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Original Article

Simultaneous control of glycemic, blood pressure, and lipid significantly reduce the risk of renal progression in diabetes patients

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ABSTRACT

Background and aim: Hyperglycemic, hypertension, and lipid abnormalities are risk factors for diabetic kidney disease However, no study has discussed the association of the simultaneous control of glycemic, blood pressure, and lipids with renal function among diabetes patients. Thus, this study examined the interactive effects of the intensive control of all 3 conditions on the progression of renal function.

Materials and methods: The study population was derived from eight hospitals in Taiwan from October 2008 to April 2015. Demographic characteristics were collected using structured questionnaires. Clinical variables were obtained from medical chart review. The renal progression was defined as a decline in the eGFR by more than 25% according to the baseline eGFR.

Results: Total of 1602 diabetes patients were included in the study analysis, the mean age was 63.03 ± 10.98 years, 55.56% were men. Compared to the simultaneous control of glycemic, blood pressure and lipid group, the poor control of all three diseases had the highest risk of renal progression, with an adjusted OR of 2.21 (95% CI, 1.26–3.86). Even if the patients with an intensive control of lipid, the result showed that the poor control of both glycemic and hypertension was associated with the increased risk of renal progression than the reference group.

Conclusion: This study demonstrated that the simultaneous poor control of glycemic, blood pressure, and lipid had the highest risk of renal progression. Thus, patients with type 2 diabetes should not only control glycemic but also manage their blood pressure and lipid.

1. Introduction

Diabetes mellitus (DM) is a crucial public health threat worldwide. Diabetic kidney disease is a major complication in patients with diabetes. This disease can cause end-stage renal disease (ESRD), cardiovascular disease, and increased mortality in patients with diabetes [1–4]. According to previous reports, 29%–47% of patients with type 2 diabetes develop chronic kidney disease (CKD) [5] and 0.8% develop ESRD [6,7]. In summary, patients with type 2 diabetes might develop renal dysfunction during their lifetime [6].

Aging, sex, genetic factors, hyperglycemic, hypertension, lipid abnormalities, and family history are risk factors for diabetic kidney disease [8,9]. Among the aforementioned factors, hyperglycemic, hypertension, or lipid abnormalities are modifiable risk factors [9]. Therefore, the improved control of glycemic, blood pressure, and lipid exerts beneficial effects in patients with diabetes. Intensive diabetes management decreases the risk of microvascular complications [10,11]. Moreover, a study found that intensive glucose control improved major renal outcomes in patients with type 2 diabetes [12]. Intensive treatment of elevated blood pressure not only improves the prognosis of patients with diabetic kidney disease [13,14] but also reduces macrovascular complications [15]. In previous studies on type 2 diabetes, dyslipidemia has been independently associated with the renal progression [6,16,17].

Several patients with DM exhibit multiple health conditions such as comorbid hypertension and dyslipidemia [18]. In addition to controlling glycemic, patients with diabetes should manage blood pressure and lipid. However, only 12% of patients with diabetes simultaneously control all the aforementioned conditions [19]. A previous study indicated that controlling low-density lipoprotein (LDL) cholesterol and blood pressure reduces the incidence of atherosclerosis in individuals with type 2 diabetes [20]. However, to our knowledge, there was no study that simultaneously discussed the effects of controlling glycemic, blood pressure, and lipid on renal function. In this study, we examined the interactive effects of controlling the 3 conditions on the renal progression among patients with type 2 diabetes.

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2. Methods

2.1. Study population

In this prospective cohort study, 17,030 participants aged ≥18 years were recruited from 8 hospitals in Taiwan (Tri-Service General Hospital, Cardinal Tien Hospital, Shuang Ho Hospital, China Medical University Hospital, Kaohsiung Medical University Chung-Ho Memorial Hospital, National Cheng Kung University Hospital, Changhua Christian Hospital, and Kaohsiung Chang Gung Memorial Hospital) from October 2008 to April 2015. In total, 5115 patients with DM were enrolled. This study uses self-report questionnaire to define DM patients. Diagnosis question was "Have you ever been diagnosed with diabetes by physicians? Answer: Yes/no" If participants answer yes, the participants will be defined to be the DM patients. Patients for this study were excluded selected according to the following criteria: renal function cannot be assessed (n = 83); serum creatinine levels measured only once and follow-up periods were less than 12 months (n = 1893); missing glycated hemoglobin (HbA1C), systolic blood pressure (SBP) and total cholesterol data (n = 1537). As such, the remaining patients (n = 1602) were recorded in the flowchart (Fig. 1). The same medical laboratory criteria and protocol were used in our studying hospitals, and the value of serum creatinine derived from different hospitals can be compared and standardized with each other. This study was approved by the Joint Institutional Review Board of Taipei Medical University (No. 201204036), and written informed consent was obtained from the patients.

2.2. Study variables and definitions

Structured questionnaires were used to collect patients' demographic characteristics, comorbidities, and health-related behaviors, including age, diabetes duration, regular drug therapy, sex, hypertension, dyslipidemia, gout, cardiovascular disease, anemia, CKD, cigarette smoking, and alcohol consumption. Physical examination variables and laboratory variables were obtained by medical chart review, including waist circumference, body mass index (BMI), SBP, diastolic blood pressure, serum creatinine, HbA1C, total cholesterol, and uric acid. The renal progression was defined as a decline in the estimated glomerular filtration rate (eGFR) by more than 25% according to the baseline eGFR [21]. The progressors refer to the patients with renal progression while the not progressors refer to the patients who have no renal progression in the study period. In this study, we measured the change of CKD progression at the individual level. Each patient was reexamined in the same hospital to control the individual variation. The case group refers to the patients with renal progression while the control group refers to the patients who have no renal progression in the study period. The eGFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation [eGFR (ml/min/1.73 m^2) = 141 × min(serum creatinine (SCr)/κ, 1)$^{\alpha}$ × max(SCr/κ, 1)$^{-1.209}$ × 0.993^{age} × (1.018 if female) × (1.159 if black)], κ = 0.7(female) and 0.9(male), α = −0.329 (female) and −0.411(male), min indicated the minimum of SCr/κ or 1, and max indicated the maximum of SCr/κ or 1 [22]. The definition of CKD is based on the presence of kidney damage (i.e., proteinuria dipsticks ≥ 1+, urine protein-to-creatinine ratio (UPCR) ≥ 150, or urine albumin-to-creatinine ratio (UACR) ≥ 30) or eGFR < 60 ml/min/1.73 m^2 [23].

According to the diabetes guidelines, the intensive control of glycemic, blood pressure, and lipid was defined as HbA1C < 7%, SBP < 130 mm Hg, and total cholesterol <200 mg/dl, respectively. The poor control of glycemic, blood pressure, and lipid was defined as HbA1C ≥ 7%, SBP ≥ 130 mm Hg, and total cholesterol ≥200 mg/dl, respectively [4].

The BMI was classified as <18.5, 18.5–23.9 and ≥24 kg/m^2 [24]. Waist circumference was classified as normal (<90 cm for men and < 80 cm for women) or abnormal (≥90 cm for men and ≥80 cm for women) [25,26]. Cigarette smoking was dichotomized as ever smoking

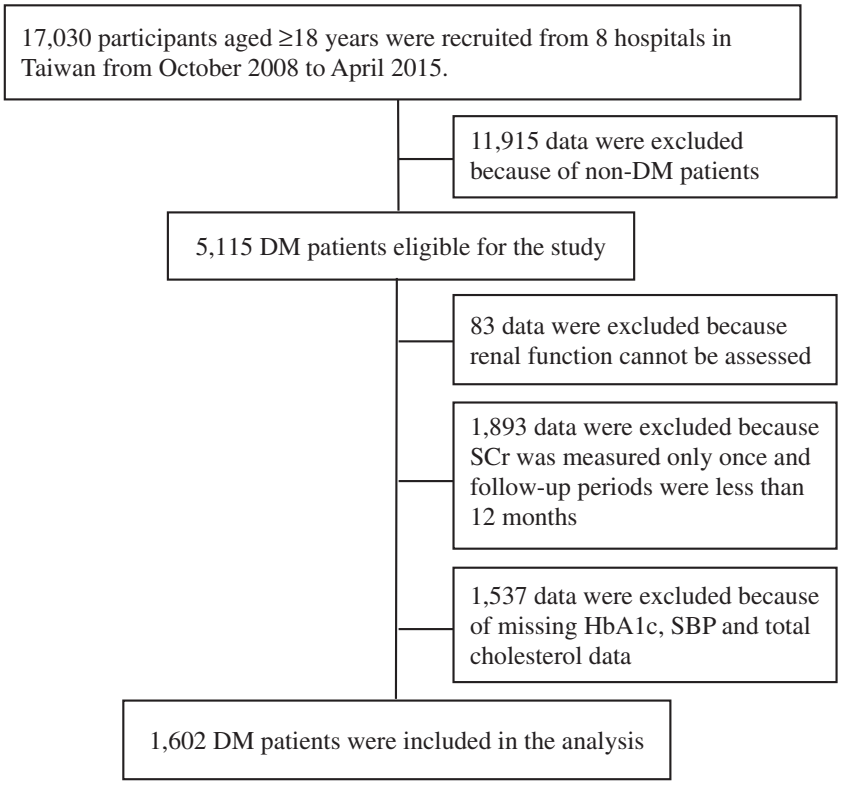

Fig. 1. Selection flowchart for the inclusion and exclusion.

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