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# Improved Renal Function in Obese Patient with Chronic Kidney Disease (CKD) by Low Carbohydrate Diet (LCD)

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## Abstract

Chronic kidney disease (CKD) has been a progressive disease affecting elderly people. The case is 66-year-old male with CKD. His body weight increased from 62kg to 87kg for 24 years. He was treated for hypertension, dyslipidemia and CKD as Cre 1.53 mg/dL and eGFR 36.8 mL/min/1.73m$^2$. He started low carbohydrate diet (LCD) and successfully reduced weight as 76kg, with improved Cre 1.18 mg/dL and eGFR 48.4 mL/min/1.73m$^2$. From a recent report, clinical efficacy of LCD for renal function was shown for 30 months, as Cre 80.0 to 74.5 μmol/L ($p < 0.001$) and eGFR 85.5 to 88.0 mL/min/1.73m$^2$ ($p=0.003$).

**Keywords:** Chronic kidney disease (CKD); Estimated glomerular filtration rate (eGFR); Low carbohydrate diet (LCD); Weight reduction; Improved renal function

## Introduction

Across the world, chronic kidney disease (CKD) has been a debilitating progressive disease which affects elderly people [1]. For adequate management of CKD, various interventions have been presented such as lifestyle modification, applicable medication for type 2 diabetes (T2D) and hypertension (HTN). Main purpose is to delay the progress of CKD in several stages. As to nutritional aspect, low-protein diet (LPD), Mediterranean diet (Med), the alternate Mediterranean (aMed) diet, the Alternative Healthy Eating index (AHEI) may slow the CKD progression. The strategy of weight reduction has been also effective for suppressing the exacerbation of CKD when the patient has been obesity problem [2]. For weight control, low carbohydrate diet (LCD) has been one of the effective measures with satisfactory result.

On the other hand, CKD has mutual relationship with atherosclerotic cardiovascular disease (ASCVD) [3]. Arteriosclerotic diseases include T2D, HTN, dyslipidemia, CKD, CVD, cerebral vascular accident (CVA), and metabolic syndrome (Met-S)-related diseases. These diseases need adequate control of blood pressure (BP), blood glucose, LDL-C and other factors. For clinical management of CKD, the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines have been recommended to be applied [4].

For improving the QOL in CKD patient, the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) established the guideline for make slowing the progression of renal diseases [5]. Some study presented that low-protein diet (LPD) may be effective for serum urea and uric acid in CKD patient [6]. However, compared with usual diet, LPD did not show certain efficacy on serum creatinine value [7]. Other nutritional options for CKD show aMed diet and Alternative Healthy Eating Index (AHEI)-2010. These aMed and AHEI showed lower risk for progress in CKD [8]. When low-salt diet is continued, the doubling time of increasing Cre becomes moderately longer. However, this clinical effect has not been clarified for proteinuria, estimated glomerular filtration rate (eGFR), or all-cause mortality, where further investigation will be required [9].

Authors and collaborators have continued our clinical practice and related research on various fields. They include T2D, CKD, hemodialysis (HD), ASCVD, CVD, CVA, meal tolerance test (MTT), continuous glucose monitoring (CGM), and others [10-

12]. Among them, several cases were provided LCD as nutritional treatment. Currently, we have an impressive male patient with CKD. He was obese, and then treated to continue LCD. He had successively showed weight reduction, followed by the improvement of renal function. These general situations and some perspectives are described in the current article.

## Presentation of the Case

### Medical history

The patient is 66-year-old male with CKD. When he was 20 years old, his body weight was 62kg. After that, his weight had been gradually increased, and he had 87kg as the maximum level 2 years ago. He was pointed out to have hypertension and dyslipidemia, and had been prescribed amlodipine and rosuvastatin. He visited the internal medicine and diabetes department of our hospital in May 2020. We had further evaluation of his medical check-up in detail.

### Physicals and laboratory exams

His physical examination in May 2020 showed the following status: consciousness and speech are normal during the conversation in our out clinic, his vitals are in the normal ranges such as pulse, BP, temperature, respiration and SpO2, unremarkable changes were found in the heart, lung, abdomen and extremities, and neurological findings were intact. His physique showed 171 cm in height and 87.0 kg in weight with BMI 29.7 kg/m$^2$.

***Table 1:*** *Laboratory Results.*

| | Lab | May 2020 | May 2021 | unit |
|---|---|---|---|---|
| Glucose | HbA1c | 6.1 | 5.3 | % |
| Liver | AST | 57 | 15 | U/L |
| | ALT | 117 | 19 | U/L |
| | GGT | 71 | 28 | U/L |
| Lipids | LDL | 178 | 128 | mg/dL |
| | HDL | 39 | 50 | mg/dL |
| | TG | 214 | 213 | mg/dL |
| Renal | BUN | 26 | 28 | mg/dL |
| | UA | 7.1 | 5.3 | mg/dL |
| | Cre | 1.53 | 1.24 | mg/dL |
| | eGFR | 36.8 | 46.1 | mL/min/1.73m*2 |
| | Na | 149 | 144 | mEq/L |
| | K | 102 | 102 | mEq/L |
| | Cl | 4.6 | 4.4 | mEq/L |
| CBC | WBC | 70 | 9300 | 10*2/μL |
| | RBC | 537 | 545 | 10*4/μL |
| | Hb | 16.9 | 16.9 | g/dL |
| | Ht | 50.6 | 50.8 | % |
| | MCV | 94.1 | 93.3 | FL |
| | MCH | 31.5 | 31 | PG |
| | MCHC | 33.4 | 33.2 | g/dL |
| | Plt | 24.1 | 23.4 | 10*4/μL |

Biochemical examination was conducted, and their data are shown in Table 1. Among them, positive results were in the following: Cre 1.53 mg/dL, eGFR 36.8 mL/min/1.73m2, LDL-C 163 mg/dL, AST 57 U/L, ALT 117 U/L. Urinalysis showed protein (-), glucose (-), urobilinogen (+/-), pH 6.0, ketone bodies (-), occult blood (-), urinary microalbumin 6.9 mg/g･cre (0-26.9). Chest X-ray revealed no remarkable changes. Electrocardiogram (ECG) showed ordinary sinus rhythm, pulse 64/min, normal axis deviation, no ST-T changes. He had the exam of arteriosclerosis for mechanocardiogram and sphygmogram (Figure 1). The result showed that ankle brachial index（ABI）was 0.88/0.98 for right/left respectively, and that cardio-ankle vascular index (CAVI) was 6.0/5.8 for right/left, respectively. As its detail analysis, upstroke time (UT) and % mean arterial pressure (%MAP) showed unremarkable results.

### Clinical course

His medical problems were summarized as follows: #1 hypertension, #2 dyslipidemia, #3 obesity, #4 CKD, #5 T2D due to increased HbA1c and #6 fatty liver from elevated AST/ALT.

After clarifying the diagnosis at that time, he was ordered to start super-LCD method in order to decrease his body weight. Super LCD includes 12% of carbohydrate in calorie ratio, in which bread, rice, noodles and other carbo food are restricted. His diet therapy was successfully continued for 1 year (Figure 2). His general data were improved as 87kg to 78 kg in weight, 6.1% to 5.3% in HbA1c, 1.53 mg/dL to 1.24 mg/dL in creatinine and 36.8 to 46.1 mL/min/1.73m$^2$ in eGFR. In Jan 2023, he showed weight 76kg, HbA1c 5.2%, Cr 1.18 mg/dL and eGFR 48.4 mL/min/1.73m$^2$, associated satisfactory improvement.

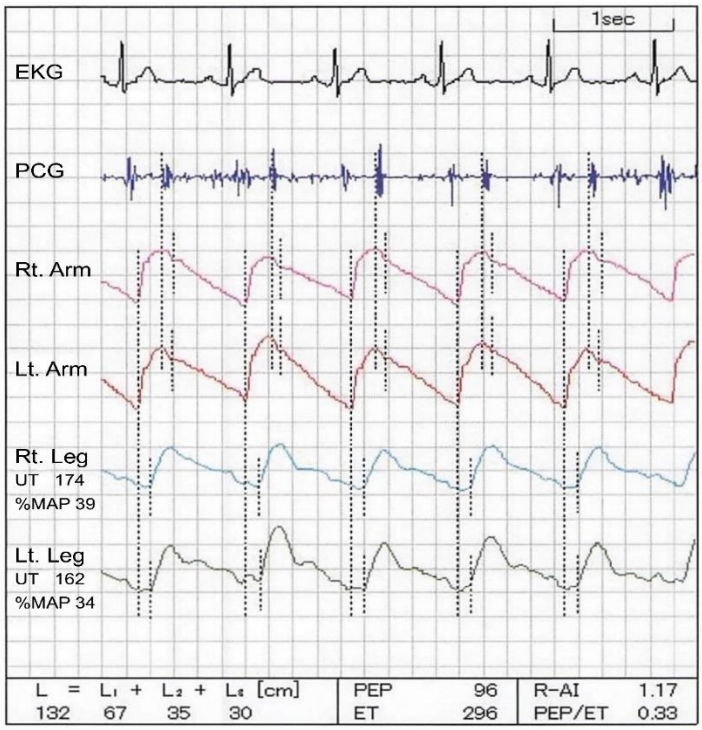


***Figure 1:*** *The results of mechanocardiogram and sphygmogram.*

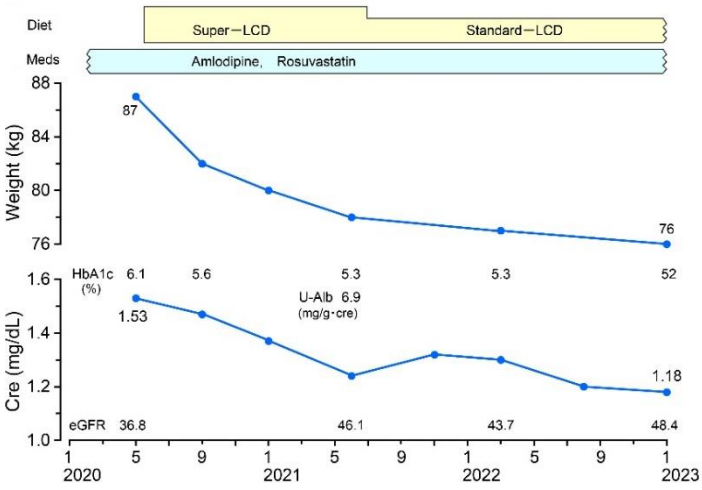


***Figure 2:*** *Clinical progress about changes in Creatinine and eGFR.*

## Ethical standards

This male case has been complied with the ethic guideline for previous Declaration of Helsinki. In addition, some comment was along with the standard protection regulation concerning the personal information. This principle was also based on usual ethical rules for clinical practice and related research for human. Several guidelines were conducted from the proposal of Japanese Ministry. They are on the Ministry of Health, Labor and Welfare, Japan and the Ministry of Education, Culture, Sports, Science Technology, Japan. The authors in current article have established our ethical committee as to this research that was in Sakamoto Hospital in Kagawa prefecture, Japan. It included professional medical and also legal persons that has hospital president, physicians, pharmacist, surgeon, nurse, registered nutritionist and legal professionals. Those members have discussed satisfactory about this case, and agreed the current protocol about this research.

## Discussion

The current case was 66-year-old male, who had medical problems of hypertension, dyslipidemia, obesity, CKD, T2D, and fatty liver in May 2020. These diseases have mutual complex relationships and influences [13]. He has successfully continued LCD for about 2 years. Consequently, several biomarkers were improved as follows; weight 87kg to 76kg, Cr 1.53 mg/dL to 1.18 mg/dL, eGFR 36.8 to 48.4 mL/min/1.73m$^2$, HbA1c 6.1% to 5.2%, and ALT 117 to 23 U/L. In this case, three aspects of discussion can be supposed, which will be described in this order.

Firstly, this case had clinical efficacy by LCD. Concerning LCD, authors' research group have continued LCD development for years through Japan LCD promotion association (JLCDPA) [14]. As practical LCD meal method, we have recommended three types of LCD. They are super-LCD, standard-LCD and petite-LCD, which include carbohydrate ratio as 12%, 26% and 40%, respectively [15]. When applying super-LCD, T2D patient had shown significant improvement of glucose variability associated with remarkable weight reduction [16]. LCD is expected to be more recognized as useful nutritional method for weight reduction.

Secondly, the relationship between LCD and diabetic nephropathy (DN) was investigated. The protocol showed two groups of with and without DN. Furthermore, 147 items of biochemical and anthropometric measures were analyzed [17]. From these data, LCD score was calculated. Thus, LCD score and odd ratio for developing to DN were compared. As a result, LCD scores were not significantly related with DN (OR=0.39). However, by the highest quartile of LCD score showed 71% lower risk of DN (OR =0.29). For significant trend, urinary albumin was decreased associated with elevation of LCD score

(p=0.005). In conclusion, LCD showed inverse association with DN risk. Future detail investigation will be required for confirming these results. Concerning the efficacy of LCD on renal function in T2D, meta-analysis was performed [18]. The method included 12 controlled trials with 942 cases were analyzed. As a result, significant differences were not found for eGFR, Ccr, urinary albumin and serum creatinine. Consequently, clinical efficacy was not observed for renal function by the comparison of LCD and control diet for T2D.

Concerning the progress of DN, the influence of daily meal was investigated. The protocol included 210 female T2D with and without DN (2 groups of 105 and 105) [19]. The meal was used for the Dietary Approaches to Stop Hypertension (DASH) diet, and detail questionnaire of food intake with 147 items. By conducting the control of potential confounders, the highest DASH adherence showed 84% lower add ratio of DN. It was compared to those of the lowest, which showed odd ratio of 0.16 ($p< 0.001$). Recently, LCD has been known for its clinical efficacy for T2D. In the case of T2D with nephropathy, LCD may elevate usual protein intake. Dietary protein amount can influence renal function, and then various debate has been observed. From the cohort study, clinical efficacy of LCD for renal function was investigated for 143 cases [20]. As a result, LCD contributed the improvement of renal and cardiovascular risk factors for T2D. In the comparative cohort study with mild CKD and normal renal function for 30 months, serum creatinine level was improved significantly. For the detail data, serum creatinine showed the improvement from 80.0 to 74.5 μmol/L ($p <0.001$), and eGFR showed the improvement from 85.5 to 88.0 mL/min/1.73m$^2$ ($p=0.003$).

Thirdly, a recent report was found as to CKD and obesity [21]. Totally 140 CKD patients were included and analyzed, in which average data were age 69, body weight 99kg, BMI 36 kg/m$^2$, eGFR 17 mL/min/1.73m$^2$ (12-20), HbA1c 7.0% (5.9-8.1), and albumin to creatinine ratio 61 mg/g･Cr (18.3-220.1). For further detail data, etiology of CKD showed diabetes 56%, hypertension 39%, renovascular disease 4%, and obesity-related comorbidity showed diabetes 66%, hypertension 70%, dyslipidemia 16%, cardiovascular disease 26%. Related nephrologists showed the agreement that obesity would affect negatively health of CKD cases. Both of T2DM and obesity may lead to CKD and DKD associated with acceleration of renal function impairment. Adequate diet can bring the suppression of DKD, CKD or progression by reducing blood pressure and body weight [22]. It can contribute more by reducing inflammatory phenomenon and renal hyperfiltration. By continuing LCD, T2D case will have successful improved glycemic control and weight reduction. However, it may bring some concerning of DKD/CKD from relatively higher intake of protein.

The relationship of CKD and weight reduction was in focus, and comprehensive reviews were reported with impressive content [23,24]. From these results, cases with remarkable weight reduction have showed stable or improved GFR and proteinuria excretion by observational and interventional investigations [25,26]. These reports showed the involvement of lifestyle analysis, pharmacological treatment, and surgical interventions. In addition, weight reduction and CKD biomarkers in these circumstances showed better results than surgical interventions.

Some limitation may exist in this report. This case showed the improvement of renal function. The reason would be from weight reduction by LCD. However, other factors may be involved in the clinical progress, such as blood pressure, blood glucose, lipids, and arteriosclerosis. Further follow up will be required in this case.

In summary, the case of 66-year-old male with CKD was presented and some perspectives as to CKD, LCD and weight reduction were described. Some impressive points will become a useful reference for future practice and research of CKD.

## Conflict of Interest

The authors declare no conflict of interest.

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## References

1. Ardavani A, Curtis F, Khunti K, Wilkinson TJ. The effect of pharmacist-led interventions on the management and outcomes in chronic kidney disease (CKD): A systematic review and meta-analysis protocol. Health Sci Rep. 2023; 6: e1064.
2. Jiang Z, Wang Y, Zhao X, Cui H, Han M, Ren X, et al. Obesity and chronic kidney disease. Am J Physiol Endocrinol Metab. 2023; 324: E24-E41.
3. Gawash A, Zia H, Lo DF. Refining ASCVD Risk Prediction and Temporal Trends: The Role of Chronic Kidney Disease, Polygenic Risk Scores, and Longitudinal Studies. Eur J Prev Cardiol. 2023; 18: 014.
4. Navaneethan SD, Zoungas S, Caramori ML, Chan JCN, Heerspink HJL, Hurst C, et al. Diabetes Management in Chronic Kidney Disease: Synopsis of the KDIGO 2022 Clinical Practice Guideline Update. Ann Intern Med. 2023.
5. Garneata L, Stancu A, Dragomir D, Stefan G, Mircescu G. Ketoanalogue-Supplemented Vegetarian Very Low-Protein Diet and CKD Progression. J Am Soc Nephrol. 2016; 27: 2164-2176.
6. Hahn D, Hodson EM, Fouque D. Low protein diets for non-diabetic adults with chronic kidney disease. Cochrane Database Syst Rev. 2020; 10: CD001892.
7. Naber T, Purohit S. Chronic Kidney Disease: Role of Diet for a Reduction in the Severity of the Disease. Nutrients. 2021; 13: 3277.
8. Hu EA, Coresh J, Anderson CAM, Appel LJ, Grams ME, Crews DC, et al. Adherence to Healthy Dietary Patterns and Risk of CKD

Progression and All-Cause Mortality: Findings From the CRIC (Chronic Renal Insufficiency Cohort) Study. Am J Kidney Dis. 2021; 77: 235-244.

9. Shi H, Su X, Li C, Guo W, Wang L. Effect of a low-salt diet on chronic kidney disease outcomes: a systematic review and meta-analysis. BMJ Open. 2022; 12: e050843.
10. Fujikawa T, Kato Y, Bando H, Kakutani H, Kawata T, Yamamoto M, et al. The Administration of Xultophy for Diabetic Patients on Hemodialysis. Diab Res Open Access. 2020; 2: 72-78
11. Miyashiro H, Bando H, Kato Y, Yamashita H, Kato Y. Improved Glucose Variability of Continuous Glucose Monitoring (CGM) By Intake of Japanese Healthy Tofu as Low Carbohydrate Diet (LCD). Int J Endocrinol Diabetes. 2022; 5: 136.
12. Bando H, Yamashita H, Kato Y, Kawata T, Kato Y, Kanagawa H. Seasonal Variation of Glucose Variability in Rather Elderly Patients with Type 2 Diabetes (T2D) Treated by Vildagliptin and Metformin (EquMet). Asp Biomed Clin Case Rep. 2022; 5: 146-151.
13. Alkhatib L, Velez Diaz LA, Varma S, Chowdhary A, Bapat P, Pan H, et al. Lifestyle Modifications and Nutritional and Therapeutic Interventions in Delaying the Progression of Chronic Kidney Disease: A Review. Cureus. 2023; 15: e34572.
14. Muneta T, Hayashi M, Nagai Y, Matsumoto M, Bando H, Ebe K, et al. Ketone Bodies in the Fetus and Newborn During Gestational Diabetes and Normal Delivery. Int J Diabetes. 2022; 3: 142-148.
15. Bando H. Useful Tips for Actual Low Carbohydrate Diet (LCD) with Super-, Standard- and Petit-LCD Methods. EC Nutrition. 2020; 5; 01-04.
16. Kanazawa S, Kato Y, Bando H. Significant weight reduction by super low carbohydrate diet with improved lipid profiles. International Medicine. 2020; 2: 175-178.
17. Hajishizari S, Mirzababaei A, Abaj F, Khosroshahi RA, Barekzai AM, Worm N, et al. The association between a low-carbohydrate diet score and the risk of diabetic nephropathy in women: A case-control study. Nutrition. 2023; 107: 111930.
18. Suyoto PST. Effect of low-carbohydrate diet on markers of renal function in patients with type 2 diabetes: A meta-analysis. Diabetes Metab Res Rev. 2018; 34: e3032.
19. Mirzababaei A, Abaj F, Hajishizari S, Bahrampour N, Noori S, Barekzai AM, et al. The association of dietary approaches to stop hypertension (DASH) with the odds of diabetic nephropathy and metabolic markers in women: a case-control study. BMC Womens Health. 2023; 23: 63.
20. Unwin D, Unwin J, Crocombe D, Delon C, Guess N, Wong C. Renal function in patients following a low carbohydrate diet for type 2 diabetes: a review of the literature and analysis of routine clinical data from a primary care service over 7 years. Curr Opin Endocrinol Diabetes Obes. 2021; 28: 469-479.
21. Chiu M, Moist L, Al-Jaishi A, Jain AK. Recognition of Obesity and Perceptions of Weight Loss Management in Patients with Chronic Kidney Disease: A Retrospective Cross-Sectional Study. Can J Kidney Health Dis. 2022; 9: 20543581221129465.
22. Mitchell NS, Scialla JJ, Yancy WS Jr. Are low-carbohydrate diets safe in diabetic and nondiabetic chronic kidney disease? Ann N Y Acad Sci. 2020; 1461: 25-36.
23. Kiortsis DN, Christou MA. Management of obesity-induced kidney disease: a critical review of the literature. Obes Facts. 2012; 5: 821-832.
24. Navaneethan SD, Yehnert H, Moustarah F, Schreiber MJ, Schauer PR, Beddhu S. Weight loss interventions in chronic kidney disease: a systematic review and meta-analysis. Clin J Am Soc Nephrol. 2009; 4: 1565-1574.
25. Bolignano D, Zoccali C. Effects of weight loss on renal function in obese CKD patients: a systematic review. Nephrol Dial Transplant. 2013; 28: 82-98.
26. Schrauben SJ, Apple BJ, Chang AR. Modifiable Lifestyle Behaviors and CKD Progression: A Narrative Review. Kidney360. 2022; 3: 752-778.