

ORIGINAL PAPER

doi: 10.5455/medarch.2016.70.328-331

Med Arch. 2016 Oct; 70(5): 328-331

Received: AUG 15, 2016 | Accepted: OCT 05, 2016

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The Relationship Between Hemodialysis and the Echocardiographic Findings in Patients with Chronic Kidney Disease

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ABSTRACT

Background: The incidence of cardiac morbidity and mortality is high in patients treated with hemodialysis (HD). The aim of this study was to evaluate the relationship between HD and the echocardiographic findings in patients with chronic kidney disease (CKD). **Methods:** Between 2012 and 2014, 150 patients with CKD. The echocardiographic data were done based on American Society of Cardiology (ASE). Measurement method for Ejection Fraction was E balling and for Diastolic Function was Tissue Doppler. Anemia, thyroid conditions and dialysis through an arteriovenous fistula or permanent catheter of dialysis for the patients are not considered. **Results:** The mean age at diagnosis for the patients was 57.8 years, 52.7% were males. Out of 150 patients, 112 patients (74.7%) had diabetes and 117 patients (78%) had a history of hypertension. The prevalence of all echocardiographic findings was more after the first dialysis compared with before the first dialysis in diabetic patients ($P < 0.05$), but in non-diabetic patients, was not for the tricuspid valve stenosis, impaired right ventricular volume, systolic dysfunction and pulmonary hypertension ($P > 0.05$). **Conclusions:** According to the findings of this study, seems that more accurate selection of patients for dialysis, paying special attention to hemodynamic change during dialysis, patient education about diet and better control of uremia and diabetes is essential.

Key words: Hemodialysis, Chronic kidney disease, Echocardiography.

1. INTRODUCTION

Chronic kidney disease (CKD), which prevalence is still growing worldwide, confers a higher risk of coronary artery disease (CAD), chronic heart failure (CHF) and/or death independently of conventional cardiovascular risk factors (1, 2). Tens of millions of persons worldwide have combined cardiovascular disease (CVD) and CKD (3). The risk of CVD in patients with chronic renal disease appears to be far greater than in the general population (4).

The incidence of cardiac morbidity and mortality is high in patients treated with hemodialysis (HD) (5). Cardiovascular disease is the principal cause of mortality in patients with renal failure and left ventricular (LV) abnormalities that are adverse prognostic indicators for cardiovascular outcome (6). Dialysis patients who develop cardiac failure have a poor prognosis. HD-induced myocardial stunning driven by ischemia is a recognized complication of HD, which can be ameliorated by HD

techniques that improve hemodynamic (7). End-stage renal disease (ESRD) associates with numerous changes in cardiac structure and function that may account for the sustained high prevalence of morbidity and mortality from cardiovascular disease, particularly ischaemic heart disease and heart failure (8).

The aim of this study was to evaluate the relationship between HD and the echocardiographic findings in patients with advanced renal failure in the west of Iran.

2. MATERIALS AND METHODS

In an analytical and cross-sectional study between 2012 and 2014 that was approved by the Ethics Committee of Kermanshah University of Medical Sciences, 150 patients with chronic kidney disease (CKD) (disease signs were confirmed for them clinically) referred to Emam Reza Hospital, Kermanshah, Iran. We checked the general characteristics such as age, sex, hypertension and diabetes in the patients. The echocardiographic information was checked in all patients before the first HD and after one year. The echocardiographic data were done based on American Society of Cardiology (ASE). Measurement method for Ejection Fraction was E balling and for Diastolic Function was Tissue Doppler. Anemia, thyroid conditions and HD through an arteriovenous fistula or permanent catheter of HD for the patients are not considered.

Inclusion criteria: Advanced kidney disease, having of complete echocardiographic information and the similarity of effects on echocardiographic findings, such as drugs of Inotrope.

Exclusion criteria: Having of incomplete echocardiographic information, effective treatment measures, such as CABG and valve repair.

Statistical analysis

For analyzing of data, was used SPSS version 20 software (SPSS, Inc., Chicago, USA). The T-test was done for means and Chi-square test for other values. P-values <0.05 were considered statistically significant.

3. RESULTS

The mean age at diagnosis for the patients was 57.8 years (range, 12 to 86 year), 79 patients (52.7%) were males (Table 1). Out of 150 patients, 112 patients (74.7%) had diabetes and 117 patients (78%) had a history of hypertension.

There were significant differences between before the

Variables	n(%)	Mean±SD	Range
Age (years)		57.8±19	12-86
Sex	79(52.7)		
Male	71(47.3)		
Female	112(74.7)		
Diabetes	38(25.3)		
Yes	117(78)		
No	33(22)		
Hypertension			
Yes			
No			

Table 1. The characteristics of patients (n=150)

first HD and after one year for all the echocardiographic findings in Table 2. Prevalence of the echocardiographic

Variables	Before	After	P-value
The pulmonary valve regurgitation			
Yes	6(4)	23(15.3)	0.001
No	144(96)	127(84.7)	
The tricuspid valve stenosis			
Yes	1(0.7)	7(4.3)	0.031
No	149(99.3)	143(95.3)	
Pericardial effusion			
Yes	18(12)	42(28)	0.001
No	132(88)	108(72)	
Left ventricular hypertrophy			
Yes	51(34)	86(47.3)	0.001
No	99(66)	64(42.7)	
Impaired right ventricular volume			
Yes	38(25.3)	61(40.7)	<0.001
No	112(47.4)	89(59.3)	
Systolic dysfunction			
Yes	28(18.7)	58(38.7)	<0.001
No	112(81.3)	82(61.3)	
Pulmonary hypertension			
Yes	64(42)	97(64.7)	0.001
No	87(58)	53(35.3)	
Aortic valve stenosis			
Yes	11(7.3)	18(12)	0.001
No	139(92.7)	132(88)	
Aortic valve regurgitation			
Yes	52(34.7)	92(61.3)	0.001
No	98(65.3)	58(38.7)	
The tricuspid valve regurgitation			
Yes	93(62)	138(92)	0.001
No	57(38)	12(8)	

Table 2. The echocardiographic findings of the patients, before and after the first hemodialysis (n=150)

findings was more after the first HD compared with before the first HD in all patients (P<0.05).

Table 3 shows the echocardiographic findings for 112 diabetic patients, before the first HD and after one year. Prevalence of the echocardiographic findings was more after the first HD compared with before the first HD in diabetic patients (P<0.05).

Table 4 shows the echocardiographic findings for 38

Variables	Before	After	P-value
The pulmonary valve regurgitation	1(0.9)	10(9)	0.004
The tricuspid valve stenosis	0	6(5.4)	0.031
Pericardial effusion	14(12.5)	28(25)	0.007
Left ventricular hypertrophy	41(36.6)	98(60.7)	0.001
Impaired right ventricular volume	15(22.3)	47(42)	0.001
Systolic dysfunction	18(16.1)	46(41.1)	0.001
Pulmonary hypertension	47(42)	76(67.9)	0.001
Aortic valve stenosis	3(7.9)	14(12.5)	0.001
Aortic valve regurgitation	42(37.5)	75(66)	0.001
The tricuspid valve regurgitation	64(59.8)	107(95.5)	0.001

Table 3. The echocardiographic findings of diabetic patients, before and after the first hemodialysis (n=112)

non-diabetic patients, before the first HD and after one year. The prevalence of the echocardiographic findings was more after the first HD compared with before the

Variables	Before	After	P-value
The pulmonary valve regurgitation	5(13.2)	13(34.2)	0.008
The tricuspid valve stenosis	1(2.6)	1(2.6)	1.000
Pericardial effusion	4(10.5)	14(36.8)	0.002
Left ventricular hypertrophy	10(26.3)	18(47.4)	0.008
Impaired right ventricular volume	13(34.2)	14(36.8)	1.000
Systolic dysfunction	10(26.3)	12(31.6)	0.625
Pulmonary hypertension	15(40.5)	20(54.1)	0.219
Aortic valve stenosis	3(7.9)	4(10.5)	0.083
Aortic valve regurgitation	10(27.3)	17(44.7)	0.005
The tricuspid valve regurgitation	26(69.4)	31(81.6)	<0.001

Table 4. The echocardiographic findings of non-diabetic patients, before and after the first hemodialysis (n=38)

first HD in non-diabetic patients ($P < 0.05$), exception for the tricuspid valve stenosis, impaired right ventricular volume, systolic dysfunction and pulmonary hypertension that had no significant differences before and after the first HD ($P > 0.05$).

4. DISCUSSION

In this study, we checked the relationship between HD (before the first dialysis compared with after one year) and the echocardiographic findings in patients with CKD. In addition, we divided the patients into two groups (diabetic and non-diabetic patients) and then compared the echocardiographic findings before the first dialysis compared with after one year.

CVD is the leading cause of mortality in uremic patients. A lot of cross-sectional studies in dialysis patients reported that traditional CVD risk factors such as hypertension and hypercholesterolemia had low predictive power, while markers of inflammation and malnutrition were highly correlated with cardiovascular mortality (9). On the other hand, patients with CKD have increased risks of accelerated atherosclerosis, nonfatal myocardial infarction, congestive heart failure, atrial and ventricular arrhythmias, and cardiac death and also present difficult scenarios in using conventional cardioprotective therapy (3). CKD accelerates the course of coronary artery disease, independent of conventional cardiac risk factors (10). Vascular calcification (VC) is highly prevalent and rapidly progressive in high stage CKD (11). In CKD patients, LV diastolic dysfunction occurs frequently and is associated with heart failure (HF) and higher mortality (12). Cardiomyopathy in chronic uremia results from pressure and volume overload. The former causes concentric LV hypertrophy, results of hypertension and aortic stenosis, and is also associated with diabetes mellitus and anemia. The clinical consequences of cardiomyopathy include heart failure, ischaemic heart disease, dialysis hypotension, and arrhythmias. The adverse impact of ischaemic heart disease is probably mediated through the development of cardiac failure (13). The results indicate that LV diastolic dysfunction as revealed by the increased peak velocity of atrial filling reflects arterial stiffening in type 2 diabetic (T2D) patients. In addition, myocardial wall thickening at the LV outflow tract reflects not only arterial stiffening but also carotid atherosclerosis. Therefore, these abnormal echocardiographic findings of LV diastolic dysfunction and myocardial wall thickening may be useful markers of the presence of progressive arteriosclerosis in T2D patients (14).

One study (11), showed for the first time that microcirculatory dysfunction is specifically associated with a VC. Furthermore, both VC and microcirculatory dysfunction are associated with atherosclerosis, arterial stiffness, autonomic dysfunction and LV hypertrophy as well as all cause and cardiovascular mortality (11, 15, 16). It has been reported that ischemia maintained for several hours by *subtotal* coronary occlusion can also cause LV dysfunction that persists for days after the release of the occlusion and restoration of myocardial blood flow. Stunning has also been demonstrated in conscious dogs

with subtotal coronary obstruction in which ischemia was induced by muscular exercise (17). HD-induced myocardial stunning is common, and may contribute to the development of heart failure and increased mortality in HD patients. After 12 months, both groups of patients (with and without evidence of HD-induced regional wall motion abnormalities) exhibited a significant deterioration in SBP during HD. Conventional HD exerts a significant acute cardiovascular stress, the exact consequences of which are poorly understood. This study supports the contention that subclinical myocardial ischemia is commonly precipitated by dialysis (18).

The absence of sinus rhythm was an important risk indicator for all-cause death and cardiovascular events in patients with T2D on HD. LV hypertrophy was predictive of stroke and sudden death (19). Compared with non-diabetics, diabetics had a 48% significant increase in the primary endpoint, a 56% significant increase in cardiovascular death, a 30% significant increase in myocardial infarction, a 39% significant increase in stroke, and a 206% significant increase in hospitalization for congestive heart failure (20). In our study, there was no significant difference between before and after the first dialysis in non-diabetic patients compared with diabetic patients in some of CVD factors. Therefore, diabetics are at more risk for CVD.

5. CONCLUSION

Diabetes is a risk factor for CVD. Also, according to the findings of this study, seems that more accurate selection of patients for dialysis, paying special attention to hemodynamic change during dialysis, patient education about diet and better control of uremia and diabetes is essential.

• Conflict of interest: none declared.

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