ECHOCARDIOGRAPHIC STUDY OF CARDIAC DYSFUNCTION IN PATIENTS OF CHRONIC KIDNEY DISEASE ON HEMODIALYSIS

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ABSTRACT

Objective: The objective of this study was to see echocardiographic findings of cardiac dysfunction in patients of chronic kidney disease (CKD) on hemodialysis.

Study Design: Comparative cross sectional study.

Place and Duration of Study: Department of nephrology, Pakistan Institute of Medical Sciences. Islamabad from September 2014 to February 2015.

Patients and Methods: One hundred patients of either gender were included in this study. Fifty patients of chronic kidney disease stage V on hemodialysis were taken for echocardiography and fifty were normal. Echocardiography was done for cardiac dysfunction. Systolic function was measured by ejection fraction (EF) and fractional shortening (FS). Diastolic function was measured by E/A ratio.

Results: Out of 100 patients included in the study, 50 patients were on hemodialysis and 50 were control. Left ventricular end systolic and end diastolic volumes were higher in patients on hemodialysis than controls as well as left atrial enlargement and inter ventricular septum which was statistically significant. Ejection fraction, although normal and fractional shortening decreased in patients on hemodialysis ($p<0.05$). Diastolic dysfunction was present in 36 patients on hemodialysis, while absent in the control group.

Conclusion: Patients with chronic kidney disease on hemodialysis have higher prevalence of cardiac dysfunction.

Keywords: Diastolic dysfunction, Echocardiography, Hemodialysis.

INTRODUCTION

CKD Patients have increased risk for cardiovascular disease (CVD). Ten to 30 fold increased cardiovascular mortality risk is present in dialysis patients as compared with the general population, and had 44% of overall mortality[1]. Evidence is present which indicates that a portion of this cardiovascular damage may be due to hemodialysis (HD). HD causes hemodynamic instability through the development of subclinical myocardial ischemia[2]. In another study, cardiac arrhythmias are caused by abnormal ventricular morphology and function in patients[3]. Cardiac function is routinely measured using diagnostic imaging techniques. Echocardiography (ECHO) is one method for assessment of cardiac dysfunction[2]. Echocardiography and tissue doppler analysis provide additional diagnostic data on ventricular function[4]. Presently, the ratio of early diastolic mitral inflow velocity to early diastolic mitral annulus velocity (E/e' ratio) is used for the evaluation of LV filling pressure, and it has been used as a marker to diagnose diastolic HF[5,6]. The prevalence of left ventricular systolic and diastolic dysfunction is less clear. Cardiac disease usually presents before dialysis and cardiac dysfunction is common[7]. The present study was aimed at assessing the prevalence of cardiac dysfunctions by echocardiography in patients on hemodialysis.

PATIENTS AND METHODS

This comparative cross sectional study was conducted at department of Nephrology, Pakistan Institute of Medical Sciences Islamabad for a period of six months from September 2014 to February 2015. In this study 100 patients, 50 from CKD stage V and 50 normal persons were

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taken through non probability consecutive sampling. The sample size was calculated using Open Epi sample size calculator version 2.3. Patients aged 15 to 70 with CKD V on hemodialysis were included, who had no history of cardiac disease or symptoms. Patients fulfilling the aforesaid criteria were enrolled in the study and informed consent was obtained. Vital signs were recorded. For checking cardiac status, clinical examination was done. Patients with already known cardiac disease were excluded. The purpose of study was explained to all the patients. All patients were in dialysis unit and echocardiography and investigations were done in OPD. Echocardiography was done by consultant cardiologist by cardiology department, Pakistan Institute of Medical Sciences (PIMS). All findings were noted and record was kept. Left ventricular systolic function was taken as LVEF and fractional shortening (FS). E/A ratio showed diastolic dysfunction. E is peak early diastole velocity and A is peak atrial filling velocity of left ventricle across mitral valve. E/A ratio less than 0.75 and more than 1.8 was considered as diastolic dysfunction. Fractional shortening normal range was 25% to 45%. Ejection fraction was taken normal = 59.2 ± 6%. There are three echocardiographic patterns of diastolic heart failure. The mildest form is called an "abnormal relaxation pattern", or grade I diastolic dysfunction. On the mitral inflow doppler echocardiogram, there is reversal of the normal E/A ratio. Grade II diastolic dysfunction is called "pseudonormal filling dynamics". This is considered moderate diastolic dysfunction. Grade III and IV diastolic dysfunction are called "restrictive filling dynamics". Both of these are severe forms of diastolic dysfunction. The data from patients were collected on a proforma. Statistical analysis was done by SPSS software version 16. All data were tabulated and analyzed. Cardiac dysfunction was expressed as mean ± standard deviation. To test for differences in mean values between two groups student's t-test was used. *p* value < 0.05 was condidered significant.

RESULTS

A total of 100 patients were included in the study according to inclusion criteria. Fifty patients were on hemodialysis and 50 were controls. The mean age of patients on dialysis was 39.5 years (SD=14.1) and 35.7 years (SD=17) in the control group. Twenty seven patients (54%) were males and twenty three (46%) were females in patients on hemodialysis with male to female ratio of 1:1.17, while twenty five (50%) were males and twenty five (50%) were females with male to female ratio was 1:1 (table-I) in the control group. Distribution of patients in two groups with respect to echocardiographic parameters were given in table-II. Left ventricular end systolic and end diastolic volume were higher in patients on hemodialysis than controls as well as left atrial enlargement and inter ventricular septum which were statistically significant. Ejection fraction, although normal and fractional shortening decreased in patients on hemodialys is (*p*-value <0.05). Diastolic dysfunction was present in 36 patients on hemodialysis, while absent in control group (table-III).

DISCUSSION

The analysis of echocardiographic findings in this study showed that CKD in patients on hemodialysis was associated with a significant increase in both systolic and diastolic left ventricular dimensions. In one study, 30% patients had EF <50% which was significantly different from controls[7]. In our study, patients on hemodialysis EF was 65% and control had 56%. In this study, there was no difference in the mean fractional shortening among the two groups i.e, control and patients on hemodialysis. Raj et al (1997) found fractional shortening (FS) in dialysis patients to be 33.3 ± 13.0%, while in controls it was 33 ± 9.3%. FS in dialysis patients were 31.7 ± 7.9% and it was control is 36.2 ± 6.0% in our study[8]. In a study by Greaves et al, FS showed a trend from being highest in the controls (36.5 ± 5.6%), and lowest in the dialysed patients (29.8 ± 8.9%) and LV systolic function generally

preserved[9]. Harnett et al, found a mean FS of 35 ± 6, only 4% patients had systolic dysfunction. All these studies showed that fractional shortening is good in CRF patients[7]. According to studies the occurrence of systolic dysfunction of LV varies from 15% to 28% in patients on dialysis. In our study, systolic dysfunction was present in significantly change after one session of hemodialysis and therefore E' parameter can be particularly useful for dialysis patients to differentiate between pseudonormalization and normal diastolic function profile[13]. The analysis of LV diastolic parameters on the basis of E/A ratio was significantly higher in dialysis patients. Also

Table-I: Age and sex distribution among the study group.

		Control (n=50)	Patients on dialysis (n=50)
Age	Mean ± SD	35.7 ± 17 years	39.5 ± 14.1 years
	Range	10-85 years	18-65 years
Sex	Male	25 (50%)	27 (54%)
	Female	25 (50%)	23 (46%)

Table-II: Distribution of patients by echocardiographic measures among the study group.

Echocardiographic Parameters	Control (n=50)	Patients on dialysis (n=50)	*p*-value
LVES, (mm)	27.4 ± 4.5	36.2 ± 5.9	<.001
LVED, (mm)	43 ± 4.8	52.4 ± 4	<.001
Left atrial Enlargement, (mm)	27.7± 4.4	35.2 ± 7.3	<.001
IVS, (mm)	9.1 ± 1.1	11.6 ± 2.2	<.001
EF (%)	65.4 ± 4.8	56 ± 10.4	<.001
FS (%)	36.2 ± 6.0	31.7 ± 7.9	<.002

LVES–Left ventricular volume at end systole. LVED – Left ventricular volume at end diastole, IVS–Interventricularseptal thickness. EF–ejection fraction. FS–Fractional shortening.

Table-III: Diastolic dysfunction among the study group.

	Control (n=50)	Patients on dialysis (n=50)
Absent	50 (100%)	14 (25%)
Mild	0	21 (42%)
Moderate	0	15 (30%)
Severe	Nil	Nil

hemodialysis patients as compared to controls. *p*-value <0.05)[10]. Left ventricular diastolic dysfunction is an important cause of cardiac morbidity in end stage renal disease (ESRD) patients. Diastolic dysfunction appears to be the initial left ventricular dysfunction and might even precede left ventricular hypertrophy[11]. In the present study, the mean E/A ratio in control group was 1.5 (normal). One study reported a significant reduction in E/A ratio in haemodialysis patients as compared to controls as in ours[12]. A study, conducted on patients on dialysis showed that diastolic velocities were 'relatively' independent of preload, did not in another study E velocity was significantly lower in healthy subjects and CKD patients stage II–IV (p<0.01–0.02) compared to stage V and E/A and E' could help to differentiate between healthy subjects and patients with early stage of CKD. In this study, E/A ratio did not differ before and after the dialysis[14]. According to other studies the incidence of diastolic LV dysfunction in CKD ranges from 50% to 65% including patients non-dialysed, those on dialysis and renal transplant recipients where as in our study it was 72%[15]. One study showed that LV diastolic function may influence the increase in left ventricular preload as a result of CKD

progression. Therefore, LV hypertrophy may be a better prognostic factor than the LV diastolic dysfunction in predicting low eGFR in patients with CKD. The increase in diastolic LV dimension observed in this study as well as very high prevalence of CKD-associated diastolic dysfunction may be an indicator of left ventricular volume overload which is due to over-hydration[16]. Chronic effects of HD on LV diastolic function is unclearly. Studies were reported different results: a significant alterations at LV longitudinal myocardial function parameters assessed by color doppler, improved indices for left ventricular diastolic function and did not change Doppler parameters of mitral inflow[17,18]. During ventricular diastole the LA is directly exposed to LV filling pressure. Therefore, increased LA size and volume may reflect the duration and severity of diastolic dysfunction. Effect of HD on LA dimension could be explained by the factors that influence LV filling. Left atrial pressure increases and results in augmented LA dimensions whenever preload increases and/or LV compliance decreases. In patients undergoing HD, the LA parameters reported as a marker of chronic diastolic dysfunction, however some investigators showed that LA parameters were similar in the group of healthy volunteers. The mean LA dimension was significantly higher after HD treatment than base line value. Myocardial velocity was relatively preload independent measurements of diastolic function and more accurately reflects LV diastolic dysfunction. In patients with ESRD, because of the renal anemia, systemic hypertension, volume overload, and the presence of an AVF with high-flow rates, LV systolic and diastolic diameters, wall thickness and cardiac output are increased and indirectly EF is decreased. Several studies have shown that patients with ESRD before and on dialysis had higher LV volumes and dimensions. Increases in LVEDD, LVESD were found after maintenance HD treatment in that study. In that study, 2% decrease in ejection fraction was observed following the HD treatment. In our study, EF decreased[19]. One study, showed that HD treatment was associated with significant reductions in myocardial blood flow. Stress–induced myocardial ischemia occurs in the absence of large-vessel epicardial coronary disease and repetitive episodes of ischemia may lead to LV systolic dysfunction[20]. Another study showed that the long-term effects of HD on LV and RV functions were insignificant in patients with end-stage renal disease. We have demonstrated that the LV and RV functions did not change significantly after long-term HD treatment. But in our study, cardiac dysfunction present[21]. In NP singh study,LVH was 76.92%, 72% diastolic dysfunction was 72% but systolic dysfunction not present in CKD patients[22]. .Agarwal study showed diastolic dysfunction in 60% and systolic dysfunction in 15%, as in our study 72% had mild and moderate diastolic dysfunction[7]. Seventeen cases (48%) had diastolic dysfunction, 11 (29%) systolic dysfunction, 8 (18%) had normal echocardiogram and 2 (5%) had dilated left ventricle with normal ejection fraction[23]. In more than half of the patients increased left ventricle end-diastolic dimension and worsening of diastolic function (shortening of deceleration time, E wave, the increase in E/A) were observed as in our study[24].

There are several limitations of this study. We did not perform any routine follow-up of the patients. Our study was performed on a relatively small population (n=50), but still can be compared to previous studies in the field. The study was shown that there is a need for further studies for cardiac status and prognosis of patients.

CONCLUSION

The present study shows that there is high prevalence of cardiac dysfunction in hemodialysis patients.

CONFLICTOF INTEREST

This study has no conflict of interest to declare by any author.

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