable to multiple factors, including LCD, imeglimin, SGLT2 inhibitor therapy, and the patient's continued diligence in maintaining lifestyle modifications.

Keywords

Low-Carbohydrate Diet, Lumbar Spinal Stenosis, Imeglimin, Low Back Pain, Trials of IMeglimin for Efficacy and Safety

Abbreviations

ALT: Alanine Aminotransferase; AST: Aspartate Aminotransferase; BMI: Body Mass Index; GI-AE: Gastrointestinal Adverse Effect; GGT: Gamma-Glutamyl Transferase; HbA1c: Hemoglobin A1c; LBP: Low Back Pain; LCD: Low-Carbohydrate Diet; LSS: Lumbar Spinal Stenosis; SGLT2-i: Sodium-Glucose Cotransporter-2 Inhibitor; T2D: Type 2 Diabetes; TIMES: Trials of IMeglimin for Efficacy and Safety

Introduction

Diabetes has been an important disease, and its standard management has been presented by the American Diabetes Association (ADA) [1]. Diabetic complications include various forms of arteriosclerosis involving macroangiopathy and microangiopathy [2]. Related problems include obesity, fatty liver, or metabolic dysfunction-associated steatotic liver disease

(MASLD) as comorbidities of metabolic syndrome (MetS) [3]. As a basic treatment, diet therapy has been crucial, and calorie restriction (CR) was formerly conducted. Low-carbohydrate diet (LCD) has recently been evaluated for diabetes and obesity [4]. The authors established the Japan LCD Promotion Association (JLCDPA) and have developed the social movement of LCD until now [5]. We have presented practically useful LCD methods as super-, standard-, and petite-LCD [6].

On the other hand, patients with obesity and type 2 diabetes (T2D) often show low back pain (LBP) derived from lumbar spinal stenosis (LSS) [7]. They have problems of pain, imbalance, frailty, activities of daily living (ADL), and quality of life (QOL) [8]. The authors and colleagues have continued clinical practice for elderly patients with diabetes, arteriosclerosis, LBP, LSS, and others [9]. Among various diseases associated with MetS, lifestyle-related diseases, diabetes, fatty liver, LBP, and LSS, we recently treated an impressive male patient with new-onset T2D. His clinical progress and related perspectives will be described in this article.

Case Presentation

The patient was a 56-year-old male with obesity, T2D, and fatty liver. In 2024, he moved back to his hometown and was referred to the orthopedic department. He was diagnosed with LSS and bilateral knee osteoarthritis. MRI showed mild nerve compression at the L4/5 intervertebral level. He had been receiving intra-articular hyaluronic acid injections for his knees. In the summer of 2025, he complained of dry mouth, and blood tests revealed a markedly elevated HbA1c level, leading to a referral to a diabetes specialist.

Physical examination in September 2025 revealed the following: consciousness and speech were normal, and his vital signs revealed BP 134/80 mmHg, pulse 76 beats/min, and SpO_2 99%. Unremarkable findings were observed in the head, heart, lungs, abdomen, and neurological examinations. His physique showed a height of 168 cm, body weight of 97 kg, and BMI of 34.4 kg/m^2.

Medical progress of blood biochemistry and treatment is summarized in (**Fig-1**). It showed elevated values of HbA1c, AST, ALT, and GGT. Chest X-ray was negative, and electrocardiogram (ECG) showed ordinary sinus rhythm (OSR) with no specific ST-T changes (**Fig-2**).

	Units	2025 Sep	Oct	Dec	2026 Jan	Feb
Diabetes						
Treatment			empagliflozin			
			Imeglimin			
HbA1c	(%)	12.7	10.8	7.6	6.3	6.4
glucose	(mg/dL)		116	99	110	118
Nutrition						
TP	(g/dL)					8.2
Alb	(g/dL)					4.5
Liver						
AST	(U/L)	176				49
ALT	(U/L)	209				75
GGT	(U/L)	723				400
ALP	(U/L)					131
Lipids						
HDL	(mg/dL)	40				54
LDL	(mg/dL)	151				196
TG	(mg/dL)	304				183
Renal						
UA	(mg/dL)					8.3
BUN	(mg/dL)					20
Cre	(mg/dL)	0.94				1.07
eGFR	(mL/min/1.73m^2)	66				57
CBC						
WBC	(x10^2/μL)	73				73
RBC	(x10^4/μL)	553				584
Hb	(g/dL)	16.7				17.0
Ht	(%)	50.2				51.9
Plt	(x10^4/μL)	18.8				21.2

Fig-1: Blood Chemistry and Treatment

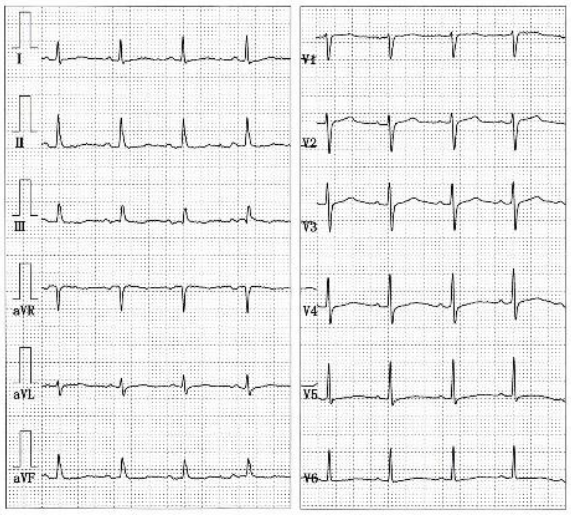

Fig-2: The Result of Electrocardiogram

Clinical Progress

After detailed evaluation, standard-LCD was immediately initiated as dietary treatment. Furthermore, some oral hypoglycemic agents (OHAs) were added in the following order: i) imeglimin (Twymeeg) 2000 mg/day from September; ii) empagliflozin (Jardiance) 25 mg/day from October. The clinical progress is shown in (**Fig-1**), including the changes in HbA1c and blood chemistry. HbA1c decreased to 6.4% within 5 months, and body weight decreased to 90 kg. His LBP was satisfactorily relieved. No gastrointestinal adverse effect (GI-AE) of imeglimin was found during the clinical course.

Ethical Standards

This report complied with the Helsinki Declaration [10]. Some commentaries have presented the protection of personal rights. The principle describes the ethical rules for human subjects in clinical research. The required guidelines are from the Ministry of Education, Culture, Sports, Science and Technology, Japan, and the Ministry of Health, Labour and Welfare. The authors established the ethical committee in Sakamoto Hospital, including the director, physician, nurse, pharmacist, nutritionist, and legal professional. We discussed the protocol sufficiently, reached agreement, and obtained informed consent.

Discussion

From a clinical aspect, the current case showed some characteristic points as follows: i) obesity; ii) LSS and knee problems; iii) fatty liver or MASLD; iv) new-onset T2D; v) benefits of standard-LCD; vi) effects and GI-AEs of imeglimin; vii) empagliflozin as a sodium-glucose cotransporter 2 inhibitor (SGLT2-i); viii) clinical and biochemical improvement; and ix) his regular and diligent lifestyle every day.

This case showed a remarkable decrease in HbA1c from 12.7% to 6.4% and a weight reduction of 7 kg within only 5 months. This may be due to the combination of continued LCD, imeglimin, empagliflozin, and a diligent lifestyle. Among them, the clinical efficacy of LCD over several months would be the main factor. From practical perspectives, standard-LCD has a carbohydrate ratio of 26% of total caloric intake [6]. We have statistical data for weight reduction by LCD from 2700 cases. About 24% of them showed a 10% weight reduction with satisfactory results [11]. By applying LCD, diabetic cases have shown significant weight reduction using our practical LCD method so far [12]. LCD also shows augmentation of immune function as a beneficial effect [13].

The current case successfully showed decreased HbA1c and body weight, in which imeglimin may have contributed considerably as a recently useful OHA. It stimulates insulin secretion from beta cells and reduces insulin resistance in the muscles and liver [14]. It shows a variety of clinical benefits for T2D [15]. As international clinical studies, the Trials of IMeglimin for Efficacy and Safety (TIMES) were conducted with several significant reports [16]. In TIMES 1 and 3, combined OHA treatments were reported for HbA1c improvement, associated with monotherapy (-0.46%), biguanides (-0.67%), SGLT2-i (-0.57%), and others [17]. In this case, the combination of LCD, imeglimin, and empagliflozin was continued.

Regarding blood biochemistry, liver function tests including AST, ALT, and GGT showed remarkable improvement after treatment with LCD, imeglimin, and empagliflozin. The VCTE-Prognosis Study Group evaluated weight changes in MASLD cases (n = 10,014) [18]. With weight gain >5%, the risk of liver-related events (LREs) increased with an adjusted hazard ratio (aHR) of 1.84 and liver stiffness progression with an adjusted odds ratio (aOR) of 2.07. With weight reduction >5%, liver stiffness progression was improved. A systematic literature review for MASLD was conducted using 52 reports (64,708 cases) selected from 1,748 reports [19]. For patients with MASLD/MASH and T2D, preferred pharmacological interventions include GLP-1RA, PPAR-γ agonists, and SGLT2 inhibitors. In the future, GLP-1/GIP or triple GLP-1/GIP/glucagon agonists will probably play important roles.

Some limitations may be present in this article. Combination treatment of imeglimin and OHA may be effective [20]. Moreover, several related factors have been involved in the current clinical progress. We need to follow him up with careful attention.

In summary, this middle-aged male showed improvement in T2D, obesity, and fatty liver through several combined treatment factors. This paper will hopefully become a beneficial reference for T2D, MetS, MASLD, and related diseases.

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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