Which blood pressure metrics should be used in patients on dialysis?

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Remarkable progress has recently been achieved in blood pressure (BP) control based on key research findings in the general population. It has been observed that maintaining BP slightly lower than previously recommended goals leads to better clinical outcomes, provided that patients can tolerate it. Previously, BP control targets for dialysis patients were extrapolated from studies conducted on the general population. However, dialysis patients are considered a distinct group with unique characteristics, which makes defining appropriate BP targets a matter of debate. Several observational studies measuring BP in hemodialysis (HD) patients within dialysis units have shown that lower peridialysis BP (pre-, post-, and interdialytic BP) is associated with worse clinical outcomes. However, this association is likely confounded by factors specific to dialysis patients. The relationship between BP and mortality appears to be more linear in patients with fewer underlying cardiovascular diseases and longer survival. Recent studies have indicated that BP measurements taken outside of dialysis sessions, such as standardized BP on nondialysis days, home BP, and ambulatory BP monitoring between HD sessions, are more predictive of clinical outcomes. Due to the varied effects of dialysis-related treatment practices on BP, there is a lack of data from large-scale clinical trials. As a result, it is challenging to provide strong recommendations for BP targets directly applicable to dialysis patients. This review addresses various factors influencing BP in dialysis patients, including the establishment of individualized target BP levels and discussions on maintenance strategies, while incorporating a recent literature review.

Keywords: Blood pressure determination, Dialysis, Risk assessment

Introduction

Hypertension is a very common clinical condition among chronically ill patients and is one of the important factors in end-stage kidney disease (ESKD) [1-4]. In addition, blood pressure (BP) status long-term hemodialysis (HD) is often not properly diagnosed and is poorly controlled [5-7]. Moreover, the recent coronavirus disease 2019 pandemic has served as an opportunity to confirm once again how difficult it is to maintain public health while consuming many social resources [8-10].

Unlike the linear relationship between BP and mortality in the general population [11,12], the inverse or U-shaped association between pre- and postdialysis BP and mortality in HD patients is important for controlling hypertension and setting target BP in HD patients [13,14]. In contrast, there are consistent reports that elevated BP, as assessed by home BP recording or ambulatory BP (ABP) monitoring...
between dialysis sessions, provides direct and unequivocal signs of death [15,16]. These results suggest that the patient’s underlying disease and comorbidities affect dialysis-related BP fluctuations and consequently affect clinical outcomes. As in the general population, further research is needed on whether maintaining tolerably low BP in dialysis patients is associated with positive clinical outcomes.

Although it is difficult to determine the exact level of BP to target in HD patients, a meta-analysis of randomized trials reports that lowering BP using antihypertensive therapy improves clinical outcomes, particularly in hypertensive patients [17]. In addition, in the case of HD patients, it is possible to administer antihypertensive drugs together with nonpharmacological strategies such as sodium and body fluid control in order to stably maintain HD [18–22]. Through this strategic therapeutic combination, an appropriate BP for each individual patient should be targeted and maintained.

In this review, the author has considered multiple factors affecting BP in HD patients, establishing individualized target BP levels and discussing strategies for maintenance, accompanied by a recent literature review.

Blood pressure targets in the general population and chronic kidney disease

The SPRINT (Systolic Blood Pressure Intervention Trial) is considered to be one of the studies that have the greatest impact on target BP change in the recent clinical practice guidelines for BP control. A total of 9,631 nondiabetic patients at relatively high risk of cardiovascular (CV) event were enrolled, and their effects on CV, renal, and mortality outcomes were investigated in a control group with a target systolic BP (SBP) of <140 mmHg and an intensive group with a target SBP of <120 mmHg [23]. They reported a 25% reduction in the primary composite outcome of CV mortality and morbidity in those randomized to the intensive group (hazard ratio [HR], 0.75; 95% confidence interval [CI], 0.64–0.89) [23]. In addition, the result of subgroup analysis targeting only chronic kidney disease (CKD) patients showed a similar all-cause mortality reduction effect (HR, 0.72; 95% CI, 0.53–0.99) [24].

In contrast, in the ACCORD-BP (Action to Control Cardiovascular Risk in Diabetes-BP) trial, the target SBP of <120 mmHg group was compared with the target SBP of <140 mmHg in 4,733 diabetic patients with serum creatinine concentration of ≤1.5 mg/dL, but there was no reduction effect in the primary CV composite outcome (HR, 0.88; 95% CI, 0.73–1.06) [25]. However, among the prespecified secondary outcomes, a reduction in stroke incidence was reported (HR, 0.59; 95% CI, 0.39–0.89) [25].

As a result of the AASK (African American Study of Kidney Disease and Hypertension) trial in 1,094 nondiabetic hypertensive African Americans, among patients with a protein-to-creatinine ratio of 0.22 g/g or higher, patients in the intensive group (target mean BP, 92 mmHg), compared to the control group (target mean BP, 102–107 mmHg), showed a reduction in the incidence of ESKD or death (HR, 0.67; 95% CI, 0.52–0.87) [26].

In the STEP (Strategy of BP Intervention in the Elderly Hypertensive Patients) trial with 8,511 relatively elderly (60 to 80 years of age) Chinese patients, the intensive treatment group (target SBP, 110–130 mmHg), compared with the control group (target SBP, 130–150 mmHg), showed a reduction effect on primary CV (HR, 0.74; 95% CI, 0.60–0.92), but the renal outcome as a secondary outcome (>50% reduction of estimated glomerular filtration rate in CKD patients at baseline) showed no reduction effect (HR, 1.01; 95% CI, 0.06–16.09). In addition, the risk of developing hypertension according to the BP-lowering effect of the intensive treatment group was also reported to be high (HR, 1.31; 95% CI, 1.02–1.68) [27].

Recently, different organization guidelines [28–30] have set the target BP somewhat lower. However, since this target BP is a value measured by standardized BP equipment, it tends to be difficult to apply in the outpatient clinic environment in Korea. Therefore, the Korean Society of Hypertension sets the target value somewhat higher in consideration of conventional BP measurement variations [31,32].

Blood pressure and outcomes in dialysis patients

The 2005 National Kidney Foundation Kidney Disease Outcomes Quality Initiative (KDOQI) clinical practice guidelines recommend pre- and postdialysis BP goals of 140/90 and 130/80 mmHg, based in part on data in the nondialysis population [33]. However, most previous studies have shown a J- or U-shaped association, which appears to increase mortality when SBP is low [13,14].
Study), which enrolled 25,907 HD patients in 922 facilities, predialysis SBP and diastolic BP (DBP) were set and analyzed with 130 to 139 mmHg and 80 to 89 mmHg, respectively, as reference groups, and it was found that HR increased in the BP reduction group [13].

In a study that analyzed all-cause mortality over 548 days in a prospective study of 9,333 HD patients in France, the association between predialysis SBP and DBP and all-cause mortality showed also a U-shaped association that the lowest risk in that study was observed at around 165 mmHg [14].

As a result of a domestic study that analyzed 2,299 patients receiving dialysis (both HD and peritoneal dialysis [PD]) from the CRC-ESRD (Clinical Research Center for End-Stage Renal Disease) data, a U-shaped relationship was reported between SBP and mortality during the median follow-up period of 4.5 years [34]. The lowest risk was shown in the groups with 130 to 150 mmHg of SBP. When the continuous BP was categorized, the group with SBP under 110 mmHg and the group with SBP higher than 170 mmHg showed an increased HR for mortality during follow-up [34]. The lowest SBP was the only risk factor for death in the elderly and those with diabetes or coronary artery disease, whereas the highest SBP was the only risk factor in younger people [34]. A U-shaped association was seen in patients undergoing HD (this association was not seen in PD patients), and among HD patients, a U-shaped association was more pronounced when the dialysis period was short and the weight gain during dialysis was small [34].

As for the reasons why the relationship between BP and mortality was different in the dialysis group compared to nondialysis patients, serious coexisting conditions in HD patients and confounding due to poor health status were suggested [13,18–21,35,36].

The relationship between blood pressure and mortality in hemodialysis patients varies depending on the timing of observation or the presence of comorbidity

A study of a cohort of HD patients (n = 16,959) in the United States between January 1, 1993, and December 31, 2003, showed that low SBP of <120 mmHg during the first 2 years of follow-up was associated with an increased mortality rate, and only patients who survived more than 3 years were analyzed, and a SBP of ≥150 mmHg was associated with increased mortality [37]. These data suggest the possibility that high mortality in the low BP group may be confounding due to underlying disease and not a causal risk factor for adverse outcomes.

As a result of analyzing 6,585 prevalent HD patients randomly selected from the United States Renal Data System data, the low BP group showed a higher mortality rate only in the comorbidity group such as congestive heart failure or coronary artery disease [38]. However, the increase in mortality in the hypotension group was not significant in the group without comorbidities [38].

In a study in which 344 HD patients (105 with atrial fibrillation, heart failure, or both) were analyzed by measuring 24-hour ABP starting before the dialysis session [39]. In a linear subgroup analysis, SBP and pulse pressure were independent predictors of risk and showed a significant inverse association with all-cause and CV death in patients with atrial fibrillation or heart failure [39]. However, in patients without these comorbidities, these associations were in the opposite direction [39]. Furthermore, it suggests that the associations can be explained by underlying cardiac disease. These findings support the importance of considering the comorbidity of cardiac disease when treating hypertension in HD patients. The authors claim that this opposite linear association can be explained by the presence or absence of underlying heart disease, further supporting the importance of considering the comorbidity of heart disease when treating hypertension in HD patients [39].

Our society is rapidly transitioning from an “aged society” to a “super-aged society,” highlighting the significance of maintaining CV health as part of our efforts to safeguard the well-being of the growing elderly population [40]. This issue is of great importance not only for dialysis patients but also for the general elderly population. For frail individuals, including those with severe comorbidities or advanced age, providing immediate and intensive medical support, such as determining the optimal timing to initiate dialysis and target BP, can significantly reduce premature mortality [41]. Therefore, it is crucial to consider the prudent utilization of our societal resources in addressing this matter collectively.
**Time points of blood pressure measurement on the outcomes in hemodialysis patients**

**Dialysis-unit blood pressure measurement**

The BP behaviors of HD patients presented a unique pattern much different from those of the general population. This pattern is composed of chronic BP burden over interdialytic period and acute BP fluctuation during HD sessions. Peri-, inter-, and intradialysis are three routinely used time points to capture this complex BP behavior [42]. However, BP at each time point was measured in various forms and conveyed different prognostic information [42]. There has been debate as to which BP metrics should be used, both in studies and in clinical practice (Fig. 1).

SBP decreased by an average of 8 to 10 mmHg after HD, showing great differences among patients and individuals [42]. As a result of a meta-analysis comparing ABP and pre- and postdialysis BP in patients who performed HD three times a week, predialysis BP tended to be higher than ABP, while postdialysis BP tended to be low [43].

Single-point measurement of BP is insufficient to evaluate prognosis in HD patients. As a result of 35 months of follow-up by measuring average weekly BP and pulse pressure, it has been reported that mean BP can be a better prognostic indicator than single-point BP measurement for the incidence of CV events and all-cause mortality in HD patients [44].

Some researchers suggest that the ultimate BP target for all HD patients should include targets for peridialytic, interdialytic, and intradialytic BP, not a single target [42].

**Out-of-dialysis blood pressure measurement**

Home blood pressure (HBP) monitoring is widely applied and strongly recommended for the diagnosis and management of hypertension in the general population in current international and domestic clinical practice guidelines [28,29,32]. These HBP monitoring may be particularly useful in HD patients than in any other patient population. While the agreement between peridialytic BP and interdialytic ABP was poor, average self-measured systolic HBP was useful for detecting hypertension between dialysis using 44-hour ABP monitoring as a reference [45]. While short-term variability in BP records before and after HD is high [46], HBP is highly reproducible as a result of weekly measurement [47]. HBP is also superior to dialysis-unit-BP in predicting future risk of CV and mortality [16,48].

To date, interdialytic ABP monitoring is considered as the gold standard for BP measurement among HD patients [48,49]. ABP levels between dialysis are highly reproducible [33], correlate with left ventricular hypertrophy [50], and show a direct correlation with mortality [16,48]. The advantage of this method is not only that the number of ABP measurements is performed more frequently but also that it can reflect a wider range of situations and activities in

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**Figure 1. Time point of BP measurement in HD patients.**

ABP, ambulatory BP; BP, blood pressure; HD, hemodialysis.

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the patient’s living environment related to dialysis so that the patient’s general BP burden can be more accurately reflected [16,18,20,22,48]. In addition, while dialysis-unit BP measurement cannot avoid the white coat effect, in which BP is high only on dialysis and normal BP outside of HD, this effect can be easily confirmed by self-measured HBP or ABP measurement [16,48,49].

ABP monitoring between dialysis provides very powerful prognostic information, but it is impractical to continuously use this measurement method for hypertension management in HD patients. This has been a practical reason for a long time in the past that BP goal setting and overall management of hypertension were based on relatively easily available pre- and postdialysis BP records. Therefore, as a result of a recent study, it is considered realistic to use dialysis-unit BP as an auxiliary measure for the maintenance of dialysis and to use HBP monitoring as a main tool for managing hypertension in the long term. In some cases, physicians may consider using ABP monitoring individually for a specific purpose on a patient (Fig. 1).

Although it is a reality that research results for presenting target BP in HD patients are lacking, lowering interdialytic BP could be clinically beneficial, and for this purpose, proposed BP target in the study by Alborzi et al. [16] might be referred to as a target (ABP monitoring, 115–125 mmHg; HBP monitoring, 125–145 mmHg) for HD patients in clinical practice.

Pertinent information from the analysis of systematic review and meta-analysis data

There have been clinical trials on the usefulness of various antihypertensive agents in HD patients. As a result of a meta-analysis of eight studies [17], it was reported that the treatment group showed an effective BP-lowering effect compared to the control group, and showed an effect of reducing CV (HR, 0.71; 95% CI, 0.50–0.99) and all-cause (HR, 0.80; 95% CI, 0.66–0.96) mortality. In another meta-analysis of 1,202 patients from five studies [51], compared with control or placebo groups, the overall benefit of antihypertensive therapy showed the effect of reducing CV events in a fixed-effects models (HR, 0.69; 95% CI, 0.56–0.84) and random-effects models (HR, 0.62; 95% CI, 0.45–0.86). In particular, in their sensitivity analysis, the CV protective effect shown in the result of analyzing only the hypertensive group (HR, 0.49; 95% CI, 0.35–0.67) was not seen as that of the normal BP group (HR, 0.86; 95% CI, 0.67–1.12).

Some traits necessitate a careful interpretation of the study results for lowering BP in HD patients because the BP reduction achieved by patients varied widely among the trials, and the baseline BP level was heterogeneous in each study. Moreover, most randomized clinical trials were based on a specific drug, not a target BP. This made it difficult to pool BP targets when the Korean Society of Nephrology (KSN) Clinical Practice Guideline Work Group systemically reviewed the literature on BP targets of HD patients for guideline development [52,53]. Therefore, the evidence is insufficient to determine whether the effect of antihypertensive medication is a drug-specific effect or a result of reducing the BP below a certain threshold.

Noteworthy insights from the clinical trial data

A study that randomly assigns HD patients to different BP targets has not yet been conducted, and BID (Blood Pressure in Dialysis) trial is the only recent pilot study that has evaluated the possibility of a full-scale study [54]. A total of 126 patients who had been on HD for more than 3 months and had a 2-week average predialysis SBP higher than 155 mmHg were evaluated for intensive arm (110–140 mmHg, n = 62) or standard arm (155–165 mmHg, n = 64). They were randomly assigned to the predialysis SBP targets and observed for 1 year. The primary outcomes of the study were to assess the feasibility and safety of treating hypertensive patients receiving HD and to inform the design of a full-scale study and assessing changes in left ventricular mass was a secondary outcome. During months 4 to 12 the average difference in SBP across arms was 12.9 mmHg. There was no significant difference number of follow-up loss between the two groups during observation, ultimately 51 patients in the intensive group and 50 patients in the standard group were followed up. There was an increase in hospitalizations and vascular access thromboses in the intensive arm, but given the small size and relatively short follow-up time, these were not statistically significant. The incidence rate ratios for the intensive compared with the standard arm (95% CI) were 1.18 (0.40–3.33), 1.61 (0.87–2.97), and 3.09 (0.96–8.78) for major adverse CV events, hospitalizations, and vascular access thrombosis, respectively. The intensive and standard arms had similar.

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median changes (95% CI) in left ventricular mass of 20.84 g (217.1–10.0 g) and 1.4 g (211.6–10.4 g), respectively. The authors noted that, although it was not statistically significant, there was a tendency to decrease left ventricular mass [54]. Due to the small number of enrolled population and the possibility of being associated with a short observation period, they could not come to a conclusion whether the active control of predialysis BP had a long-term effect on left ventricular mass and ultimately led to an improvement in mortality [18,21,54]. Therefore, the authors suggested the need for a full-scale study to determine definitely the effects of intensive BP control on clinical outcomes in HD patients.

**Potential harms of blood pressure reduction in hemodialysis patients**

To examine the relationship between the achieving target BP (predialysis BP of 140/90 mmHg and postdialysis BP of 130/80 mmHg) recommended by the United Kingdom Renal Association and CV risk, 7,890 HD sessions for 1 week were analyzed in 2,630 patients [55]. As a result, the achieving rate of the target pre- and postdialysis BP were 36% and 42%, respectively, with large differences between centers. About 15% of patients showed symptomatic hypotension requiring fluid resuscitation, and it was reported that the higher achievement rate of the target postdialysis BP, the higher the incidence of hypotension during HD [55].

As a result of a Japanese study that analyzed risk factors for intradialytic hypotension in 111 HD patients, diabetes mellitus, excessive interdialytic weight gain, low ejection fraction, and low left ventricular volume were analyzed as independent risk factors for hypotension during HD [56]. However, no correlation was found between predialysis SBP values or the addition of antihypertensive medications and the incidence of intradialytic hypotension [56].

In clinical practice, there are HD patients who need to technically decide when or whether to continue taking or temporarily holding BP medications to maintain HD. There is a study that can serve as a reference for this regard (TAKE-HOLD trial). Compared to the holding group on the day of dialysis (HOLD), the group taking antihypertensive drugs daily (TAKE) did not show an inferior outcome in intradialytic hypotension and reduced the incidence of uncontrolled hypertension [57]. The authors concluded that the question remains as to whether the reduction in the incidence of intradialytic hypotension with the strategy of holding BP medication is an offset effect due to elevated predialysis BP [57]. The TAKE-HOLD strategies could be applied to patients with intradialytic hypotension. Therefore, if additional studies on those patients were conducted in the future, the effect of holding BP medication before dialysis would provide more useful information to clinicians who are struggling between maintaining stable HD and controlling interdialytic BP.

Generally, it is highly likely to cause intradialytic hypotension in frail patients, such as those with underlying comorbidities and/or accompanying sarcopenia [58]. In this case, the patient’s exercise power can help lower BP and improve quality of life [59].

**The current guidelines regarding blood pressure measurement and targets in hemodialysis patients**

Most of the recommendations regarding target BP for dialysis patients in the various guidelines are based on expert opinion, as existing observational and clinical studies are notably lacking. The 2005 KDOQI guidelines recommended predialysis BP targets of <140/90 mmHg and postdialysis BP of <130/80 mmHg (Table 1) [33]. However, these recommendations were given a “C” rating for their strength, as they were extracted from studies in the general population and there was no clinical trial-level evidence [33]. Additionally, the 2015 update of the guideline stated that there was insufficient evidence to support a specific BP target and did not suggest a target BP [60].

In the Canadian Society of Nephrology in 2006 [61] and Japan Society for Dialysis Therapy in 2012 [62], predialysis BP of 140/90 mmHg or higher was suggested as hypertension (Table 1). In the relatively recent European Renal Association-European Dialysis and Transplant Association (ERA-EDTA)/European Society of Hypertension (ESH) guidelines [63], peridialysis BP measurement is not recommended, and the definition of hypertension was suggested that a case where the average value of home BP measured over 6 days on nondialysis days was ≥135/85 mmHg or the average value of ABP measured for 44 hours on a weekday was ≥130/80 mmHg. In addition, when neither HBP nor ABP monitor-
Table 1. Definition of hypertension in patients on dialysis according to clinical practice guidelines

<table>
<thead>
<tr>
<th>Guidelines</th>
<th>Year</th>
<th>Definition</th>
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<tbody>
<tr>
<td>KDOQI 2005</td>
<td>2005</td>
<td>• Predialysis BP of &gt;140/90 mmHg</td>
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<td></td>
<td></td>
<td>• Postdialysis BP of &gt;130/80 mmHg</td>
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<tr>
<td>KDOQI 2015 update</td>
<td>2015</td>
<td>• No target defined, citing paucity of clinical trial data</td>
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<tr>
<td>CSN 2006</td>
<td>2006</td>
<td>• Predialysis BP of &gt;140/90 mmHg</td>
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<tr>
<td>JSST 2012</td>
<td>2012</td>
<td>• Predialysis BP of &gt;140/90 mmHg at the beginning of the week (without cardiac dysfunction)</td>
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<tr>
<td>ERA-EDTA/ESH 2017</td>
<td>2017</td>
<td>• No recommendation can be made on the basis of peridialytic BP</td>
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<tr>
<td></td>
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<td>• Home BP: an average BP of ≥135/85 mmHg for measurements collected in the morning and in the evening over 6 nondialysis days (covering a period of 2 weeks)</td>
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<td></td>
<td></td>
<td>• ABP: an average BP of ≥130/80 mmHg over 24-hr monitoring during a mid-week day free of HD. Whenever feasible, ABP monitoring should be extended to 44 hours, that is, covering a whole mid-week dialysis interval</td>
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<tr>
<td></td>
<td></td>
<td>• Office BP of ≥140/90 mmHg taken in a mid-week day free of HD (when neither ABP nor home BP measurements are available)</td>
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<tr>
<td>KSN 2021</td>
<td>2021</td>
<td>• Inconclusive, insufficient evidence to assign optimal BP target for HD patients.</td>
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</tbody>
</table>

ABP, ambulatory blood pressure; BP, blood pressure; CSN, Canadian Society of Nephrology; ERA-EDTA, European Renal Association-European Dialysis and Transplantation Association; ESH, European Society of Hypertension; HD, hemodialysis; JSST, Japan Society for Dialysis Therapy; KDOQI, Kidney Disease Outcomes Quality Initiative; KSN, Korean Society of Nephrology.

Table 2. Proposed approaches for BP management in HD patients

<table>
<thead>
<tr>
<th>Methods</th>
<th>Opinions</th>
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<tbody>
<tr>
<td>Home blood pressure</td>
<td>• All patients</td>
</tr>
<tr>
<td></td>
<td>• BP measurement twice daily for 7 days</td>
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<tr>
<td></td>
<td>• Systolic BP, 120–135 mmHg</td>
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<tr>
<td></td>
<td>• Diastolic BP, 60–80 mmHg</td>
</tr>
<tr>
<td>Office BP on a nondialysis day</td>
<td>• Alternative (when HBP is not available)</td>
</tr>
<tr>
<td></td>
<td>• Systolic BP, 140 mmHg</td>
</tr>
<tr>
<td></td>
<td>• Diastolic BP, 60–80 mmHg</td>
</tr>
<tr>
<td>Dialysis-unit BP</td>
<td>• Predialysis systolic BP, 130–159 mmHg</td>
</tr>
<tr>
<td></td>
<td>• Predialysis diastolic BP, 60–99 mmHg</td>
</tr>
<tr>
<td>44-hr Ambulatory BP</td>
<td>• Postdialysis systolic BP, 120–139 mmHg</td>
</tr>
<tr>
<td></td>
<td>• Postdialysis diastolic BP, 70–89 mmHg</td>
</tr>
<tr>
<td></td>
<td>• BP is not at the target</td>
</tr>
<tr>
<td></td>
<td>• When the patients have intradialytic hypotension or hypertension</td>
</tr>
</tbody>
</table>

BP targets in HD patients are uncertain due to the lack of clinical trial data for guidance and uncertainties in observational data. Recognizing the increasing association of out-of-dialysis BP (HBP and ABP) with clinical outcomes in patients with ESKD, we also need to acknowledge the cumbersomeness and limitations of those measures. One
approach to integrating HBP into the management of hypertension in HD patients has the potential to improve BP control, involve patients in treatment planning, and better predict hypertension outcomes. Until clinical trials that present clear clinical evidence are provided in the future, it is thought that it is best to facilitate patient BP control using all available means such as HBP and ABP rather than using only BP at the HD clinic to manage hypertension. As one of these efforts, it is possible to check the BP measurement and target BP of HD patients suggested as the experts’ opinions and to use it as a reference during clinical treatment (Table 2) [20].

Opinions regarding blood pressure measurement and targets in peritoneal dialysis patients

Compared to HD patients, there are few clinical studies that show clear evidence worldwide, but since the dialysis-related BP fluctuation is small, it can be controlled with the same management strategies as nondialysis patients. As in the case of HD, there are no guidelines for target BP for PD patients. However, the joint working group ERA-EDTA and the ESH suggested the diagnosis of hypertension in PD patients was an average value of home BP for 7 days higher than 135/85 mmHg and a 24-hour average value of ABP monitoring higher than 130/80 mmHg [63].

Conclusions

In the case of HD patients, mortality due to CV complications is high, and BP control is important as one of the efforts to prevent it. Clinical guidelines for BP treatment for the general population are continuously evolving, but in the case of dialysis patients (both HD and PD), due to the absence of clinical trials, guidelines for dialysis patients are extrapolated and applied from research results and practice guidelines for the general population. Therefore, strong recommendations for BP targets for dialysis are difficult to apply directly to patients.

A low correlation between dialysis-unit BP measurement and clinical outcomes has been reported in the HD population, and the studies reporting the importance of HBP and ABP measurement are increasing. Therefore, from a practical point of view, BP control can be attempted using dialysis-unit BP and HBP until future evidence studies are conducted and practical information is provided. As a strategic approach to control, it is necessary to set an appropriate target BP for individual patients and establish a strategy to maintain it.

Conflicts of interest

The author has no conflicts of interest to declare.

Data sharing statement

The data presented in this study are available on request from the corresponding author.

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