Original Article

Additional Small Amounts of Diuretics Improve Blood Pressure Control at Low Cost without Disadvantages in Blood Sugar Metabolism

Toshiyuki KUDOH[1)], Teruhisa NAGAWAGA[1)], and Izumi NAKAGAWA[1)]

We evaluated our present treatment of hypertension and sought a way to improve it. We studied 164 of outpatients we treated in 2002. Mean systolic blood pressure (SBP)±SD was 142.0±11.3, and 56% of patients had SBP over 140 mmHg. We used more diuretics in patients with good control of SBP (19% *vs.* 7% of patients; $p=0.012$). After observing our hypertensive patients, we changed our treatment in a goal-oriented manner. Our goal was blood pressure below 140/90 mmHg. We used, in principle, additional small amounts of diuretics for inadequately treated patients. We followed 147 of the 164 patients from 2002 to 2006. During this period, mean SBP decreased to 134.7±9.1 mmHg ($p<0.001$), and the frequency of patients with SBP >140 mmHg decreased to 14% ($p<0.001$). We used more diuretics in 2006 than in 2002 (12% to 46% $p<0.001$). To estimate the risks and benefits of diuretics, in 2006 we analyzed 510 patients who had been followed for at least 2 years. Potassium supplementation was needed in 28% of diuretic-treated patients and 7% of patients without diuretics. We found a correlation between the use of diuretics and good SBP control in the entire patient group as well as in patients with diabetes. In the control of diabetes mellitus, we found no statistical difference between patients treated with diuretics and those not. We found diuretics had no adverse effects with respect to new-onset diabetes mellitus. (*Hypertens Res* 2008; 31: 455–462)

***Key Words*: diuretics, hypertension, diabetes mellitus, potassium supplementation**

Introduction

Mega-trials for antihypertensive treatment have demonstrated the efficacy and safety of strict blood pressure control. They have also proved that, to achieve successful antihypertensive treatment, it is more important to treat hypertension sufficiently than to treat it with a particular kind of drug, except in patients with certain diseases (*1–6*).

It has been considered that antihypertensive treatment is not satisfactory because most hypertensive patients are not aware that they have hypertension and because the treatment provided by their physicians is inadequate. The rule of halves still holds in many countries as well as in Japan (*7–13*).

The increasing cost of medical treatment is a serious problem around the world. The best way to resolve this problem is through good disease control at lower cost. The Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT) and other clinical trials have proven the benefit of diuretics in disease prevention.

Diuretics are among the most inexpensive drugs. However, many clinical studies have reported that they have unfavorable effects on metabolic status, especially in patients with diabetes mellitus (DM) (*14–16*). This is a major obstacle to the increased use of diuretics in the treatment of hypertension.

We examined our hypertensive outpatients in 2002. We achieved adequate treatment of hypertension in only 44% of the patients. Those with adequate blood pressure control were more likely to use diuretics than those without. After our first observation, we adopted a goal-oriented strategy to manage hypertension. And we added small amounts of diuretics to improve the treatment we provided, in principle. In 2006 we

From the [1)]Department of Cardiovascular Medicine, Wajo-kai Eniwa Hospital, Eniwa, Japan.

Address for Reprints: Toshiyuki Kudoh, M.D., Department of Cardiovascular Medicine, Wajo-kai Eniwa Hospital, Kogane 28–6, Eniwa 061–1449, Japan. E-mail: t-kudo@pop12.odn.ne.jp

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Table 1. Cross-Sectional Study in 2002

	Total	SBP>140	SBP≤140	*p* (SBP>140 *vs*. SBP≤140)
No. of subjects	164	92	72	
Male, %	45	46	42	0.612
Age, years	67.2±10.7	67.1±10.6	67.3±11.0	0.896
Follow-up time, years	3.8±2.6	3.9±2.7	3.7±2.6	0.674
History of DM, %	19	20	16	0.519
History of HL, %	15	15	14	0.812
History of IHD, %	12	12	13	0.917
History of CVD, %	5	7	4	0.514
BMI, kg/m^2	25.5±4.8	25.1±4.5	26.0±5.1	0.213
SBP, mmHg	142.0±11.3	149.3±8.9	132.6±5.8	<0.001
SBP>140 mmHg, %	56	100	0	<0.001
DBP, mmHg	76.2±7.7	78.3±7.5	73.5±7.2	<0.001
DBP>90 mmHg, %	7	9	4	0.253
CCB, %	80	84	76	0.243
ARB, %	24	28	19	0.193
DIU, %	12	7	19	0.012
BB, %	24	22	26	0.489
ACEI, %	19	21	16	0.519
AB, %	30	3	3	0.859
ARB+ACEI, %	44	49	36	0.143
No. of drugs used	1.62±0.8	1.64±0.76	1.61±0.74	0.800
Potassium, mEq/L	4.1±0.4	4.1±0.4	4.1±0.5	0.655
K-supple, %	9	7	12	0.314
Cre, mg/dL	0.96±0.23	0.98±0.22	0.94±0.25	0.317
T-cho, mg/dL	212±34	208±31	218±38	0.052
HDL, mg/dL	55±16.4	57±17	54±16	0.294
TG, mg/dL	153±90	136±57	173±115	0.046

DM, diabetes mellitus; HL, hyperlipidemia; IHD, ischemic heart disease; CVD, cerebral vascular disease; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; CCB, calcium channel blockers; ARB, angiotensin receptor blockers; DIU, diuretics; BB, β-blockers; ACEI, angiotensin converting enzyme inhibitors; AB, α-blockers; K-supple, needs of potassium supplementations; Cre, serum creatinine level; T-cho, serum total cholesterol level; HDL, serum high-density lipoprotein level; TG, serum triglyceride level; SBP>140, SBP>140 mmHg; SBP≤140, SBP≤140 mmHg.

analyzed the data to evaluate the risks and benefits of more frequent use of diuretics to control blood pressure.

Methods

We selected 164 of our patients with essential hypertension. The first observations were made in November 2002. We examined blood pressure, age, sex, number of years of follow-up, and any history of ischemic heart disease, cerebral vascular disease, DM, or hyperlipidemia. We excluded patients who had abnormal laboratory test results indicating renal insufficiency or severe electrolyte disturbance, and patients who had a medical record of secondary hypertension. We collected data almost annually. Data were last collected in July 2006.

A doctor measured blood pressure using a sphygmomanometer, with the patient in the sitting position after 10 min of rest. Patients with white-coat hypertension measured blood pressure themselves using an automatic sphygmomanometer that was checked for accuracy by a doctor in the office. Accuracy to within 10 mmHg was accepted for these devices.

The goal for blood pressure treatment was below 140/90 mmHg for all patients regardless of age and the coexistence of other diseases, such as DM, ischemic heart disease, and chronic kidney disease.

Antihypertensive drugs were divided into six groups. These were calcium channel blockers (CCB), angiotensin receptor blockers (ARB), diuretics, β-receptor blockers (BB), angiotensin-converting enzyme inhibitors (ACEI), and α-receptor blockers (AB). Drugs were prescribed by checking the patient's latest medical records. We did not use loop diuretics for the treatment of hypertension.

For patients without DM, laboratory tests were performed every 6 months to check the onset of DM and blood potassium levels. For the diagnosis of DM, we used the criteria of the Japan Diabetes Society (1999). The onset of DM was

diagnosed using a casual plasma glucose level above 200 mg/dL or HbA1c above 6.5%. Patients with DM had blood samples checked at every visit (at intervals of 1 or 2 months). Control of DM was evaluated from HbA1c values. We regarded a blood potassium level below 3.5 mEq/L as abnormal. Drugs for potassium supplementation were added regularly.

After the first examination in 2002, we treated blood pressure in a goal-oriented manner. The first therapeutic change was, in principle, to add a small amount of diuretic to the patient's treatment regimen. Indapamide 1 mg/day accounted for 95% of the additional diuretic treatments. After the use of diuretics had started, the antihypertensive treatment was changed if we considered that doing so would be advantageous. All drugs, including diuretics, were changed if they proved to be disadvantageous or to lack efficacy.

We evaluated the effects of additional diuretics in 147 patients who were followed up from 2002 through 2006. Seventeen patients were excluded from evaluation because of inadequate medical data. In 2006, we evaluated the effects of diuretics on DM and potassium metabolism in 510 patients who had been followed up for at least 2 years in 2006.

Data Analysis

Statistical analysis was performed using SPSS version 11 (SPSS, Chicago, USA). All parametric data are reported as means±SD. Comparison of data between 2002 and 2006 was performed using the paired Student's *t*-test. Other comparisons of parametric data were performed using the unpaired *t*-test. Comparisons of nonparametric data between groups were performed using the Mann-Whitney *U*-test. Logistic regression analysis was performed to determine the independent drug and clinical factors that were statistically different in single-variant comparisons. Values of $p<0.05$ were considered to indicate statistical significance.

Results

Cross-Sectional Study in 2002

We analyzed the data of 164 patients who were treated for hypertension in a department of our hospital. Their mean age was 67.2±10.7 years. The mean follow-up time was 3.8±2.6 years (minimum 0.5 years, maximum 10 years). Mean systolic blood pressure (SBP) was 142.0±11.3 mmHg and mean diastolic blood pressure (DBP) was 76.2±7.7 mmHg (Table 1). The frequencies of patients with inadequate blood pressure control, defined as SBP >140 mmHg and DBP >90 mmHg, were 56% and 7%, respectively. We investigated the relationships between inadequate control and some clinical variables. Patients with SBP >140 mmHg were less likely to have received diuretics than patients with SBP ≤140 mmHg (7% *vs*. 19%; $p=0.012$) (Table 1).

Table 2. Multiple Logistic Regression Analysis between SBP>140 mmHg and Clinical Variables in 2002

Variable	*B*	*p*	Exp (*B*)
Follow-up time	−0.013	0.856	0.987
Sex	0.315	0.448	1.370
Age	−0.002	0.900	0.998
DM	0.113	0.811	1.120
BMI	−0.095	0.028	0.910
CCB	0.992	0.061	2.698
ARB	0.761	0.121	2.140
DIU	−1.570	0.017	0.208
BB	−0.219	0.612	0.803
CEI	0.608	0.244	1.836
AB	0.046	0.967	1.047
Cre	1.645	0.079	5.179

DM, diabetes mellitus; BMI, body mass index; CCB, calcium channel blockers; ARB, angiotensin receptor blockers; DIU, diuretics; BB, β-blockers; ACEI, angiotensin converting enzyme inhibitors; AB, α-blockers; Cre, serum creatinine level.

In logistic regression analysis, the frequency of patients given diuretics and their body mass index were both positively correlated with the frequency of patients in whom SBP was controlled adequately ($p=0.017$ and $p=0.028$, respectively). The frequency of patients with other tested variables (age, sex, follow-up time, DM, and other antihypertensive drugs) did not achieve significance (Table 2).

Effect of Additional Small Amounts of Diuretics

We analyzed data of 147 patients who were followed up from 2002 through 2006 (Table 3). In 2002, mean SBP/DBP was 142.0±11.6/76.3±7.9 mmHg, and 56% of patients had SBP >140 mmHg. In 2003, mean SBP/DBP decreased to 137.0±11.6/76.1±8.1 mmHg, the frequency of SBP >140 mmHg decreased to 31%, and the use of diuretics increased from 12% to 34% of patients. In 2006, mean SBP was 134±9.1 mmHg, mean DBP was 74.3±6.9 mmHg, 14% of patients had SBP >140 mmHg, and 3% had DBP >90 mmHg; the *p* values for the differences between 2002 and 2006 were <0.001, <0.001, <0.001, and 0.07 for the four variables, respectively. In 2006 we used more diuretics and ARB (12% *vs*. 46%; $p<0.001$ and 26% *vs*. 35%; $p<0.05$), and less ACEI (17% *vs*. 12%; $p<0.05$). There was no difference between the proportion of patients treated with ARB and those treated with ACEI (43% *vs*. 46%; $p=0.37$). We used a greater number of drugs in 2006 than in 2002 (1.6±0.8 *vs*. 2.0±1.0; $p<0.001$). The frequency of patients with potassium depletion increased from 8% in 2002 to 25% in 2006 ($p<0.001$) (Table 3).

Table 3. Effect of Additional Small Amounts of Diuretics from 2002 to 2006

	Year				
	2002	2003	2004	2005	2006
No.of patients	147				
Age, years	66.7±10.9				
Male, %	45				
BMI, kg/m^2	25.6±4.7				25.6±5.2
SBP, mmHg	142.0±11.6	137.0±11.6**	136.3±11.0**	136.4±8.7**	134.7±9.1**
SBP>140 mmHg, %	56	31**	26**	19*	14**
DBP, mmHg	76.3±7.9	76.1±8.1	73.9±7.2*	74.7±6.2*	74.3±6.9*
DBP>90 mmHg, %	93	7	4	3	3
CCB, %	81	74	73	75	80
ARB, %	26	36	36	37*	35*
DIU, %	12	34**	46**	45**	46**
BB, %	14	21	24	22	21
ACEI, %	17	14	8*	9	12*
AB, %	3	3	5	4	3
ARB+ACEI, %	43	50	44	46	46
No. of drugs used	1.6±0.8	1.8±0.9*	1.9±1.0*	1.9±10*	2.0±1.0**
Potassium, mEq/L	4.1±0.4				4.0±0.5*
K-supple, %	8				25**
Cre, mg/dL	0.97±0.24				0.80±0.30**

BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; CCB, calcium channel blockers; ARB, angiotensin receptor blockers; DIU, diuretics; BB, β-blockers; ACEI, angiotensin converting enzyme inhibitors; AB, α-blockers; K-supple, needs of potassium supplementations; Cre, serum creatinine level. *$p<0.05$; **$p<0.001$.

Effect of Diuretic Treatment on Control of Hypertension

Six hundred and twenty-two hypertensive patients visited our office between May and June 2006. Of these, 112 were excluded because of a lack of data or a follow-up period of less than 2 years. The mean blood pressure of the remaining 510 patients was 136.0±10.3/75.0±7.6 mmHg (Table 4). The frequencies of patients with SBP >140 mmHg and DBP >90 mmHg were 16% and 3%, respectively. We used diuretics in almost half of the patients.

To investigate the risks and benefits of diuretics, we divided 510 patients into 258 who had been treated with diuretics and 252 patients who had not. The patients in the former group were older than those in the latter (70.4±10.8 *vs*. 67.9±10.8 years; $p=0.008$), were less likely to have DM (22% *vs*. 34%; $p=0.003$), were less likely to have SBP >140 mmHg (12% *vs*. 19%; $p=0.03$), and had lower DBP (74.1±7.0 *vs*. 75.9±8.2 mmHg; $p=0.007$). We also used more ARB (42% *vs*. 33%; $p=0.03$) and less ACEI (6% *vs*. 12%; $p=0.035$) in the patients treated with diuretics. There was no difference between the proportion of patients treated with ARB and those treated with ACEI (45% *vs*. 43% $p=0.63$). The number of drugs used (2.4±0.9 *vs*. 1.4±0.9; $p<0.001$) and the frequency of patients given potassium supplementation (28% *vs*. 7%; $p<0.001$) were higher in the diuretic-treated group.

Effect of Diuretics on Hypertensive Patients with DM

We also analyzed whether or not diuretics affected the control of DM. Among the 510 patients described in the previous section, 143 were treated for both DM and hypertension for at least 2 years (Table 5). We divided the 143 patients according to whether or not they used diuretics. There were 57 in the diuretic-treated group with DM and 86 with DM in the non-diuretic group. The diuretic-treated group was older (70.0±9.5 *vs*. 66.4±11.0 years; $p=0.03$), had a lower frequency of patients with SBP >140 mmHg (9% *vs*. 22%; $p=0.037$), used many different drugs (2.7±0.9 *vs*. 1.6±0.7; $p<0.001$), and had a higher frequency of patients receiving potassium supplementation (25% *vs*. 4%; $p<0.001$). We analyzed the effect of diuretics on diabetic controls by measuring mean HbA1c as well as the frequencies of patients whose HbA1c was over 6.5%, 7.0%, and 8%. We found no statistically significant difference in these parameters. Although the diuretic-treated group had a significantly higher frequency of patients receiving potassium supplementation, there was no significant difference in potassium level between the two groups ($p=0.315$).

Table 4. Effect of Diuretic Treatment on Hypertensive Patients in 2006

	Total	DIU+	DIU−	*p* (DIU+ *vs*. DIU−)
No. of subjects	510	258	252	
Age, years	69.2±10.9	70.4±10.8	67.9±10.9	0.008
Male, %	44	40	48	0.068
DM, %	28	22	34	0.003
HL, %	28	24	32	0.066
BMI, kg/m^2	25.2±4.4	22.5±4.5	25.3±4.2	0.967
SBP, mmHg	136.0±10.3	135.3±10.2	136.7±10.4	0.134
SBP>140 mmHg, %	16	12	19	0.030
DBP, mmHg	75.0±7.6	74.1±7.0	75.9±8.2	0.007
DBP>90 mmHg, %	3	2	5	0.038
CCB, %	73	72	73	0.972
ARB, %	37	42	33	0.030
DIU, %	51	100	0	
BB, %	19	16	22	0.111
ACEI, %	9	6	12	0.035
AB, %	3	4	2	0.140
ARB+ACEI, %	44	45	43	0.630
No. of drugs used	1.9±1.0	2.4±0.9	1.4±0.7	<0.001
Potassium, mEq/L	3.9±0.4	3.9±0.5	3.9±0.4	0.003
K-supple, %	18	28	7	<0.001
Cre, mg/dL	0.77±0.3	0.79±0.3	0.75±0.2	0.165
T-cho, mg/dL	202±33	204±33	200±33	0.280
HDL, mg/dL	58±15	59±15	57±14	0.176
TG, mg/dL	150±104	24.00	32	0.066

DIU, diuretics; DM, diabetes mellitus; HL, hyperlipidemia; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; CCB, calcium channel blockers; ARB, angiotensin receptor blockers; BB, β-blockers; ACEI, angiotensin converting enzyme inhibitors; AB, α-blockers; K-supple, needs of potassium supplementations; Cre, serum creatinine level; T-cho, serum total cholesterol level; HDL, serum high-density lipoprotein level; TG, serum triglyceride level.

Effect of Diuretics on Hypertensive Patients without DM

Among the 510 patients, 372 were not a diagnosed for DM in 2004. Nine patients were new-onset DM (NDM) during the 2-year period (1.2 cases of NDM per 100 patient-years). We found no relation between the use of diuretics and NDM. Among patients using diuretics, 1.5 per 100 patient-years were NDM cases, whereas there were 0.9 per 100 patient-years of NDM in patients not using diuretics ($p=0.482$). There was no relation between the use of diuretics and the frequency of SBP >140 mmHg in patients without DM (Table 6).

Discussion

In our cross-sectional study in 2002, we found a correlation between good control of SBP and the use of diuretics. However, we used diuretics in only 12% of our patients because we had underestimated their effect on the treatment of hypertension and were apprehensive about their possible adverse effects on metabolic status. Mori *et al*., reporting on the current status of antihypertensive prescription in Japan, noted that Japanese doctors used a few diuretics in addition to CCB, which gave better blood pressure control than others (*12*). We wished to evaluate the ability of diuretics to improve the treatment of hypertension in our outpatient office, as we needed to improve treatment for patients with many different clinical states.

In 2002, we found no relation between good control of SBP and follow-up time. We considered it urgent that we change our management of hypertension (*17*, *18*). We chose a goal-oriented treatment approach as the best way to improve hypertensive control immediately (*19*).

In 2006, we used 34% more diuretics than in 2002. We also used 11% more ARB. For most patients we changed ACEI to ARB, because of the lack of efficacy and side effects, so the use of ARB+ACEI increased by only 3%.

In Japan, about $45 per person is spent on diuretics per year, whereas $500 is spent on ARB and $240, $280, $380, and $480 are spent on CCB, ACEI, BB, and AB, respectively. If we had selected any of these other drugs rather than diuretics for additional treatment, the cost of improving hypertensive treatment would have been at least five times greater.

Table 5. Effect of Diuretics on Hypertensive Patients with Diabetes Mellitus

	DM+	DIU+	DIU−	*p* (DIU+ *vs.* DIU−)
No. of subjects	143	57	86	
Age, years	67.6±10.6	70.0±9.5	66.4±11.0	0.030
Male, %	47	42	49	0.433
HL, %	38	37	38	0.855
HbA1c, mean±SD	7.0±1.0	6.9±1.0	7.0±1.0	0.457
HbA1c>6.5%, %	65	60	69	0.275
HbA1c>7.0%, %	40	35	43	0.346
HbA1c>8.0%, %	13	11	14	0.549
BMI, kg/m^2	26.0±4.2	26.0±4.1	26.0±4.3	0.981
SBP, mmHg	136.5±10.9	135.2±9.0	137.3±12.0	0.242
SBP>140 mmHg, %	17	9	22	0.037
DBP, mmHg	73.9±6.9	72.8±6.2	74.7±7.3	0.109
DBP>90 mmHg, %	1	0	2	0.249
CCB, %	74	81	70	0.146
ARB, %	51	56	47	0.325
DIU, %	40	100	0	
BB, %	22	46	26	0.166
ACEI, %	12	411	13	0.685
AB, %	3	5	11	0.147
ARB+ACEI, %	59	60	58	0.859
No. of drugs used	2.0±1.0	2.7±0.9	1.6±0.7	<0.001
Potassium, mEq/L	4.0±0.4	4.0±0.5	4.1±0.4	0.315
K-supple, %	13	25	4	<0.001
Cre, mg/dL	0.75±0.2	0.74±0.22	0.75±0.24	0.846
T-cho, mg/dL	192±37	195±39	190±35	0.494
HDL, mg/dL	59±19	61±10	58±27	0.823
TG, mg/dL	161±90	168±96	155±85	0.409

DM, diabetes mellitus; DIU, diuretics; HL, hyperlipidemia; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; CCB, calcium channel blockers; ARB, angiotensin receptor blockers; BB, β-blockers; ACEI, angiotensin converting enzyme inhibitors; AB, α-blockers; K-supple, needs of potassium supplementations; Cre, serum creatinine level; T-cho, serum total cholesterol level; HDL, serum high-density lipoprotein level; TG, serum triglyceride level.

Diuretics seemed to have adverse effects on potassium metabolism. There was marked potassium depletion in our diuretic-treated group. Potassium supplementation was needed in 28% of the diuretic-treated group compared with only 7% of patients not receiving diuretics; after supplementation, mean potassium levels were similar between the groups. No adverse events were attributed to low potassium levels.

Diuretics have harmful effects on blood sugar metabolism and may be detrimental to the control of DM (*14–16*). We evaluated control by measuring HbA1c. Control was not significantly different between patients receiving diuretics and those not receiving them. The use of diuretics might lead to more cases of DM in hypertensive patients. We did not find any statistically significant difference in the incidence of new-onset DM between our groups. In previous studies reporting that diuretic use led to more DM, the doses of diuretics used were higher than the doses we used in our treatment. We therefore consider that small amounts of diuretics might not worsen blood sugar metabolism. The adverse effects of diuretics were supposed to be associated with potassium depletion. We consider that the amount of potassium supplied by the supplementation in our study was enough to prevent any metabolic disadvantages of the use of diuretics (*20–22*).

In 2006, we used diuretics for 55% of patients without DM and for 40% of patients with DM. We used fewer diuretics on diabetic patients for fear of its adverse effects. However, we found diuretics to have a favorable effect on blood pressure control in DM patients. We may use more diuretics for DM patients, while bearing in mind the possibility of potassium depletion.

This study was based on annual observations of our outpatients. Our protocol was to add small amounts of diuretics at first, and to change the antihypertensive drug if the patient's physician considered it advisable. We consider that we were able to improve the control of hypertension in our outpatients by using this tactic.

Table 6. Effect of Diuretics on Hypertensive Patients without Diabetes Mellitus

	DM−	DIU+	DIU−	*p* (DIU+ *vs*. DIU−)
No. of subjects	372	205	167	
Age, years	69.6±11.0	70.5±11.2	68.6±10.7	0.109
Male, %	44	39	49	0.051
HL	24	21	29	0.083
NDM, per 100 patient-years	1.2	1.5	0.9	0.482
BMI, kg/m^2	24.9±4.5	25.0±4.6	24.7±4.3	0.579
SBP, mmHg	135.8±10.2	135.4±10.5	136.2±9.7	0.448
SBP>140 mmHg, %	15	13	18	0.203
DBP, mmHg	75.5±7.9	74.6±7.1	76.6±8.5	0.014
DBP>90 mmHg, %	4	2	6	0.042
CCB, %	72	71	74	0.534
ARB, %	32	37	25	0.014
DIU, %	55	100	0	
BB, %	19	17	21	0.282
ACEI, %	7	4	11	0.018
AB, %	3	4	2	0.415
ARB+ACEI, %	38	40	35	0.409
No. of drugs used	1.9±1.0	2.33±0.9	1.3±0.7	<0.001
Potassium, mEq/L	3.9±0.4	3.8±0.5	4.0±0.4	0.017
K-supple, %	21	29	9	<0.001
Cre, mg/dL	0.77±0.3	0.80±0.3	0.74±0.18	0.152
T-cho, mg/dL	207±31	207±31	207±31	0.914
HDL, mg/dL	58±15	59±15	57±14	0.259
TG, mg/dL	145±11	144±113	147±100	0.744

DM, diabetes mellitus; DIU, diuretics; HL, hyperlipidemia; NDM, new-onset DM; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; CCB, calcium channel blockers; ARB, angiotensin receptor blockers; BB, β-blockers; ACEI, angiotensin converting enzyme inhibitors; AB, α-blockers; K-supple, needs of potassium supplementations; Cre, serum creatinine level; T-cho, serum total cholesterol level; HDL, serum high-density lipoprotein level; TG, serum triglyceride level.

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