Left Atrial Volume Index (LAVI) in hypervolemic patients undergoing chronic hemodialysis

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BACKGROUND: Mortality in chronic hemodialysis (HD) patients are occurred often due to cardiovascular diseases. Volume overload and left atrial volume index (LAVI) are prognostic predictors both all-cause and cardiovascular mortality.

AIM: The aim of study is to search how there is a relationship between volume quantity and LAVI in chronic hemodialysis patients.

STUDY DESIGN: A prospective cross-sectional study.

METHODS: 102 hemodialysis patients (male: 53, female: 49) were included to this study. The patients were divided to two groups in according to ultrafiltration (UF) (<10 milliliter (mL)/kg/hour or ≥10 mL/kg/hour). If UF was >2.5 L, it was accepted hypervolemia. Left atrial volumes (LAV) were measured by using an echocardiography by a cardiology specialist. LAVI was determined by left atrial volume divided by body surface area. ≥32 mL/m² of LAVI was accepted high. Statistical analysis was done by using Mann-Whitney U test and Pearson correlation test.

RESULTS: In hypervolemic group (n=53), means of LAV, LAVI and UF were 52 ± 24 cm³, 32.1 ± 14 mL/m² and 27.27 ± 538mL, respectively. In normovolemic group (n=49), means of LAV, LAVI and UF were 56 ± 28 cm³, 30.3 ± 14 mL/m² and 203 ± 589 mL, respectively.

CONCLUSION: Mean of LAVI values were found high in hemodialysis patients with hypervolemia.

Key Words: Left atrial volume index; Hypervolemia; Chronic hemodialysis

INTRODUCTION

Interdialytic weight gain and residual postdialysis volume overload leads to predialysis volume overload. Predialysis volume overload is defined as ≥15% above normal extracellular fluid volume (ECV), equivalent to ≥2.5 L on average [1]. The frequency of predialysis volume overload > 15% ECV in 34 European hemodialysis (HD) centers was 28.3%. In a patient undergoing classic HD, 15% ECV overload corresponds to 2.5 L of excess volume [2,3].

Volume overload leads to a high risk for intradialytic hypotension due to the high ultrafiltration (UF) rate in patients undergoing HD [4,5]. As the UF rates increase (>10 mL/hour/kg body weight), mortality increases; therefore, interdialytic weight gain may be associated with mortality risk [6,7].

The relationship between left atrial size (left atrial volume [LAVI]) and cardiovascular outcome in end-stage renal disease have been determined. Large left atrial size is a predictor of mortality and adverse cardiovascular events [8]. It was reported that the left atrial volume index (LAVI) is an independent predictor of prognosis in patients undergoing HD [9]. High LAVI levels have been observed in hypervolemic chronic kidney disease [10].

The aim of this study was to identify LAVI values in chronic HD patients with high UF.

METHODS

This study was a prospective cross-sectional clinical study. One-hundred and two patients undergoing chronic HD (male=53, female=49) were included. This study was approved by the local ethics committee of the medical school. Patients were categorized into two groups according to the mean UF rate over the 3-month period prior to the beginning of the study. The UF rate limit was determined to be 10 mL/body weight (kg)/hour. The blood pressure of all patients was measured during rest days after dialysis. The body surface area (BSA) was calculated by the DuBois formula [11]. Biochemical values were obtained from medical records taken 1 month prior.

Exclusion criteria for the study were patients with heart failure, an active infection, atrial fibrillation, major heart valve disease, uncontrolled hypertension, no consent, or HD time<3 months.

Transthoracic echocardiography (Philips Envisor C HD) was performed together with an electrocardiogram (ECG) by a cardiology specialist who was blinded to the patients’ medical information. Echocardiographic images were obtained from parasternal and apical windows while the patients were in the left lateral decubitus position. Apical four spaces and the parasternal long and short axis were evaluated as appropriate [12]. The sizes of the left ventricle, left atrium, and aortic root from the parasternal long axis, and other heart spaces from the four apical spaces were measured. Left atrial size and volume were measured during the largest size of the left atrium after the end of the T wave on ECG using the Simpson method [13]. The LAVI was calculated as LAV divided by body surface area.

All values were calculated as arithmetic means, standard deviations, and medians. The normality of the data distribution was investigated. Statistical analysis was conducted using Student’s t-test. A p-value<0.05 was considered significant.

RESULTS

One-hundred and two patients undergoing HD were included in this study. Mean body surface area was normal (1.73 m²). The patients had diabetes mellitus (n=33, 32%) and hypertension, controlled by medication (n=58, 57%). The mean LAVI and other parameters are summarized in Table 1.

Mortality and complications were higher in patients undergoing HD with >10 mL/body weight (kg)/hour UF rate [14,15]. Therefore, the patients were separated into two groups according to UF rate. It was accepted that patients with a >=10 mL/kg/hour UF rate (group 1; n=53) were hypervolemic, and those with a UF rate £ 10 mL/kg/hour (group 2; n=49) were normovolemic. 52% of patients were hypervolemic. Mean UF amount was 2,727 ± 538 mL in group 1 patients and 2,063 ± 589 mL in group 2 patients (p=0.001). That is, group 1 patients were hypervolemic (>2.5 L). Significant results in these groups are shown in Table 2.

LAVI values (>32 mL/m²) were high in patients with a high UF amount (>2.5 L) (Table 2). A significant twosided, positive correlation was detected between left atrial size and LAVI in all patients (r=0.548; p<0.001).
LAVI values of diabetic (n=33; 32 ± 15) and non-diabetic patients (n=69; 30 ± 13) were not different (p=0.429). LAVI values were not different between patients with hypertension (n=59; 33 ± 14), using anti-hypertensive drugs, and normotensive patients (n=43; 28 ± 13) (p=0.146).

**DISCUSSION**

Cardiovascular events occur frequently in patients with CKD, and are the most frequent causes of mortality in patients undergoing dialysis [14,15]. The predictors that decrease survival must be determined using cardioprotective dialysis methods to improve survival of patients undergoing HD.

LAVI was found an independent predictor of all-cause mortality. Based on this finding, the normal LAVI was identified to be ≤ 28 mL/m² in patients with normal LV filling pressure and preserved LVEF [16].

LAVI is an independent predictor of poor cardiac events, and was high in the CKD group [17]. High LAVI (>32 mL/m²) is accepted as a significant risk factor for a cardiovascular event in patients undergoing dialysis [18,19]. In additionally, it was reported that high LAVI level was an independent predictor for all-cause mortality [19]. Left atrial expansion occurs as a consequence of pressure or volume overload. Mitral valve disease or left ventricular dysfunction leads to pressure overload [20]. The causes of left atrial expansion leading to high LAVI are age, diabetes mellitus, low ejection fraction, left ventricular hypertrophy, mitral regurgitation, and high pulmonary pressure in patients with end-stage renal disease [21].

A relationship between LAV and hydration stage has been reported in review [22].

Yilmaz A. et al reported that there were hypervolemia and high LAVI values in 48.5% of patients with non-dialysis chronic kidney failure [10]. The ratio of overhydrated HD patients was high (67.1%) before HD [23]. Also, there was hypervolemia in our patients (52%). However, volume overload in 34 European hemodialysis (HD) centers was found lower as 28.3% [2,3]. A strong correlation was observed between hydration status and LAVI. Overhydrated HD patients have high LAVI values [20]. High LAVI (>32 mL/m²) was reported in 28 (16%) of 174 patients undergoing HD [18]. In our study, high LAVI (>32 mL/m²) was 52%. The discrepancy in the frequency may be due to the clinically different patients in these studies.

It was found that fluid overload was positively associated with LAVI in CKD5 patients not undergoing dialysis [23]. Similarly, it was reported that LAVI are related on hydration status in chronic hemodialysis patients [24].

Most patients undergoing HD have chronic predialysis volume overload. Fluid overload is defined as ≥2.5 L of dry body weight [2].

In our study, mean total UF amount was 2.7 L in 52% of the patients; that is, there is hypervolemia. These patients with hypervolemia had high LAVI values. Therefore, UF rate is a survival predictor. Thus, positive relationship was reported between ultrafiltration rate and LAVI in hemodialysis patients [26].

**CONCLUSION**

In this study, LAVI values were found high in chronic hemodialysis patients with high UF (≥2.5L). Therefore, prognosis of these patients can be considered to be poor.

**CONFLICT OF INTEREST**

The authors declare that they have no conflict of interest.
REFERENCES


