

## Original Article

## Home blood pressure monitoring in blood pressure control among haemodialysis patients: an open randomized clinical trial

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### Abstract

**Background.** It is not known if the adjustment of antihypertensive therapy based on home blood pressure monitoring (HBPM) can improve blood pressure (BP) control among haemodialysis patients.

**Methods.** This is an open randomized clinical trial. Hypertensive patients on haemodialysis were randomized to have the antihypertensive therapy adjusted based on predialysis BP measurements or HBPM. Before and after 6 months of follow-up, patients were submitted to ambulatory blood pressure monitoring (ABPM) for 24 h, HBPM during 1 week and echocardiogram.

**Results.** A total of 34 and 31 patients completed the study in the HBPM and predialysis BP groups, respectively. At the end of study, the systolic (SBP) and diastolic (DBP) blood pressure during the interdialytic period measured by ABPM were significantly lower in the HBPM group in relation to the predialysis BP group (mean 24-h BP:  $135 \pm 12$  mmHg/ $76 \pm 7$  mmHg versus  $147 \pm 15$  mmHg/ $79 \pm 8$  mmHg;  $P < 0.05$ ). In the HBPM analysis, the HBPM group showed a significant reduction only in SBP compared to the predialysis BP group (weekly mean:  $144 \pm 21$  mmHg versus  $154 \pm 22$  mmHg;  $P < 0.05$ ). There were no differences between the HBPM and predialysis BP groups in relation to the left ventricular mass index at the end of the study ( $108 \pm 35$  g/m<sup>2</sup> versus  $110 \pm 33$  g/m<sup>2</sup>;  $P > 0.05$ ).

**Conclusions.** Decision making based on HBPM among haemodialysis patients has led to a better BP control during the interdialytic period in comparison with predialysis BP measurements. HBPM may be a useful adjuvant instrument for blood pressure control among haemodialysis patients.

**Keywords:** ambulatory blood pressure monitoring; haemodialysis; home blood pressure monitoring; hypertension

### Introduction

The mortality rate for haemodialysis patients is 20% during the first year of treatment and 70% after 5 years [1]. Among

causes of death, cardiovascular diseases are responsible for >50% of the deaths [1,2]. The high prevalence of traditional risk factors for cardiovascular disease (hypertension, diabetes, dyslipidaemia) along with the presence of risk factors considered non-traditional (uraemia, chronic inflammatory status, oxidative stress) peculiar to this population is certainly associated with the origin of the problem [3].

Although the relative importance of each one of these factors is not yet fully known among haemodialysis patients, one of the variables that contributes significantly to this scenario is the hypertension, since only 20% of the haemodialysis patients are normotensive without antihypertensive medication, and among those who are hypertensive, only 30% are controlled [4].

A unique challenge that exists among haemodialysis patients is how and when the blood pressure (BP) should be measured. Traditionally, and mostly for practical reasons, BP measured before the dialysis session (predialysis BP) has been used for the diagnosis of hypertension and the prescription of antihypertensive therapy [5]. Nevertheless, the known variability of blood pressure during the interdialytic period has raised questions about the clinical usefulness of this type of measurement [6].

Several studies have shown that predialysis BP overestimates systolic (SBP) and diastolic (DBP) blood pressures during the interdialytic period when compared to the ambulatory blood pressure monitoring (ABPM) [7,8]. Additionally, ABPM also presents a better correlation with the left ventricular mass index (LVMI) [9] and has shown a better association with significant cardiovascular outcomes than predialysis BP [10–12].

Within this context, home blood pressure monitoring (HBPM) is an interesting option to blood pressure measurement among haemodialysis patients since it shares the same advantages of the ABPM [13–15], besides showing good acceptability by patients when the procedure needs to be repeated [16].

Nevertheless, it is not known if the adjustment of antihypertensive therapy based on BP values of the interdialytic period evaluated by HBPM can improve the blood pressure control among haemodialysis patients in relation to

predialysis BP measurements. The answer to this question is the main objective of this study.

## Subjects and methods

### Study subjects

Patients were selected from one single dialysis unit located in São Paulo, Brazil. Inclusion criteria were men or women aged  $\geq 18$  years presenting chronic renal disease of any aetiology on haemodialysis three times a week for at least 3 months; hypertension, defined as a mean of the predialysis BP from nine consecutive sessions  $\geq 140$  mmHg for SBP and/or  $\geq 90$  mmHg for DBP and/or use of antihypertensive medication; haemoglobin  $\geq 11$  g/dl and  $\leq 14$  g/dl; single-pool Kt/V  $\geq 1.2$  and serum albumin  $\geq 3.5$  g/dl. The patients with visual or cognitive insufficiency, cardiac arrhythmias, severe heart or liver failure and pregnant women were excluded. Patient inclusion began in August 2006, and the study was completed in November 2007.

All patients agreed to participate in the study and signed informed consent forms. The present study was approved by the Ethics Committee of the University of São Paulo General Hospital.

### Study protocol

This is an open randomized clinical trial. The patients were randomized into two groups, control and intervention, with a table of random numbers. The patients from the control group had modifications of their antihypertensive therapy based on predialysis BP measurements during monthly clinical visits by nephrologists from the dialysis unit, for 6 months, with target predialysis BP  $< 140/90$  mmHg. On the other hand, for the intervention group, decisions on antihypertensive therapy were based on HBPM measurements made once a month, during 7 days and also for 6 months. Modifications in the antihypertensive therapy were under the responsibility of one single nephrologist, with a mean weekly therapeutic goal  $\leq 135/85$  mmHg.

In order to reach the therapeutic goals, the treatment strategies available were the adjustment of the dry weight and modifications of the antihypertensive medications. Dry weight was defined clinically [17]. When the adjustment of the dry weight was not sufficient to reach the therapeutic goals, antihypertensive medications were modified. The introduction sequence and minimal and maximal doses of the medications followed this order:

- Stage 1: angiotensin-converting enzyme inhibitors: captopril-50 to 150 mg.
- Stage 2: dihydropyridine-type calcium channel blocker: nifedipine – 40 to 60 mg.
- Stage 3: beta-blocker: propranolol, 80–240 mg.
- Stage 4: central adrenergic inhibitors: alpha-methyldopa, 500–1500 mg
- Stage 5: direct vasodilators: minoxidil, 5–10 mg.

Before and after the 6 months of randomization, the patients of the control and intervention groups performed ABPM, HBPM and echocardiogram.

### Blood pressure at the dialysis unit

Blood pressure measurements before each dialysis session (predialysis BP) were made by the routine procedure of the dialysis unit by the nursing staff—auscultatory method with an aneroid device (Welch Allyn Tyco, Model TR 1, New York, USA). Although the nursing staff were trained according to international guidelines [18] for proper blood pressure measurement, no specific protocol was defined to measure BP in this study. For analysis, the arithmetic means of SBP and DBP from nine consecutive haemodialysis sessions during the randomization month and 6 months later were considered.

### ABPM

ABPM was performed by the Spacelabs 90207 device (SpaceLabs Medical, Washington, USA) [19]. An appropriately sized cuff for the arm circumference was installed on the arm with no vascular access for haemodialysis. ABPM was installed at the end of the second haemodialysis session of the week and was removed 24 h later. Blood pressure was measured every 20 min and awake (daytime) and sleep (nighttime) periods were determined according to information provided by the patients. ABPM

was accepted if it had a minimum of 16 awake and 8 sleep measurements [20]. The variables analysed were the SBP and DBP means during 24 h, awake and sleep periods. In relation to day–night BP variation, only the percentage variation of the SBP and DBP means between the periods of awake and sleep were considered, calculated according to the following formula: mean awake BP – mean sleep BP/mean awake BP  $\times 100$ . The sleep BP fall was classified as follows: (i) ‘dippers’—whenever the differences between daytime and night time SBP and DBP were  $\geq 10\%$  and (ii) ‘non-dippers’—whenever the differences between daytime and night time SBP and DBP were  $< 10\%$  [21].

### HBPM

HBPM was performed by the Omron HEM 705-CP model automatic oscillometric device (Omron Healthcare, Kyoto, Japan) [22]. The patients were trained on how to use the device and instructed to measure their own BP twice a day, before breakfast and dinner, three consecutive times on each occasion, for 7 days. The cuff used for the measurement was appropriate for the circumference of the arm. The arithmetic mean of all the measurements made represented the weekly patient’s BP mean. The recordings were accepted for interpretation if they had at least 12 BP measurements during the week [20].

All patients included in the study underwent HBPM at the time of inclusion and at the end of the study. During the 6 months of follow-up, the HBPM was performed monthly only by patients from the intervention group.

### Echocardiogram

All measurements of echocardiographic parameters were standardized according the Brazilian Society of Cardiology [23]. The M mode transthoracic echocardiogram was performed by a single observer (HA) with the Hewlett-Packard Sonos 1000 device (Hewlett-Packard, California, USA) after the patient had already undergone at least two haemodialysis sessions in the week. LVMI was calculated according to the formula previously validated by Devereux *et al.* [24] and corrected by the body surface (Du Bois Formula) [25]:

- Left ventricular mass (grams) =  $0.832 [(IVSTd + LVIDd + PWTd)^3 - (LVIDd)^3] + 0.60$ , in which IVSTd = thickness of the interventricular septum; LVIDd = left ventricular diastolic diameter; PWTd = posterior wall thickness of the left ventricle.
- Body surface area ( $m^2$ ) =  $0.007184 \times \text{height } 0.725 \times \text{weight } 0.425$ , with height in centimetres and weight in kilograms.
- Left ventricular mass index ( $g/m^2$ ): left ventricular mass (grams)/body surface area ( $m^2$ ).

The patients were classified as having left ventricular hypertrophy (LVH) when the LVMI was  $\geq 96$   $g/m^2$  for women or  $116$   $g/m^2$  for men [26].

### Study outcomes

Primary outcomes were changes in SBP and DBP during the interdialytic period analysed by ABPM and HBPM 6 months after randomization. Secondary outcomes were changes in predialysis SBP and DBP and in the LVMI.

Adverse effects of antihypertensive drugs were considered only when they motivated discontinuation of the medication. Adverse effects related to haemodialysis were collected monthly: number of episodes of symptomatic intradialytic hypotension (drop of at least 20 mmHg in systolic blood pressure associated with clinical symptoms and the need for volemic expansion) [27], number of episodes of muscular cramps needing intervention (volemic expansion and/or use of hypertonic solutions) or loss of the vascular access due to thrombosis.

The compliance with the prescribed drug therapy was assessed monthly by the percentage of tablets ingested according to those prescribed by counting the number of tablets.

### Statistical analysis

Sample size was calculated considering a 5% significance level, 80% test power, 15 mmHg as the standard deviation of the blood pressure and expecting that the difference between the groups in mean 24-h SBP to

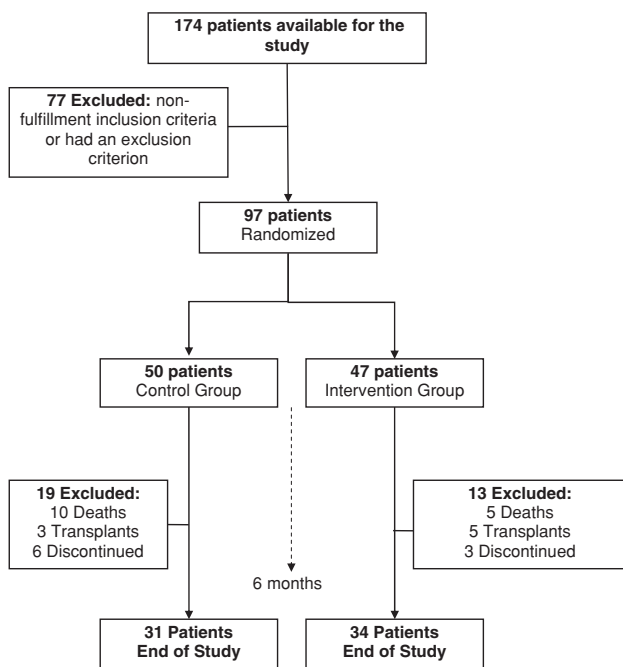


Fig. 1. Flowchart of entry and discontinuation of subjects during the study.

reach 10 mmHg at the end of the study. Respecting these premises, a sample size of 35 patients was determined for each group.

Only data from the patients who effectively completed the entire protocol were analysed (per-protocol analysis) [28]. The continuous variables will be displayed descriptively as means and standard deviation, and the categorical variables as absolute numbers and/or relative frequencies. A comparison of the continuous variables with normal distribution was made using Student's *t*-test. Continuous variables that did not show a normal distribution were analysed with the Wilcoxon points test for paired variables and the Mann–Whitney test for non-paired variables. To compare categorical variables, the chi-squared test was used. *P*-values < 0.05 were considered significant.

## Results

### Sample characteristics

After selection, 97 patients were randomized: 50 patients into the control group and 47 patients into the intervention group (Figure 1). The percentage of patients who did not complete the protocol after randomization between the control and intervention groups (38% versus 27.6%), as well as the total mortality rate (20% versus 10.6%) and the cardiovascular mortality rate (10% versus 6.3%), was not different ( $P > 0.05$  for all comparisons).

Demographic and clinical characteristics of the groups in the baseline period were similar (Table 1).

### Outcomes: blood pressure and left ventricular mass index

In the analysis of ABPM data (Table 2), there was a significant reduction in SBP in 24 h, awake and sleep periods between the beginning and the end of the study in the intervention group. Additionally, a significant number of patients also developed a dipping BP pattern during sleep after 6 months (11.7% versus 38.2%,  $P < 0.05$ ).

For HBPM (Table 3), a similar situation was observed: whereas the control group maintained unchanged SBP and DBP weekly means between the beginning and the end of the study, the intervention group displayed a significant reduction in the weekly SBP, although the same reduction was not noted for the weekly DBP.

The intervention group also showed a reduction in predialysis SBP between the beginning and end of the study ( $157 \pm 25$  mmHg versus  $147 \pm 18$  mmHg;  $P < 0.05$ ), something not seen in the predialysis DBP ( $89 \pm 18$  mmHg versus  $86 \pm 11$  mmHg;  $P < 0.05$ ). The control group has neither shown significant differences between the beginning and end of the study in terms of predialysis SBP ( $159 \pm 21$  mmHg versus  $154 \pm 22$  mmHg;  $P > 0.05$ ) nor predialysis DBP ( $87 \pm 16$  mmHg versus  $89 \pm 14$  mmHg;  $P > 0.05$ ).

None of the echocardiographic parameters were significantly changed at the end of the study according to the baseline values, whether in the control or intervention group. There were no differences between the intervention and control groups accordingly to the LVMI at the end of the study ( $108 \pm 35$  g/m<sup>2</sup> versus  $110 \pm 33$  g/m<sup>2</sup>,  $P > 0.05$ ).

### Antihypertensive drugs, compliance and adverse effects

As shown in Table 4, at the end of the study, the patients of the intervention group had a greater number of prescribed antihypertensive class medications, as well as a larger number of tablets per day. Compliance with the antihypertensive drug therapy prescribed was also significantly greater in the intervention group in relation to the control group at the end of the study, at least regarding the analysis made within the percentage of tablets consumed.

The adverse effects verified in the control and intervention groups are shown in Table 5. The numbers of adverse effects observed in both groups were similar, except for the greater number of intradialytic cramps in the intervention group.

## Discussion

As far as we know, after reviewing the *PubMed*, this is the first study that evaluated HBPM as an adjustment instrument of antihypertensive therapy among haemodialysis patients. The results showed that decision making based on HBPM was efficient in BP control among haemodialysis patients, since there was a significant BP reduction, especially SBP, during the interdialytic period in the group of patients randomized to HBPM.

Although promising, the use of HBPM to guide antihypertensive therapy is controversial. Two studies carried out among hypertensive individuals of the general population comparing decision making based on the BP measured in the physician's office and by HBPM questioned the use of HBPM in prescribing antihypertensive therapy. At the end of both studies, the patients randomized to HBPM, although having used less number of antihypertensive agents, showed a smaller BP reduction, even though this was not reflected in a poorer protection for target organs [29,30].

**Table 1.** Baseline demographic and clinical characteristics of patients in the control (predialysis BP) and the intervention (HBPM) groups

Demographic and clinical characteristics	Control group <i>n</i> = 31 (%)	Intervention group <i>n</i> = 34 (%)
Age (years)	51.9 ± 13.7	51.3 ± 11.6
Gender (male/female)	21 (67.7)/10 (32.3)	22 (64.7)/12 (35.3)
Body mass index (kg/m <sup>2</sup> )	24.33 ± 05.5	24.60 ± 05.1
Skin colour		
White	18 (58.0)	19 (55.8)
Non-white	13 (42.0)	15 (44.2)
Predialysis blood pressure		
Systolic (mmHg)	159 ± 21	157 ± 25
Diastolic (mmHg)	87 ± 16	89 ± 18
Interdialytic weight gain (kg)	2.83 ± 0.84	2.95 ± 0.81
Time on dialysis (months)	55.06 ± 40.49	60.55 ± 39.92
Haemoglobin (g/dl)	11.5 ± 0.6	11.8 ± 0.7
Albumin (g/dl)	3.8 ± 0.4	4.0 ± 0.5
Kt/V	1.36 ± 0.16	1.33 ± 0.12
Erythropoietin dose (IU/week)	6345 ± 1205	6528 ± 1413
Duration of dialysis (hours)	3.60 ± 0.19	3.62 ± 0.20
Residual diuresis		
< 200 ml/day	28 (90.3)	29 (85.3)
≥ 200 ml/day	03 (9.7)	05 (14.7)
Vascular access		
Arteriovenous fistula	28 (90.3)	29 (85.3)
Vascular graft	01 (03.2)	03 (08.8)
Vascular catheter	02 (06.5)	02 (05.9)
Aetiology of the renal disease		
Hypertensive nephrosclerosis	11 (35.5)	15 (44.1)
Glomerulonephritis	07 (22.5)	06 (17.6)
Diabetic nephropathy	07 (22.5)	08 (23.5)
Polycystic renal disease	02 (06.5)	01 (03.0)
Urologic	02 (06.5)	01 (03.0)
Other	02 (06.5)	03 (08.8)
Associated comorbidities		
Diabetes mellitus	10 (32.2)	08 (23.5)
Coronary disease	07 (22.6)	10 (29.4)
Heart failure	04 (13.0)	05 (14.7)
Peripheral vascular disease	02 (06.5)	03 (08.8)
Cerebrovascular disease	03 (09.7)	05 (14.7)

*P* > 0.05 for all comparisons between the control and intervention groups.

**Table 2.** Technical aspects and blood pressure means measured by ABPM at the beginning and end of the study for the control and intervention groups

ABPM variable	Control group ( <i>n</i> = 31)		Intervention group ( <i>n</i> = 34)	
	Basal	Final	Basal	Final
Hours of recording	23.4 ± 1.2	22.9 ± 0.8	23.7 ± 1.0	23.4 ± 0.9
Number of measurements	50 ± 07	52 ± 06	52 ± 05	51 ± 07
Mean 24-h SBP (mmHg)	145 ± 13	147 ± 15	144 ± 14	135 ± 12* <sup>#</sup>
Mean 24-h DBP (mmHg)	80 ± 6	79 ± 8	83 ± 7	76 ± 7* <sup>#</sup>
Mean SBP awake (mmHg)	149 ± 15	150 ± 19	149 ± 15	142 ± 14* <sup>#</sup>
Mean DBP awake (mmHg)	83 ± 9	82 ± 11	85 ± 10	78 ± 9*
Mean SBP sleep (mmHg)	143 ± 11	145 ± 11	141 ± 10	129 ± 9* <sup>#</sup>
Mean DBP sleep (mmHg)	80 ± 6	77 ± 7	79 ± 7	75 ± 6
SBP dip during sleep (%)	3.5 ± 3.1	3.8 ± 2.9	5.1 ± 3.7	8.1 ± 3.4 <sup>#</sup>
SBP dip ≥ 10% – dippers (%)	03 (09.6)	05 (14.7)	04 (11.7)	13 (38.2)* <sup>#</sup>
DBP dip during sleep (%)	3.5 ± 2.4	5.0 ± 2.2	7.0 ± 2.8	3.9 ± 2.9
DBP dip ≥ 10% – dippers (%)	04 (12.9)	02 (06.5)	04 (11.7)	04 (11.7)

ABPM: ambulatory blood pressure monitoring; SBP: systolic blood pressure; DBP: diastolic blood pressure.

\**P* < 0.05 intervention group – basal versus final.

<sup>#</sup>*P* < 0.05 intervention group final versus control group final.

**Table 3.** Number of measurements and weekly blood pressure means measured by HBPM at the beginning and end of the study for the control and the intervention groups

HBPM variable	Control group (n = 31)		Intervention group (n = 34)	
	Basal	Final	Basal	Final
No. of measurements a week	25 ± 6	24 ± 5	22 ± 5	23 ± 3
Mean weekly SBP (mmHg)	153 ± 20	154 ± 22	154 ± 23	144 ± 21* <sup>#</sup>
Mean weekly DBP (mmHg)	88 ± 12	86 ± 12	90 ± 15	88 ± 10

HBPM: home blood pressure monitoring; SBP: systolic blood pressure; DBP: diastolic blood pressure.

\**P* < 0.05 intervention group – basal versus final.

<sup>#</sup>*P* < 0.05 intervention group final versus control group final.

**Table 4.** Prescribed antihypertensive drugs and compliance with drug treatment

Antihypertensive therapy	Control group (n = 31)		Intervention group (n = 34)	
	Basal	Final	Basal	Final
No. of antihypertensive class	2.1 ± 0.5	2.4 ± 0.4	2.3 ± 0.6	2.9 ± 0.5* <sup>#</sup>
ACEI	18 (58.0)	20 (64.5)	22 (64.7)	27 (79.4)* <sup>#</sup>
CCB	17 (54.8)	20 (64.5)	19 (55.8)	25 (73.5)* <sup>#</sup>
Beta-blockers	14 (45.1)	13 (41.9)	20 (58.8)	24 (70.6) <sup>#</sup>
Adrenergic inhibitors	4 (12.9)	2 (6.4)	06 (17.6)	04 (11.7)
Direct vasodilators	1 (03.2)	1 (03.2)	01 (02.9)	01 (02.9)
Other antihypertensives	4 (12.9)	2 (06.4)	07 (20.0)	04 (11.7)
Number of tablets a day	4.5 ± 1.1	4.5 ± 1.2	4.6 ± 1.5	6.7 ± 1.5* <sup>#</sup>
Percentage of tablets consumed/month	–	50.7 ± 12.4	–	74.6 ± 8.2 <sup>#</sup>

ACEI: angiotensin-converting enzyme inhibitor; CCB: calcium channel blocker \**P* < 0.05 intervention group basal versus final.

<sup>#</sup>*P* < 0.05 intervention group final versus control group final.

**Table 5.** Adverse effects in the control and intervention groups observed during the study

Adverse effect	Control group (n = 31)	Intervention group (n = 34)
Hospitalizations per patient/6 months	0.3	0.2
Cardiovascular causes	14	19
Infectious causes	21	17
Other	21	15
Drug-related		
Cough (%)	4 (12.9)	3 (08.8)
Headache (%)	2 (07.0)	1 (02.9)
Oedema (%)	0 (00.0)	1 (02.9)
Bradyarrhythmias (%)	1 (03.2)	0 (00.0)
Erectile dysfunction (%)	2 (07.0)	3 (08.8)
Dry cough (%)	1 (03.2)	0 (00.0)
Haemodialysis related		
Access thrombosis (%)	4 (12.9)	3 (8.8)
Hypotension per patient/month	0.6	0.9
Muscular cramps per patient/month	0.5	1.5*

\**P* < 0.05 intervention group versus control.

In our study, different results were identified: greater use of antihypertensive medications and greater BP reduction with the use of HBPM. Possible explanations would be (i) the completely different nature of the study populations, i.e. hypertensive individuals from the general population versus hypertensive individuals with chronic renal disease

on haemodialysis and (ii) small methodological differences between the studies, especially the BP target to be achieved. While our study had different therapeutic target for the two groups (BP ≤ 135/85 mmHg for the HBPM group and < 140/90 mmHg for the predialysis BP group), the previous studies presented the same BP target (BP < 140/90 mmHg) for both groups, HBPM and the physician's office BP groups.

Regardless of these differences, one of the factors responsible for a greater reduction of blood pressure among patients who systematically performed HBPM was greater compliance with the drug treatment prescribed. Various possibilities may be raised for this, such as a better understanding from the patient about his/her blood pressure elevations during the day and his/her response to the treatment [31]. Additionally, success in treatment of various chronic diseases such as hypertension and diabetes has a close approach to the patient's active involvement in his/her own treatment, such as measuring his/her own blood pressure at home [32].

Another interesting finding seen in the intervention group was an increase in the number of patients who developed a dipping BP pattern during sleep. The non-dipper profile has prognostic implications among haemodialysis patients. An observational study carried out with 80 haemodialysis patients in Japan pointed out the non-dipper BP pattern as an independent risk factor for cardiovascular mortality [11]. Our study shows that with the use of HBPM a significant portion of the patients developed a dipping

BP pattern, 11.7% at the beginning of the study versus 38.2% at the end, which is particularly positive.

Nevertheless, despite the reduction in blood pressure during the interdialytic period and the change in blood pressure behaviour during sleep, no benefit was observed in the reversal of the target-organ damage in the intervention group. The LVMI was not changed after 6 months.

The LHV reversal has proven to be a difficult goal to reach among haemodialysis patients. Several factors make this task extremely hard to be accomplished and hypertension is merely one of them [33]. So far, interventions that have proven to be the most effective in reducing the LVMI among patients on haemodialysis are those which significantly intensify the dose of dialysis [34]. A randomized clinical trial between daily nocturnal haemodialysis (six times a week, 6–8 h per session) and conventional haemodialysis (three times a week, 4 h per session), which evaluated the ventricular mass by magnetic resonance, was able to identify benefits in predialysis BP control and LVMI reduction in the group of patients who underwent daily nocturnal haemodialysis [35].

Logically, some methodological limitations of our protocol may explain why there was no change in the LVMI. The limited follow-up (6 months) may not have been sufficient, so that the best BP control achieved did not display a better cardiac remodelling, not to mention the small number of patients included in the study. Besides this, the timing of echocardiograms was not fixed in relation to dialysis. Since volume changes can alter dimensions of the left ventricle, this additional variation may have reduced the power of the study to detect a true blood pressure reduction effect on LVMI.

Another limitation, now related to the benefit observed in BP reduction, is the fact that this is an open-label study, which does not allow us to assess the placebo effect or avoid investigators observational biases [36].

All these limitations exemplify the difficulty in obtaining stronger evidence by the BP treatment among haemodialysis patients. It seems clear that the therapeutic goal should be BP control during the interdialytic period, but the best strategies to achieve this objective are uncertain.

Despite these limitations, our study shows that HBPM can be a useful adjuvant instrument for a better BP control among haemodialysis patients.

*Conflict of interest statement.* None declared.

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