



Physician perceptions of blood pressure control in patients with chronic kidney disease and target blood pressure achievement rate

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Background: Blood pressure (BP) control is the most-established method for the prevention of chronic kidney disease (CKD) progression. However, the ideal BP target for CKD patients is still under debate.

Methods: We performed a survey of regular registered members of the Korean Society of Nephrology to determine physician perceptions of BP control in patients with CKD. In addition, we evaluated the target BP achievement rate using data from the AProDiTe-2 study.

Results: Two-thirds of physicians considered the target BP for CKD to be < 130/85 mmHg. The systolic BP (SBP) thresholds for diabetic CKD, proteinuria ≥ 300 mg/day, $30 \leq$ glomerular filtration rate (GFR) < 60 mL/min/1.73 m², age < 60 years, and the presence of atherosclerotic (ASO) complications were significantly lower than the SBP thresholds of the opposite parameters. The three major hurdles to controlling BP were non-compliance with life-style modification and medications, and self-report of well-controlled home BP. Most physicians prescribed home and ambulatory BP monitoring to less than 50% of their patients. The target BP achievement rates using the SBP thresholds in this survey were as follows: non-diabetic (69.3%); diabetic (29.5%); proteinuria < 300 mg/day (72.3%); proteinuria > 300 mg/day (33.7%); GFR ≥ 60 (76.4%); GFR < 30 (47.8%); no evidence of ASO (67.8%); and the presence of ASO (42.9%).

Conclusion: The target BP was lower in patients with higher cerebro-cardiovascular risks. These patient groups also showed lower target BP achievement rates. We also found a relatively lower application and clinical reflection rate of home or ambulatory BP monitoring.

Keywords: Chronic kidney disease, Survey, Target blood pressure

Introduction

Chronic kidney disease (CKD) is becoming an increasingly prevalent and important public health problem in an aging society. Hypertension is a main cause of CKD, and CKD itself can cause blood pressure (BP) to increase. Hypertension accelerates the age-related decline of renal function if BP is not adequately controlled [1]. Moreover, CKD substantially increased the risk of hypertension-related cardiovascular events [2–5].

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The Kidney Disease Improving Global Outcomes (KDIGO) recommended a target BP of $\leq 130/80$ mmHg for CKD patients with proteinuria (≥ 30 mg/g creatinine [Cr]) and $\leq 140/90$ mmHg for CKD patients without proteinuria (< 30 mg/g Cr) [6]. The Eighth Joint National Committee (JNC 8) recommended broader and higher BP targets based on age [7]. In addition, low-quality evidence suggests a target of $< 130/90$ mmHg in patients with proteinuria at > 300 mg/g Cr [8]. However, a recent meta-analysis showed that systolic BP (SBP) reduction decreased major cardiovascular disease events, coronary heart disease, heart failure, and all-cause mortality with similar proportional reductions, irrespective of starting BP, even in patients with SBP of < 130 mmHg; however, it failed to show the overall benefit of BP reduction for renal failure events [9]. The report also suggested that risk-based target BP may be better than arbitrary and rigid BP targets. The target BP, especially in CKD patients, remains a matter of debate.

In contrast, real-world BP control has been reported to be poor [10]. Our team also reported that a majority of Korean CKD patients had uncontrolled BP and abnormal nocturnal dipping patterns based on findings from the Association between Blood Pressure and Target Organ Damage in Patients with Chronic Kidney Disease and Hypertension (APrODiTe) and APrODiTe-2 studies [11,12]. Poor control of BP was associated with lower renal function and higher urinary protein excretion; better BP control and dipping status changes were associated with better renal function and proteinuria, as well as decreased cardio-cerebrovascular damage [11,12].

In this study, we aimed to evaluate physician perceptions of BP control in patients with CKD, including the matter of target BP, and we analyzed the target BP achievement rates based on the APrODiTe-2 study.

Methods

Study design

We performed a survey of regular registered members of the Korean Society of Nephrology (KSN) to determine physician perceptions of BP control in patients with CKD from May 30, 2016 to June 30, 2016. We sent and received surface and e-mail communications to regular members of the KSN. The questionnaire asked the following: 1)

demographics, including age, sex, and medical school graduation year; 2) affiliated hospitals and specialties; 3) general target BP (choice of 1 out of 4: $< 120/80$, $< 130/85$, $< 140/90$, and $< 150/100$ mmHg) and purpose of BP control in CKD patients; 4) BP targets (subjective answers) according to the presence of diabetes, proteinuria, glomerular filtration rate (GFR), age, and the presence of atherosclerotic (ASO) complications; and 5) hurdles to controlling BP in CKD patients (multiple choice format [choices of 3 out of 7], including renal function decrease due to medication, intolerance to medications, high BP targets from international guidelines, patient non-compliance to medication, patient non-compliance to lifestyle modification, self-report of well-controlled home BP, and co-prescription from other specialties).

In addition, we evaluated the target BP achievement rates based on the findings of the APrODiTe-2 study. The APrODiTe-2 study was a longitudinal study that aimed to identify the distribution changes in BP control categories and to evaluate target organ damage according to BP patterns, as well as the associations between BP pattern changes and target organ damage [12]. APrODiTe-2 recruited a total of 378 patients; 273 of these patients repeated the tests 1 year later. All clinic BP measurements were acquired by trained staff using an oscillometric OMRON MX-3 automatic BP device (IntelliSense™, Omron Corporation, Kyoto, Japan). Three consecutive seated BP readings were recorded at intervals of 1 to 2 minutes, and the clinic BP reading was taken as the mean of the last 2 readings. Twenty-four-hour ambulatory blood pressure monitoring were collected with an oscillometric TM-2430 monitor (A&D Co. Ltd., Seoul, Korea). The monitor was programmed to record BP every 30 minutes.

This study has got a waiver from the institutional review board because this study covered only non-vulnerable subjects and their opinions in addition to using already reported APrODiTe-2 data.

Statistical analysis

Baseline characteristics of participants, the comparison of target BPs, and achievement rates were analyzed using chi-square tests, Student's *t* tests, and ANOVA/Kruskal-Wallis tests, as appropriate. We considered the standard deviation of SBP and diastolic BP (DBP) in the 24-hour BP data of the APrODiTe-2 study as the coefficient of

variation (CoV) of BP. Continuous variables are expressed as mean ± standard deviation, and categorical variables are expressed as number (%). P values were 2-tailed and were considered significant at P < 0.05.

Results

We sent surface and e-mail communications to a total of 779 regular registered members of the KSN and failed to contact 31 members. Among 748 members, we received answers from 232 (31.0%) members (whole response 171 [22.9%], minimal omission 50 [6.7%], and partial response 11 [1.5%]).

The mean (median) age of the participants was 44 (43) years, and 76 (32.8%) of the participants were men. Most of the participants were affiliated with referral hospitals (university-associated hospital [59.5%], secondary hospital [26.3%], and tertiary hospital [5.2%]). Of the participants, 84.5% were nephrologists. Baseline characteristics of the participants are summarized in Table 1.

General BP target of CKD patients

Two-thirds of the physicians considered the target BP of CKD to be < 130/85 mmHg (< 120/80 mmHg [8.3%] and < 130/85 mmHg [59.0%]). More participants who graduated earlier (before 1999, 11.7%) and older participants

Table 1. Baseline characteristics of survey participants

Variable	Data (n=232)
Sex, male	76 (32.8)
Age (yr)*	44 ± 9
< 45	122 (52.6)
45–54	66 (28.4)
≥ 55	39 (16.8)
Hospital	
Primary	8 (3.4)
Secondary	61 (26.3)
Tertiary	17 (7.3)
University-associated	138 (59.5)
Specialty (nephrology)	196 (84.5)
Graduation year†	
Before 1989	47 (20.3)
1990–1999	74 (31.9)
After 2000	103 (44.4)

Values are presented as number (%) or mean ± standard deviation. *Median, 43 years; range, 29–73 years; †range of period, 1967–2009.

Table 2. Target blood pressure in various chronic kidney disease conditions

Condition	SBP (mmHg)	P value	DBP (mmHg)	P value
Non-diabetic	136 ± 5.4	< 0.001	87 ± 4.4	< 0.001
Diabetic	131 ± 6.2		84 ± 4.9	
Proteinuria (mg/day)				
< 300	135 ± 6.0	< 0.001	86 ± 4.8	< 0.001
≥ 300	128 ± 5.0		81 ± 4.2	
GFR (mL/min/1.73 m ²)				
≥ 60	135 ± 7.1	< 0.001*	86 ± 5.0	< 0.001*
30–60	132 ± 6.4	< 0.001†	84 ± 4.7	< 0.001†
< 30	134 ± 6.7	0.08‡	85 ± 5.0	0.02‡
Age (yr)				
< 60	133 ± 6.5	< 0.001§	85 ± 4.8	< 0.001§
60–80	139 ± 6.2	< 0.001	88 ± 3.9	0.2
≥ 80	144 ± 6.6	< 0.001¶	87 ± 15.7	0.2¶
ASO				
Negative	136 ± 6.0	< 0.001	87 ± 14.3	< 0.001
Positive	134 ± 6.5		85 ± 4.7	

Values are presented as mean ± standard deviation. ASO, atherosclerosis; DBP, diastolic blood pressure; GFR, glomerular filtration rate; SBP, systolic blood pressure. *GFR ≥ 60 vs. 30 ≤ GFR < 60; †30 ≤ GFR < 60 vs. GFR < 30; ‡GFR < 30 vs. GFR ≥ 60; §age < 60 vs. 60 ≤ age < 80; || 60 ≤ age < 80 vs. age ≥ 80; ¶age ≥ 80 vs. age < 60 years.

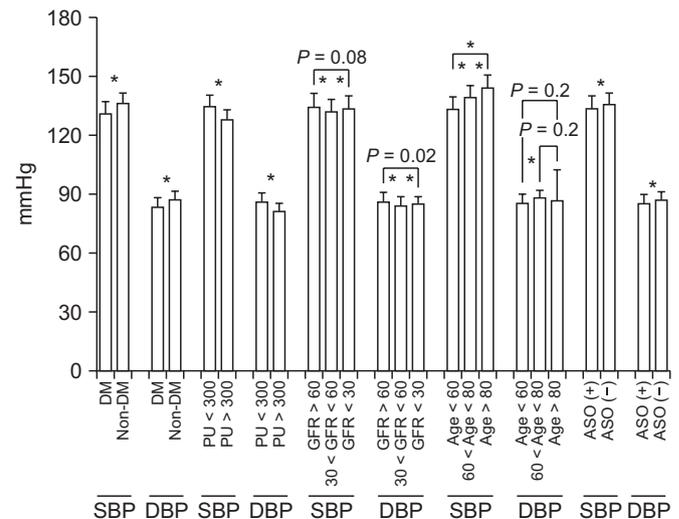


Figure 1. Target blood pressure in various chronic kidney disease conditions. Bars and lines represent mean and standard deviation, respectively; *P < 0.001.

ASO, atherosclerosis; DBP, diastolic blood pressure; DM, diabetes mellitus; GFR, glomerular filtration rate; PU, proteinuria (mg/g creatinine); SBP, systolic blood pressure.

(≥ 45 years old, 13.5%) answered < 120/80 mmHg in comparison with participants who graduated later (after 2000, 3.9%) and younger participants (< 45 years old, 4.1%). In addition, almost all physicians indicated that renal function preservation (66.3%) and the prevention of cerebrocardiovascular events (33.3%) were the primary goals of controlling BP in CKD patients.

Target BP in various CKD conditions

Target SBP and DBP in various CKD conditions are summarized in Table 2 and Fig. 1. For example, SBP thresholds for non-diabetic and diabetic CKD were 136 ± 5.4

and 131 ± 6.2 mmHg, respectively (*P* < 0.001). The SBP and DBP thresholds for proteinuria ≥ 300 mg/day, 30 ≤ GFR < 60 mL/min/1.73 m², age < 60 years, and the presence of ASO complications were significantly lower than the SBP and DBP thresholds of the opposite parameters. Further analysis according to responder's age and graduation year is presented in Table 3.

Hurdles to controlling BP in CKD patients

We provided 7 choices regarding the hurdles to controlling BP in CKD patients, from which participants could select 3. The four major hurdles to controlling BP in CKD

Table 3. Target blood pressure according to responder age and graduation year

Condition	SBP (mmHg)						DBP (mmHg)					
	Responder age (yr)			Graduation year			Responder age (yr)			Graduation year		
	< 45	≥ 45	<i>P</i> value	Before 1999	After 2000	<i>P</i> value	< 45	≥ 45	<i>P</i> value	Before 1999	After 2000	<i>P</i> value
Non-diabetic	137 ± 4.6	136 ± 6.2	< 0.001	136 ± 6.0	138 ± 4.3	< 0.001	88 ± 4.3	87 ± 4.5	0.25	87 ± 4.5	88 ± 4.1	0.01
Diabetic	132 ± 6.4	130 ± 5.9	0.001	130 ± 5.7	133 ± 6.6	< 0.001	84 ± 5.2	83 ± 4.4	0.03	83 ± 4.4	85 ± 5.2	0.04
Proteinuria (mg/day)												
< 300	136 ± 5.3	134 ± 6.5	0.01	134 ± 6.2	136 ± 5.3	0.03	87 ± 4.5	85 ± 5.1	0.10	85 ± 5.0	87 ± 4.5	0.18
≥ 300	129 ± 5.1	127 ± 4.8	0.05	127 ± 4.8	129 ± 5.2	0.09	82 ± 4.5	80 ± 3.5	< 0.001	80 ± 3.5	82 ± 4.6	< 0.001
GFR (mL/min/1.73 m ²)												
≥ 60	135 ± 6.3	134 ± 6.5	0.60	134 ± 6.4	136 ± 6.3	0.53	86 ± 4.8	86 ± 5.2	0.51	85 ± 5.2	87 ± 4.6	0.14
30–60	134 ± 5.8	131 ± 6.0	0.006	131 ± 5.8	134 ± 6.0	< 0.001	85 ± 4.7	83 ± 4.5	0.25	83 ± 4.3	86 ± 4.8	0.03
< 30	135 ± 5.9	132 ± 7.2	0.56	133 ± 7.1	135 ± 6.0	0.52	86 ± 4.8	84 ± 5.0	0.93	84 ± 5.0	86 ± 4.7	0.75
Age (yr)												
< 60	134 ± 6.6	133 ± 6.4	0.46	133 ± 6.2	134 ± 6.8	0.09	86 ± 4.6	85 ± 5.1	0.36	85 ± 4.9	86 ± 4.5	0.56
60–80	139 ± 6.1	140 ± 6.4	0.59	139 ± 6.3	139 ± 6.2	0.66	89 ± 3.7	88 ± 4.0	0.22	88 ± 4.1	89 ± 3.6	0.04
≥ 80	144 ± 6.7	144 ± 6.7	0.88	144 ± 6.7	145 ± 6.7	0.86	87 ± 15.2	87 ± 13.8	0.75	86 ± 15.6	88 ± 13.5	0.33
ASO												
Negative	136 ± 5.8	135 ± 6.1	0.15	135 ± 6.1	137 ± 5.7	0.02	88 ± 4.0	87 ± 4.7	0.03	87 ± 4.6	88 ± 3.9	0.005
Positive	134 ± 6.6	133 ± 6.5	0.58	134 ± 6.3	134 ± 6.8	0.16	85 ± 4.8	85 ± 4.6	0.22	85 ± 4.6	86 ± 4.8	0.14

ASO, atherosclerosis; DBP, diastolic blood pressure; GFR, glomerular filtration rate; SBP, systolic blood pressure.

Table 4 . Hurdles to controlling blood pressure (BP) in chronic kidney disease patients

Variable	Age (yr)			Graduation year		
	< 45	≥ 45	<i>P</i> value	Before 1999	After 2000	<i>P</i> value
Renal function decrease due to medication	27	29	0.261	32	23	0.575
Intolerance to medications	47	31	0.466	34	39	0.172
High BP targets from international guidelines	41	15	0.007	23	36	0.014
Patient non-compliance to medication	41	54	0.007	74	35	0.002
Patient non-compliance to life-style modification	68	68	0.139	87	58	0.131
Self-report of well-controlled home BP	76	47	0.158	57	65	0.07
Co-prescription from other specialties	58	40	0.508	51	46	0.741

patients were: non-compliance to life-style modification (21.9%), self-report of well-controlled home BP (18.5%), non-compliance with medications (16.4%), and co-prescription from other specialties (14.6%), which were followed by intolerance to medications (11.1%), high BP targets from international guidelines (9.0%), and renal function decrease due to medication (8.4%).

When we divided the participants according to graduation year (before 1999 and after 2000) and age (< 45, 45–54, and ≥ 55 years), participants who graduated earlier (before 1999) and older participants (≥ 45 years) more frequently indicated that non-compliance with medications was a hurdle to controlling BP ($P = 0.002$ and 0.007 , respectively). Participants who graduated later (after 2000) and younger participants (< 45 years) more frequently indicated that high BP targets from international guidelines were a hurdle to controlling BP ($P = 0.014$ and 0.007 , respectively; Table 4).

Significance of home or ambulatory BP monitoring

Application rates of home and ambulatory BP monitoring, as well as their impact on clinical practice, are summarized in Table 5. A majority of participants prescribed home and ambulatory BP monitoring to less than 50% of their patients. Even the clinical reflection rate was far lower than our expectations. Approximately half of the participants considered home or ambulatory BP results

Table 5. The prescription and clinical reflection rate of home or ambulatory blood pressure (BP) monitoring

Variable	Data (n=232)
Home BP check (%)	
< 25	72 (31.0)
25–50	100 (43.1)
50–75	42 (18.1)
> 75	6 (2.6)
Ambulatory BP check (%)	
< 25	198 (85.3)
25–50	20 (8.6)
50–75	6 (2.6)
> 75	0 (0)
Clinical reflection (%)	
< 30	111 (47.8)
30–70	91 (39.2)
> 90	23 (9.9)

Values are presented as number (%).

less than 30% prior to prescribing BP medications.

Target BP achievement rates using APrODiTe-2 data based on survey target BPs

We calculated the target SBP and DBP achievement rates using clinic and 24-hour mean BP data from the APrODiTe-2 study based on the survey target BPs. The results are summarized in Table 6. Generally, the target DBP achievement rate was higher than the target SBP achievement rate. The target clinic SBP achievement rates using the SBP thresholds in this survey were as follows: non-diabetic (69.3%); diabetic (29.5%); proteinuria < 300 mg/day (72.3%); proteinuria > 300 mg/day (33.7%); GFR ≥ 60 (76.4%); 30 ≤ GFR < 60 (54.4%); GFR < 30 (47.8%); age < 60 years (63.5%); 60 years ≤ age < 80 years (64.0%); no evidence of ASO (67.8%); and the presence of ASO (42.9%). In addition, the target clinic BP achievement rates using the DBP thresholds were as follows: non-diabetic (74.3%); diabetic (73.1%); proteinuria < 300 mg/day (75.9%); proteinuria > 300 mg/day (52.4%); GFR ≥ 60 (75.5%); 30 ≤ GFR < 60 (62.2%); GFR < 30 (72.8%); age < 60 years (61.3%); 60 years ≤ age < 80 years (83.8%); no evi-

Table 6. Target blood pressure (BP) achievement rates in various chronic kidney disease conditions based on survey target BPs

Condition	SBP		DBP	
	Clinic	24 hr mean	Clinic	24 hr mean
Non-diabetic	69.3	70.7	74.3	79.0
Diabetic	29.5	32.1	73.1	64.1
Proteinuria (mg/day)				
< 300	72.3	75.4	75.9	84.3
≥ 300	33.7	44.4	52.4	54.0
GFR (mL/min/1.73 m ²)				
≥ 60	76.4	80.2	75.5	85.8
30–60	54.4	65.6	62.2	73.3
< 30	42.8	45.7	72.8	69.6
Age (yr)				
< 60	63.5	66.9	61.3	73.5
60–80	64.0	61.4	83.8	77.7
ASO				
Negative	67.8	65.6	74.9	78.5
Positive	42.9	57.1	66.7	69.8

Values are presented as percent only.

ASO, atherosclerosis; DBP, diastolic blood pressure; GFR, glomerular filtration rate; SBP, systolic blood pressure.

dence of ASO (74.9%); and the presence of ASO (66.7%). Patients with higher cerebro-cardiovascular risks, including diabetic CKD, lower GFR, higher proteinuria, and the presence of ASO, showed lower target BP achievement rates. In addition, these patient groups showed higher achievement rate differences between SBP and DBP.

Discussion

In this study, we found that Korean physicians, mainly nephrologists, set lower target BP thresholds for CKD patients than those recommended by the 2012 KDIGO or JNC 8. The target BP was lower in patients with higher cerebro-cardiovascular risks, including diabetic CKD, lower GFR, higher proteinuria, and the presence of ASO. These patient groups also showed lower target BP achievement rates based on the APrODiTe-2 study data. Generally, target BP achievement rates were higher for DBP than for SBP. Physicians considered patient compliance to medication or life-style modification, self-report of home BP, and medication intolerance when they prescribed medications. Co-prescription from other specialties was also a major hurdle to controlling BP in CKD patients. Older physicians more frequently reported non-compliance to medications as a hurdle to controlling BP, while more of the younger physicians reported high BP targets from international guidelines as a hurdle. In addition, we revealed a relatively lower application and clinical reflection rate of home or ambulatory BP monitoring than what was expected.

Furthermore, we found a greater target SBP and DBP achievement difference in patients with diabetic CKD, lower GFR, higher proteinuria, and ASO. This may be related to higher pulse pressure, and this phenomenon may be one of the practical hurdles to controlling BP, as medication intolerance may occur due to lower DBP.

We also observed higher target SBP achievement rates in the abovementioned patients when using 24-hour mean BP data compared to using only clinic BP data. In the APrODiTe-2 study, we reported a high proportion of sustained uncontrolled- or masked hypertension and non- or reverse-dippers in these patient groups based on the criteria of daytime BP < 135/85 mmHg and nighttime BP < 120/70 mmHg [12]. These two findings appeared to be contradictory, and we postulated two causes, higher BP variability in those patient groups and the effect of

different BP control criteria between the two studies. We further analyzed the CoV in SBP using APrODiTe-2 data and found that there was no difference in CoV-SBP between patients with and without cerebro-cardiovascular complications. The different BP criteria between this survey and the APrODiTe-2 study could provide a rational explanation.

As we mentioned above, recent guidelines from the 2012 KDIGO and JNC 8 recommended broader and higher BP targets [6,7]. In addition, SBP < 120 mmHg did not significantly reduce the incidence of cardiovascular events compared with SBP > 130 mmHg in the ACCORD trial [13]. The ACCORD study suggested that aggressive BP reduction strategies would not be necessary for diabetic patients and it also showed that intensive treatment was associated with serious side effects that occurred almost 3 times as frequently relative to conventional treatment. The HOPE-3 study focused on intermediate-risk patients without cardiovascular disease and found that the reduction of BP with angiotensin receptor blockers and thiazide diuretics was not associated with a lower rate of major cardiovascular events [14].

However, in the SPRINT trial that studied non-diabetic patients with increased cardiovascular risks, intensive treatment (SBP target of 120 mmHg) showed a lower occurrence of primary outcomes, including composite of myocardial infarction, other acute coronary syndromes, stroke, heart failure, or death from cardiovascular cause [15]. In terms of renal outcomes, there was no evidence of substantial permanent kidney injury associated with lower SBP goals, although renal outcomes occurred more frequently in the intensive treatment group of patients without CKD at baseline. In addition, a meta-analysis study of 123 hypertension trials found that the reduction of BP significantly reduced the risk of major cardiovascular disease events, coronary heart disease, stroke, heart failure, and all-cause mortality, with similar proportional reductions across various population subgroups irrespective of starting BP [9]; however, there was a lack of overall benefit for renal failure events from BP reduction. In addition, proportional risk reductions were smaller in patients with CKD than in patients without CKD. Very recent reports suggested different effects of intensive BP control according to different organs, including kidney, heart, and brain, and on underlying cardiovascular risks, as well as possible reverse causality, in CKD patients [16–

19].

As a result, the optimal BP in CKD patients is still under debate. We found that Korean physicians adopted BP targets for CKD patients lower than the recent recommendations, and we assumed that Korean physicians recognized the value of CKD as a major cerebro-cardiovascular risk.

What should be considered in determining target BP?

In a recent meta-analysis, the proportional reduction in major cardiovascular disease events from BP reduction did not differ with the presence or absence of previous cardiovascular disease events, coronary heart disease, or cerebrovascular disease [9]. We can expect that the absolute benefits of BP reduction would be greatest among patients at the highest absolute risk of cerebro-cardiovascular events and that CKD could be a disease that would benefit from BP reduction. In addition, this approach of individualized risk scoring could be more reasonable in determining target BP than an arbitrary threshold for a single risk factor, such as diabetes or CKD. Physicians in this study thought that target BP should be lower in patients with higher cerebro-cardiovascular risks, including diabetic CKD, lower GFR, higher proteinuria, and the presence of ASO.

In addition, we should consider the autoregulation properties of vital organs. The lower SBP group in the ACCORD trial showed a significant reduction in the risk of stroke, but not myocardial infarction [13]. Furthermore, the incidence of hemorrhagic and ischemic stroke was lowered by achieving SBP \leq 120 mmHg in the PROGRESS, INVEST, and ONTARGET studies [20]. The optimal SBP may be different for different vital organs; for example, the brain and the kidney have excellent blood flow autoregulation properties, and this property could preserve the perfusion of these organs at low BP values [20].

In terms of target BP achievement, it is difficult to follow BP guidelines for CKD patients because of several factors, including extracellular fluid (ECF) volume expansion, the activation of the RAAS, and increased sympathetic nervous system activity [21–26]. In addition, these factors interact with each other. The loss of dipping and the subsequent high BP burden, which enhances cardiovascular risk, are caused by ECF volume expansion and subsequent oxidative stress and sympathetic nervous system activation [22–26]. Moreover, CKD patients are getting older in conjunction with an aging society, and are more

susceptible to adverse events related to medications. The KDIGO guidelines for elderly patients with CKD suggest that age, comorbidities, and other therapies should be considered when determining BP treatment regimens. In addition, we should gradually escalate treatment and attend to adverse events, such as electrolyte disorders, acute deteriorations in renal function, and orthostatic hypotension [6]. These CKD-related factors and patient demographics, which are associated with adverse events, can make it difficult for physicians to adequately control BP.

Using this survey, we found that a majority of participants prescribed home and ambulatory BP monitoring to less than 50% of their patients. In addition, approximately half of the participants revealed that their reflection rate of home or ambulatory BP results in the prescription of BP medications was less than 30%. We already know that the clinic BP provides an incomplete and misleading assessment of BP status, and ambulatory BP monitoring is the recognized gold standard for the assessment of hypertension [27]. In addition, home BP is also superior to clinic BP in terms of reducing the misclassification of hypertension caused by white-coat and masked hypertension [28], as well as predicting CKD-associated complications [29]. If we cannot prescribe ambulatory BP monitoring as frequently, because of the difficulty of the procedure, we should at least pay greater attention to home BP monitoring. This method is simpler and easier for patients to adopt. Furthermore, Ryu et al [30] reported the time points at which representative 24-hour BP measurements were obtained for CKD patients, and they were 7:00 am and 9:30 pm.

In conclusion, target BP was lower in patients with higher cerebro-cardiovascular risks, such as diabetic CKD, lower GFR, higher proteinuria, and the presence of ASO. These patient groups also exhibited lower target BP achievement rates. In determining individualized target BP, we should attempt to acquire more data regarding patients' BP values through frequent home BP or ambulatory BP monitoring, as well as frequent assessment of adverse events related to BP control. In addition, it is necessary to design studies more carefully regarding target BP in CKD patients, considering individualized risk scoring of cerebro-cardiovascular events and medication-associated adverse events.

Conflicts of interest

All authors have no conflicts of interest to declare.

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