



## An Arteriosclerotic Diabetic Male with Clinical Effect by Low Carbohydrate Diet (LCD) and Vildagliptin/Metformin (EquMet)

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### Abstract

The case was a 75-year-old male with hypertension, dyslipidemia, type 2 diabetes (T2D), mild cognitive impairment (MCI), and a general presence of arteriosclerosis for years. HbA1c remained stable at about 7.1–7.4%, and otherwise, no remarkable biochemical results were observed. Pulse wave velocity (PWV) showed an ankle-brachial index (ABI) of 0.96/1.12 and a cardio-ankle vascular index (CAVI) of 9.1/8.6 (right/left), respectively. CAVI values remained stable for 6 years.

These results suggested the presence of generalized arteriosclerosis due to his previous diseases. He has been treated with vildagliptin/metformin (EquMet). From summer 2025, he maintained a low-carbohydrate diet (LCD) satisfactorily, and then HbA1c decreased to 6.0% in 2026.

### Keywords

Arteriosclerosis, Type 2 Diabetes, Pulse Wave Velocity, Cardio-Ankle Vascular Index, Ankle-Brachial Index

### Abbreviations

T2D: Type 2 Diabetes; PWV: Pulse Wave Velocity; CAVI: Cardio-Ankle Vascular Index; ABI: Ankle-Brachial Index

### Introduction

Type 2 diabetes (T2D) has been a crucial clinical, social, and economic problem worldwide [1]. Regardless of age and other factors, T2D can cause macrovascular and microvascular damage, leading to various impairments in the body. Among these, atherosclerotic cardiovascular disease (ASCVD) is often observed in T2D cases, such as cerebrovascular accident (CVA), coronary heart disease (CHD), and peripheral artery disease (PAD) [2].

Nutritional treatment has been fundamental in diabetic therapy throughout its long history. Previously, calorie restriction (CR) was widely used, after which Atkins and Bernstein introduced the low-carbohydrate diet (LCD) in Western countries. The efficacy of LCD has gradually become recognized, and our research group has introduced LCD in Japan. We have established the Japan LCD Promotion Association (JLCDPA) and promoted the benefits of LCDs [3]. These include practical applications of the petit-LCD, standard-LCD, and super-LCD, in which the

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carbohydrate ratios are 40%, 26%, and 12%, respectively [4].

Several oral hypoglycemic agents (OHAs) have been used in diabetic practice [5]. Among them, metformin has been widely used as a first-line agent worldwide for years [6]. DPP4 inhibitors (DPP4-i) are particularly effective in Asian populations due to body type, responsiveness, and safety. A combination of these agents is known as vildagliptin/metformin (EquMet) [7]. It is administered twice daily and is clinically effective, without specific adverse effects such as hypoglycemia. Based on the above, the authors and colleagues have continued diabetic practice and reporting. We recently encountered a meaningful case, which will be described with progress and discussion.

Case Report

History and several exams:

The current case was a 75-year-old male with hypertension, dyslipidemia, type 2 diabetes (T2D), and mild cognitive impairment (MCI) for years. His daily habits showed some difficulties, including heavy smoking for years and excessive consumption of sweets.

His wife had taken care of him for decades, but he did not follow her advice. In summer 2025, his wife became ill and was hospitalized. Consequently, he was transferred to a special nursing home for continued care.

His blood chemistry is summarized in Fig-1. The results for liver, renal, lipid, and complete blood count (CBC) were unremarkable for years. In contrast, HbA1c had been elevated until summer 2025. After that, HbA1c showed improvement, which may have been due to continued LCD and imeglimin (Twymeeeg).

As basic examinations, chest X-ray was negative, and electrocardiogram (ECG) showed ordinary sinus rhythm (OSR) with unremarkable ST-T changes. He underwent pulse wave velocity (PWV) testing. The ankle-brachial index (ABI) was 0.96/1.12 (right/left), which was slightly low (Fig-2). The cardio-ankle vascular index (CAVI) was 9.1/8.6 (right/left), and these values remained stable for 6 years (Fig-3). Detailed biomarkers showed L (122) = L1 (62) + L2 (33) + L3 (27), PEP 64, ET 275, R-AI 0.83, and PEP/ET 0.23.

	Units	2020 2022 2023 2024 2025								
		Feb	Jun	Feb	Sep	Mar	Jul	Oct	Dec	
Diabetes		canagliflozin, vildagliptin, glimepiride, metformin, amlodipine, rosuvastatin								
OHA										
others										
HbA1c	(%)	7.0	7.6	7.2	7.1	7.4	7.2	6.7	6.1	
glucose	(mg/dL)	199	184	177		135	180		118	
Liver										
AST	(U/L)	14	12	12	11	13		9		
ALT	(U/L)	11	13	11	10	21		8		
GGT	(U/L)	57	29	24	19	9		17		
Lipids										
HDL	(mg/dL)	73	72	63	64	67		60		
LDL	(mg/dL)	81	151	150	89	98		72		
TG	(mg/dL)	219	311	258	227	226		199		
Renal										
UA	(mg/dL)	4.6	4.8	4.0		3.9				
BUN	(mg/dL)	21	25	18		16				
Cre	(mg/dL)	0.52	0.77	0.69	0.74	0.77		0.72		
eGFR	(mL/min/1.73m <sup>2</sup> )		75	85	78	75		80		
CBC										
WBC	(x10 <sup>2</sup> /μL)	79	73	49	59	61		69		
RBC	(x10 <sup>4</sup> /μL)	476	508	459	489	520		483		
Hb	(g/dL)	15.1	16.4	15.3	15.6	16.0		15.1		
Ht	(%)	45.3	49.0	42.7	45.2	47.2		43.8		
Plt	(x10 <sup>4</sup> /μL)	24.7	26.5	24.4	26.0	27.3		26.9		

Fig-1: Progress of Biochemistry and Treatment

Case Report

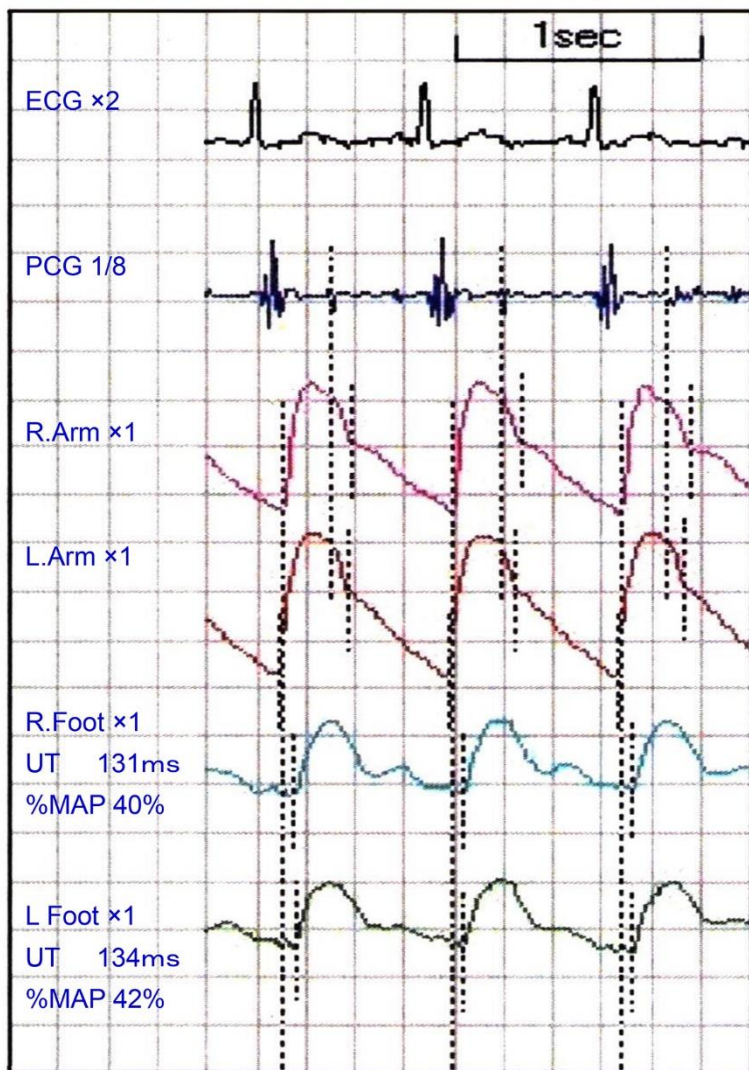


Fig-2: Result of Pulse Wave Velocity (PWV)

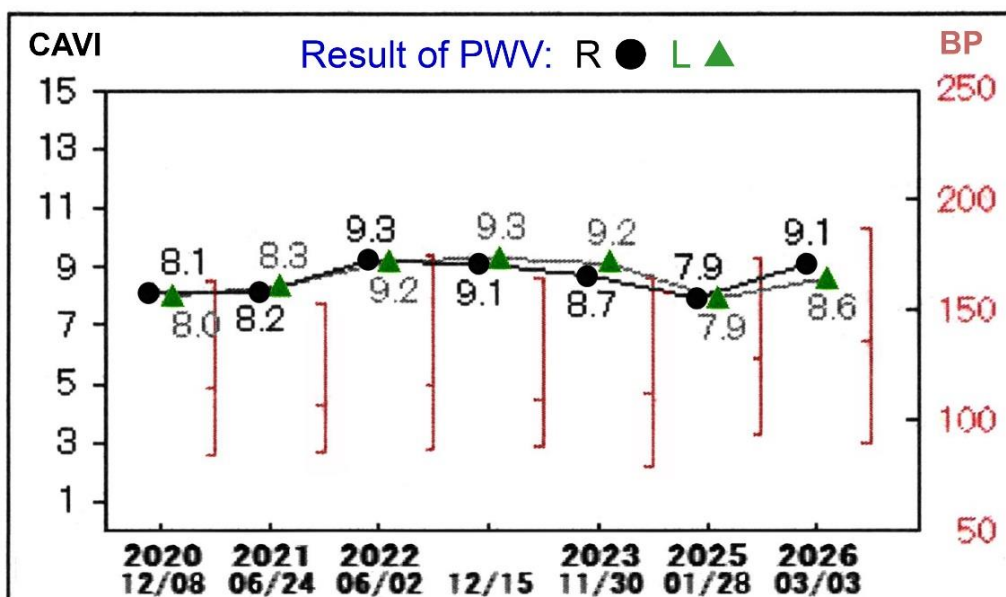


Fig-3: Annual Progress of CAVI

### *Ethical standards:*

This article complies with the guidelines of the Helsinki Declaration. The report ensures protection of personal information. The principles follow ethical rules for clinical research. Relevant guidelines were obtained from the Ministry of Health, Labour and Welfare and the Ministry of Education, Culture, Sports, Science and Technology (MHLW).

The authors established an ethical committee at Sakamoto Hospital, including the president, physicians, a pharmacist, a nurse, and a legal professional. The protocol was discussed appropriately, approved, and informed consent was obtained from the patient.

### **Discussion**

The medical issues concerning this patient are summarized as follows: #1 Type 2 diabetes (T2D), #2 Hypertension, #3 Dyslipidemia, #4 Arteriosclerosis, #5 Heavy smoker, #6 Incomplete carbohydrate restriction, #7 Admission to a special nursing home for the elderly, and #8 Improvement in glucose variability by LCD and lifestyle adjustment.

In particular, such diabetic cases with a long history require lifestyle modification. As a global health challenge, various risks arise from diabetes, obesity, and cardiovascular disease (CVD) [8]. Sedentary lifestyle and inadequate dietary habits can impair physiological function. Therefore, lifestyle modification and appropriate pharmacotherapy have emerged as key pillars of preventive medicine.

The current patient reduced carbohydrate intake after summer 2025, resulting in rapid improvement in HbA<sub>1c</sub>. The benefits of LCD have been reported for years [9]. In a review of 2,821 cases from 32 randomized controlled trials (RCTs), restricting carbohydrate intake to  $\leq 100$  g/day significantly reduced weight, BMI, and body fat percentage (BFP), though not fat mass [10]. When carbohydrate intake was reduced to  $\leq 50$  g/day for more than one month, weight, BMI, and BFP were significantly reduced.

Recent evidence highlights the importance of individualized dietary interventions [11], including metabolic profiles, cultural preferences, and comorbid

conditions. For both T1D and T2D, diets such as the Dietary Approaches to Stop Hypertension (DASH), Mediterranean diet (MD), and plant-based diet have shown effectiveness.

This case underwent PWV assessment, suggesting mild arteriosclerosis. PWV reflects large artery stiffness (LAS), which is clinically significant for predicting future cardiovascular health [12]. Since CAVI incorporates PWV measured between the heart and ankle, it reflects stiffness in both the aorta and medium-sized muscular arteries. In this case, CAVI values remained stable for years, likely due to underlying hypertension, dyslipidemia, and diabetes, and continued follow-up is required.

The patient had consumed sugary snacks for years but did not show markedly elevated HbA<sub>1c</sub> levels. This may be due to the effects of vildagliptin and metformin administered twice daily. Compared with sitagliptin once daily, twice-daily administration has been shown to reduce mean nocturnal blood glucose levels and mean amplitude of glycemic excursions (MAGE) [13]. These pharmacological effects are advantages of Equa and EquMet [14]. Combined therapy with LCD and OHA may improve quality of life (QOL), well-being, and mental health in T2D patients [15].

Some limitations may exist in this report. This case demonstrates several risk factors for arteriosclerosis related to T2D, hypertension, and dyslipidemia. The degree of arterial stiffness appears relatively low and stable over time, but continued follow-up is necessary to evaluate long-term progression.

### **Conclusion**

In summary, a 75-year-old male with T2D and arteriosclerosis was presented. Several clinical insights were discussed, and this article may serve as a useful reference for future diabetic practice and research.

### **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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