Editorial

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Blood pressure measurement in patients with chronic kidney disease: from clinical trial to clinical practice

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Hypertension is currently the leading cause of global disease burden, and it is a major modifiable risk factor for heart disease, stroke, and chronic kidney disease (CKD). Hypertension and CKD are closely associated, with an intermingled cause and effect relationship. Blood pressure (BP) typically rises in patients with CKD, and hypertension promotes progression of CKD [1]. The interaction between hypertension and CKD is complex and increases the risk of adverse cardiovascular event [2]. Thus, accurate measurement of BP is essential in the diagnosis and management of hypertension in CKD patients.

BP can be measured using one of the following three acceptable strategies: ambulatory blood pressure monitoring (ABPM), home BP monitoring (HBPM), and office-based BP measurements (automated or manual). In the out-of-office setting, ABPM is the reference standard for diagnosis of hypertension, and it is a better predictor for hypertension-related target organ damage and clinical cardiovascular outcomes compared with office-based BP measurements [3,4]. Although the hypertension guidelines recommend ABPM to both confirm the diagnosis of hypertension and titrate the dosage of antihypertensive medications, its use has remained low because of availability and inconvenience, and most of the guidelines in recent years are associated with office-based BP measurement [3,4]. The superiority of ABPM over the other methods results from its ability to identify BP patterns (i.e., sustained, white-coat, masked, and nocturnal hypertension) that cannot be detected with office BP alone [3].

HBPM is another modality for assessing out-of-office BP. Although ABPM is preferred, HBPM with an appropriate protocol is an acceptable method for confirmation of hypertension diagnosis if ABPM is not available or not tolerated [3,4]. In contrast to ABPM, HBPM is better tolerated, more widely available, and associated with lower cost. HBPM is more strongly associated with target organ damage compared with routine office BP measurements [4]. HBPM reduces misclassification of hypertension due to the white coat and masked effects, which are seen with office-based BP measurement. HBPM is also useful in management of patients with an established diagnosis of hypertension. Self-monitoring enhances patient involvement, and it could improve compliance and BP control [4]. However, concerns have been raised about reporting bias and patient familiarity with the technology. The potential problems with HBPM can be minimized by providing adequate training and by having patients bring their devices to clinic visits for accuracy assessment. In addition, HBPM devices with built-in memory that automatically store readings or home BP telemonitoring with automated teletransmission of BP data to the treating

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physician may overcome reporting bias [4].

In the office setting, the manual office BP (MOBP) has been the traditional approach for measuring BP. However, actions, such as talking with patients, not allowing for a period of rest before the reading, and rapid deflation of the cuff, have resulted in readings that are both inaccurate and inappropriately high [3,5]. Because of the problems associated with MOBP, it is being replaced by oscillometric devices in both clinical and research settings [3]. Due to availability of fully automated oscillometric sphygmomanometers capable of taking multiple readings with a single activation, automated office BP (AOBP) measurement is possible. AOBP devices perform multiple consecutive BP readings in the office while patients sit and rest, preferably without attended staff (unattended) [3].

Compared with conventional MOBP, unattended AOBP decreases the white coat response, avoids talking during the rest and measurement periods, and avoids observer error and bias [3–5]. In the CAMBO trial (Conventional Versus Automated Measurement of Blood Pressure in the Office) [6], AOBP was compared with MOBP for hypertension management in routine, community-based clinical practices. In CAMBO, 88 primary care physicians in 67 practices in five cities in eastern Canada were randomized to either use of AOBP or continued use of MOBP. The primary outcome, difference between mean awake systolic BP on ABPM and systolic BP at the first return visit, was significantly smaller in the AOBP group (2.3 mmHg) compared with the control MOBP group (6.5 mmHg). Moreover, the correlation between AOBP and awake ABPM was significantly stronger compared with the correlation between MOBP and awake ABPM. AOBP has also demonstrated a stronger association with target organ damage, including intima-media thickness of the carotid artery and left ventricular mass index, compared with MOBP [7,8].

In this issue of the journal, consistent with the previous studies that reported the superiority of AOBP over MOBP [6–8], Ezzatzadegan Jahromi et al [9] demonstrated that AOBP methods produce results more similar to BP by ABPM than do MOBP methods in patients with CKD. This study was performed in 64 patients with CKD (stage 3–4) to compare AOBP and MOBP measurements with ABPM. The mean ± standard deviation (SD) awake systolic BP obtained by ABPM was 140.2 ± 19.0 mmHg, which was lower than those the MOBP and AOBP methods (156.6 ± 17.8 and 148.8 ± 18.6 mmHg, respectively; $P < 0.001$). The mean ± SD awake diastolic BP was 78.6 ± 13.2 mmHg by ABPM, which was lower than those of the MOBP and AOBP methods (88.9 ± 13.2 and 84.1 ± 14.0 mmHg, respectively; $P < 0.001$). Using Bland–Altman graphs, MOBP systolic BP readings showed a bias of 16.4 mmHg (2SD −13.7, 46.6), while AOBP measurements indicated a bias of 8.6 mmHg (2SD −25.4, 42.6) compared with ABPM. In this study, the higher mean BPs recorded by the MOBP and AOBP methods compared to ABPM in CKD patients support the use of ABPM, at least for primary diagnosis of hypertension and monitoring antihypertensive therapy. However, because ABPM is not practical for routine use, they suggest that AOBP might be more acceptable than MOBP in CKD patients. Although this study has a limitation of small sample size, it has clinical implication in that it was performed in CKD patients to compare the MOBP/AOBP methods with ABPM.

Current hypertension treatment guidelines are based on clinical trials that used various methods of BP measurement. However, clinicians must pay attention to how BP was measured in interpreting the results of hypertension clinical trials. The recent Systolic BP Intervention Trial (SPRINT) [10] revealed that, among hypertensive patients with and without CKD, the hazard ratio for cardiovascular morbidity and mortality was reduced by 25% when BP was targeted to < 120 mmHg compared with a higher target of 140 mmHg. Results were similar in those with and without CKD. These trials used a specific rigorous method of BP measurement (patient alone in the room, enforced period of rest, and average of multiple readings) that is currently not the standard of practice in most clinics. Accordingly, it remains unclear whether the BP targets utilized in SPRINT can be implemented in the general population. Using routine methods of BP measurement while targeting BPs derived from SPRINT may result in overtreatment of hypertensive patients, exposing them to risk of unnecessary adverse events. Thus, when the results of randomized clinical trials are applied in a real clinical setting, it would be most acceptable to measure BP in the way measured in clinical trials, although doing so is not an easy task.

We frequently encounter patients with resistant hypertension and hypertensive emergency. As hypertension specialists, we should constantly try to optimize BP

measurement and not forget to properly and individually evaluate the results. It is imperative that proper BP measurement procedures be followed, including the use of validated BP devices, proper patient positioning, a quiet rest period, and measurement of 2–3 BPs. Finally, taking into account the lack of uniform methodologies among the various clinical trials, individualized care plans would be important to improve the prognosis of hypertensive CKD patients.

Conflicts of interest

The authors have no conflicts of interest to declare.

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