Original Article

The effect of intensive hemodialysis on LVH regression and blood pressure control in ESRD patients

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Abstract

Introduction: Cardiovascular diseases are considered the major cause of death in dialysis patients with end-stage renal disease (ESRD). Recently, intensive hemodialysis has increasingly used and replaced conventional hemodialysis. The present study aimed to evaluate the effect of intensive hemodialysis on LVH regression and blood pressure control. **Methods:** The present study is self-control, pre- and post-intervention clinical trial on hemodialysis ESRD patients with hypertension (52.5% female with a mean age of 55.55 ± 12.96), who were admitted to Imam Khomeini Hospitals, Golestan Ahvaz in 1396. All patients underwent intensive hemodialysis treatment 4 times a week for 2 months. 2-D color Doppler echocardiography was performed for all patients before the intervention and following 2 months of intensive hemodialysis. The results of chest echocardiographic were used to determine left ventricular thickness. **Results:** In this study, 40 patients with hypertension were studied. The results of this study showed a significant decrease ($P < 0.0001$) in the levels of LVH, SBP, DBP and mean BP after intervention in ESRD patients. The level of LVH was decreased from 15.42 ± 1.67 mmHg to 13.86 ± 1.39 mmHg, SBP from 161.50 ± 12.16 mmHg to 141.12 ± 8.87 mmHg, DBP from 25.25 ± 5.15 mmHg to 81/75 ± 2.89 mmHg, and mean BP from 114.66 ± 6.82 mmHg to 101/54 ± 3.98 mmHg. **Conclusion:** Based on the results, it can be concluded that intensive hemodialysis resulted in improved LVH regression and blood pressure control, and fewer requirements for blood pressure-lowering medications.

Keywords: End-stage renal disease, hypertension, intensive dialysis, left ventricle hypertrophy

Introduction

Cardiovascular diseases are considered the major cause of death in dialysis patients with end-stage renal disease (ESRD).[1] Most of the hemodialysis patients undergo dialysis 3 times a week which each session takes about 4 hours (3 hours and 37 minutes).[2] Recently, intensive hemodialysis has increasingly used and replaced conventional hemodialysis. The result of studies have shown that intensive hemodialysis resulted in improving the uremic toxicity clearance, LVH regression and blood pressure control, reducing left ventricular mass (LVM) and other cardiovascular outcomes, thereby improving sleep quality and quality of life.[3-6] Hypertension is one of the clinical characteristics of ESRD patients. Hypertensive nephropathy is the underlying cause of ESRD incidence in approximately 30% of patients, so that, the prevalence of hypertension in patients with newly diagnosed ESRD is more than 85%. Pre-dialysis systolic blood pressure (SBP) is about 150 mmHg in patients undergoing conventional hemodialysis. Generally, a U-shaped relationship exists between pre-dialysis SBP and mortality risk.[7] The present study aimed to evaluate the effect of intensive hemodialysis on LVH regression and blood pressure control in ESRD patients.

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Methods

The present study aimed to evaluate the effect of intensive hemodialysis on LVH regression and blood pressure control. In this study, after receiving permission from Jundishapur University of Medical Sciences, Ahvaz, a group of ESRD patients with LVH and hypertension admitted to Imam Khomeini and Golestan Hospitals in Ahvaz were asked to participate. Patients eligible for the study were selected according to inclusion and exclusion criteria. Before treatment, written informed consent was obtained for all patients. This prospective clinical trial was approved by the Research Ethics Committee of the Ahvaz Jundishapur University of Medical Sciences (Code: IR.AJUMS.REC.1396.911).

Inclusion criteria

- Over 35 years old
- SBP ≥140 mmHg
- DBP ≥90 mmHg
- LVH ≥12 mm
- Satisfaction with participation in the study.

Exclusion criteria

- Left ventricular hypertrophy due to severe valvular disease such as severe AS or cardiac myopathy hypertrophy.

Intervention

At first, demographic characteristics and medical history of patients including age, sex, weight, BMI, duration of ESRD diagnosis, history of hypertension, history of diabetes, history of smoking, medications used, and dialysis duration were recorded. Afterward, all patients underwent intensive hemodialysis treatment for 2 months. Intensive hemodialysis is defined as a hemodialysis treatment for 16 hours and over per week, which is determined on the basis of the prescription regimen on the last day of previous dialysis.[8] In all patients, the levels of SBP, DBP and mean BP were evaluated before and after intensive dialysis. 2D echocardiography was also performed to measure the level of left ventricular hypertrophy before and after intensive dialysis.

Statistical tests

Statistical indicators used to describe the data included mean, standard deviation, min, max, frequency and percentage. Kolmogorov-Smirnov test was applied to examine the normality of the data. Later, due to the non-normal distribution of data, nonparametric tests were used. The obtained results before and after the intervention were compared using the Wilcoxon signed-rank test. Mann-Whitney test and Spearman correlation were applied to examine the relationship between variables. The significance level was considered to be 0.05 in all tests.

Results

The basic characteristics of ESRD patients are presented in Table 1. The mean age of participants was 55.55 ± 12.96 (ranged from 35 to 85) years. The mean age of disease incidence was 3.45 ± 2.42 years (ranged from 1 to 9) years. The results of drug use showed that Eprex with 87.5% was the most prevalent and Carvedilol with 52.5% was the least prevalent drugs used in under-studied patients.

Table 1: Basic characteristics of ESRD patients

Variable	Group	Frequency/Mean
Old (years)		55.35±12.96 (35-85)
Sex	Female	21 (52.5)
	Male	19 (47.5)
BMI (Kg/m^2)	18-20	9 (22.5)
	20-25	22 (55.0)
	25-30	9 (22.5)
Comorbidity	DM	19 (47.5)
	HTN	40 (100)
Smoking		13 (35.5)
Duration of ESRD diagnosis (years)		3.45±2.42 (1-9)
Dialysis duration (years)		3.43±2.26 (1-9)
Drug used	CaCO3	34 (85.0)
	Nephrovit	24 (60.0)
	Renagel	29 (72.5)
	Eprex	35 (87.5)
	Valsartan	34 (85.0)
	Amlodipine	16 (60.0)
	Lasix	17 (42.5)
	Insulin	19 (47.5)
	Carvedilol	21 (52.5)

ESRD: End-stage renal disease; BMI: Body Mass Index; DM: diabetes mellitus; HTN: Hypertension

Numbers are shown as mean ± standard deviation (maximum-minimum) or frequency (percent).

The comparison results of the data related to pre- and post-intensive hemodialysis for the studied patients are presented in Table 2. In the present study, the levels of LVH, SBP, DBP and mean BP for ESRD patients were significantly decreased after the intervention ($P < 0.0001$).

The result of Spearman correlation test showed no significant relationship between LVH reduction and either of the patient age ($r = 0.265$, $P = 0.098$) or duration of disease diagnosis ($r = 0.014$, $P = 0.941$) at the end of the study. Patient age had a direct and significant relationship with changes in systolic blood pressure ($r = 0.341$, $P = 0.032$), diastolic blood pressure ($r = 0.423$, $P = 0.005$) and mean BP ($r = 0.465$, $P = 0.002$). However, there was no significant relationship between duration of disease diagnosis and changes in systolic blood pressure ($r = -0.06$, $P = 0.712$), diastolic blood pressure ($r = -0.02$, $P = 0.990912$) and mean BP ($R = -0.032$, $P = 0.864$). The results of Mann-Whitney test showed that LVH changes and systolic and diastolic blood pressures had no significant relationship with sex, smoking, and the use of CaCO3, nephrotic, Renagel and Eprex ($P < 0.05$). However, at the end of the intervention, the reduction in LVH, systolic and diastolic blood pressure and mean BP levels were significantly higher in patients taking Amillodopamin, Valsartan, Lasix,

Table 2: Comparison of pre- and post-intensive hemodialysis in ESRD patients

Variable	Before intervention	After intervention	Difference	*P*
LVH (mm)	15.42±1.67 (13-19)	13.86±1.39 (11-17)	1.55±0.95 (0-3)	<0.0001
SBP (mmHg)	161.50±12.20 (140-185)	141.12±8.87 (130-160)	20.38±8.19 (5-35)	<0.0001
DBP (mmHg)	91.25±5.15 (80-100)	81.75±2.89 (75-90)	9.50±5.40 (0-20)	<0.0001
Mean BP (mmHg)	114±6.82 (101.67-128.33)	101.54±3.98 (95.0-110.0)	13.12±5.34 (3.33-21.67)	<0.0001

Numbers are shown as mean±standard deviation (maximum-minimum) or frequency (percent)

and carvediol compared to those who did not use these drugs ($P < 0.05$).

Discussion

Several factors are involved in the development of hypertension, including permanent hypervolemia and increased environmental resistance. In the case of hemodialysis by 3 times a week, blood pressure increases during the periods between the dialysis sessions, which is associated with an increase in patient's weight during these periods, especially in older patients with higher dry weights. Increased peripheral resistance may be associated with impaired activation of the sympathetic nervous system due to higher concentrations of norepinephrine in plasma.[7] Sodium and water retention are the main causes of hypertension in dialysis patients.[9]

Various clinical trials have shown that intensive hemodialysis reduces blood pressure and the need for using antihypertensive pills. During the first 2 months of intensive hemodialysis (3 times a week), the short daily program reduced the pre-dialysis SBP to 7.7 mmHg, and the nightly hemodialysis program further reduced this to 7.3 mmHg. This improvement continued after 12 months of intensive hemodialysis. The daily short-term hemodialysis program also reduced the average number of antihypertensive drugs (from 1.7 to 1.0 in one year), and the percentage of patients who did not use these drugs increased from 21% to 47%. Nightly hemodialysis program resulted in a significant reduction in peripheral resistance and plasma norepinephrine, as well as in endothelium-dependent vasodilation. According to the results, it can be concluded that the intensive hemodialysis reduces blood pressure and the need for using antihypertensive pills.

Recently, a large number of studies have investigated the effect of intensive hemodialysis on cardiovascular parameters. For example, Kostenko *et al.*[10] studied the effects of conventional hemodialysis and intensive hemodialysis on blood pressure in US society and reported that there is a significant decrease in systolic (-7.7 mmHg) and diastolic (-1.9 mmHg) blood pressures after 2 months of daily intensive hemodialysis compared to pre-dialysis observations. In their meta-analysis in Canada, Susantitaphong *et al.*[11] investigated the effects of intensive hemodialysis on cardiovascular parameters. The results showed that intensive hemodialysis significantly reduced LVMI compared to the onset of the study (-39.8 to -22.5 g/m2). They also found a significant decrease in mean systolic and diastolic blood pressures, and in the number of antihypertensive medications. Ayus *et al.*[12] compared the effects of daily short-term and conventional hemodialysis on left ventricular hypertrophy and inflammatory markers in the US. The result of their study showed that after 12 months of intervention, the group receiving daily short-term hemodialysis experienced a significant decrease in LVMI level by 30% (from 154 ± 33 to 108 ± 25). Moreover, CRP and Erythropoietin Resistance Index were significantly decreased in this group. The results of the present study showed that intensive hemodialysis improves LVH regression and blood pressure control, which is consistent with the results of previous studies.

Conclusion

This study investigated the effect of a 2-months intensive hemodialysis on LVH regression and blood pressure control in ESRD patients. The results showed a significant decrease in the levels of LVH, SBP, DBP and mean BP after intensive hemodialysis of ESRD patients, which led to a decrease in the need for antihypertensive medications in these patients.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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