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Prevalence of Echocardiographic Abnormalities in Patients with Chronic Kidney Disease

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ABSTRACT

Objective: To assess the prevalence of systolic and diastolic dysfunction in patients of chronic renal failure on conservative management. **Background:** Cardiovascular disease is the most common cause of mortality in patients with end-stage renal disease. Determining the spectrum of echocardiographic abnormalities in these patients can help the prevention of mortality in this group of chronically ill patients. **Methods:** 100 adult patients with chronic renal failure and 100 healthy controls who underwent echocardiography during November 2008 till March 2009 were enrolled. Complete 2-D, M-mode, Doppler and color Doppler study were performed for each patient and they were recorded. The left ventricular ejection fraction (EF) and fractional shortening (FS) were taken as measures of LV systolic function**.** Diastolic function was determined by measuring E/A ratio by spectral doppler LV inflow velocity. **Results**: The mean age of patients was 50 and 52% were female. The mean age of control was 48 and 54% were female Mean blood urea of patients was 61±.38mg/dl, and mean serum creatinine was 3.8±2.38 mg/dl. Mean blood urea of controls was 24.9600±.86 and serum creatinine of control population was 1.81±3.2. Echocardiographic abnormalities were observed in 93% patients of renal failure. The mean cardiac dimensions were right ventricular diastolic dimension: 18±0.05 mm, inter-ventricular septal dimension: 12±1.2 mm, end diastolic dimension: 52±10 mm, end systolic dimension: 38.79±9.4 mm and ejection fraction: 52±11. Mean ejection fraction was 52%, and ejection fractionless than 50% was observed in 45% patients. Mean fractional shortening was 29% in patients with chronic renal failure and 30% in control population. The mean E/A ratio in CRF group 0.86 and it was 1.2 in control group. **Conclusion:** Echocardiographic abnormalities are very common in patients suffering from renal disease, so periodic echocardiographic examination for diagnosis and treatment of cardiac abnormalities is highly recommended.

Keywords: Echocardiography, chronic renal failure.

INTRODUCTION

Cardiovascular disease is the most common cause of mortality in patient with end-stage renal disease. Unrecognized systolic dysfunction is almost 3 times more common in patients with anemia+CKD, compared with those without and was associated with a significantly higher risk of death and heart failure.[1,2] Patients battling chronic kidney disease face a high risk for stroke and heart disease, alongside blood pressure and cholesterol. Pericardium myocardium and endocardium may be involved in patients with chronic renal failure. Echocardiography should be performed early in the course of CRF and may be valuable in the monitoring of therapy of these patients[3]. Diagnosis of congestive heart failure with concomitant renal failure presents a particular challenge. In the cardiovascular system, left ventricular hypertrophy (LVH) is the most frequent finding.[4] Patients with end-stage renal disease have three key mechanical contributors to congestive heart failure, including pressure overload, volume overload, and cardiomyopathy. Approximately 20% of patients undergoing hemodialysis have a diagnosis of CHF.[3, 5] Mitral annular classification cardiac volume overload, hypertension, and uremic toxins,[1] all affect valve function status in patients with chronic

renal failure. Pulmonary hypertension and pericardial effusion are other common abnormalities in patients suffering from end stage renal disease. Chronic renal failure affects almost every system of the body and results in various functional and structural abnormalities. Cardiac disease is the major cause of death in dialysis population accounting for 40% of deaths.[1] Cardiac disease is frequently noted in individuals around the time of commencement of dialysis, but there is little information on the prevalence and natural history of cardiac function in patients with milder degrees of chronic renal failure. The present study was conducted to assess the prevalence of systolic and diastolic dysfunction by echocardiography in patients with varying degrees of chronic renal failure who had been on conservative management.

MATERIALS AND METHODS

In a six month period 100 adult patients with chronic renal failure who had been on conservative management and 100 healthy controls underwent a clinical observation in our study. Echocardiography was done. Patients were enrolled from November 2008 till March 2009. Patients having chronic renal failure *i.e.* is patients having GFR <60ml per minute, of all ages and from both sex were enrolled in the study. The patients with active infection, with history of coronary artery disease and other cardiac disorders such as valvular heart disease, congenital heart disease, patients on haemodialysis, and patients with history of smoking were excluded from study. Informed consent was taken from all patients participating in the study. All subjects underwent investigations haemoglobin, total and differential white cell count, renal function tests lipid profile, renal ultrasound, chest XRY and 12-lead electrocardiography. All the patients underwent two dimensional, M mode, Doppler and color Doppler echocardiography by SSA-580 nemio XGEcho machine in the left lateral decubitus position, using 3.5 MHz transducer by a consultant physician experienced in echocardiography, in services hospital Lahore.

The left ventricular ejection fraction (EF) was measured as an index of left ventricular systolic function. The left ventricular ejection fraction (EF) was taken as measures of LV systolic function. Diastolic function was determined by measuring E/A ratio by spectral Doppler left ventricular inflow velocity. EF was determined using teicholz method. Demographic data, cardiac risk factors were also recorded. All the data were analyzed by SPSS software, version 16. Chi-square test was applied for comparison of demographic data of study population and student `t' test was applied for comparison between EF, FS and E/A ratio.

RESULTS

Echocardiographically right ventricular size, left atrial size, aortic root diameter, left ventricular internal diameters, cardiac output, left ventricular posterior wall and interventricular septal thickness, ejection time and mitral and aortic peak flow rates were significantly higher in patients with CRF than in controls. The mean age of patients was 50 and 52% were female. Mean blood urea was 61±38.7 mg/dl, and mean serum creatinine was 3.1±2.4 mg/dl. Echocardiographic abnormalities were observed in 93% patients. The mean cardiac dimensions were right ventricular diastolic dimension: 1.89±0.05 cm, inter-ventricular septal dimension: 7.64±1.75 mm, end diastolic dimension 52.01±10 cm, end systolic dimension: 38.79±10.58 cm and ejection fraction: 52±11. Mean Left atrial dimension was 35±4 (Table 1).

Valvular regurgitation mitral regurgitation in 9%, aortic regurgitation in 20% and tricuspid regurgitation in 6% and mitral valve calcification with mild to moderate mitral stenosis was seen in 10% patients. The prevalence of pulmonary hypertension (SPAP>30 mmHg) was 6% and that of pericardial effusion (> mild) was 7%. Dilated cardiomyopathy was observed in 5% of patients, restrictive cardiomyopathy in 1% patients and congestive cardiac failure (CCF) was observed in 8% of patients. Ischemic heart disease was observed in 29% of patients. Left ventricular hypertrophy was observed in 8% of patients (Table 2).

Mean ejection fraction was 52%, and ejection fractionless than 50% was observed in 45% patients (Fig. 1). Mean fractional shortening was 29% in patients with chronic renal failure and 30% in control population (Fig. 2). The mean E/A in CRF group 0.8 and it was 1.2 in control group.

Table 1: Comparison of cases/controls in demographic, biochemical and echocardiography parameters.

	Groups	N	Mean	Std. Deviation	Std. Error Mean	P-value
Age (Years)	Controls	100	48.6000	9.52084	.95208	0.103
	Cases	100	50.8800	10.21514	1.02151	
Haemoglobin (g/dl)	Controls	100	10.0000g/dl	2.08879	.20888	0.990
	Cases	100	9.9960	2.58261	.25826	
White cell count (/mm^3)	Controls	100	3683.13	2456.608	245.66083	0.000
	Cases	100	4780.32	1537.838	153.78381	
Blood urea nitrogen	Controls	100	24.9600	7.83404	.78340	0.000
	Cases	99	61.8889	38.77167	3.89670	
Serum creatinine	Controls	95	1.092	.283	0.0283	0.003
	Cases	99	3.0525	2.35672	.23686	
Left atrial diameter (LAD) mm	Controls	100	32.1600	3.55823	.35582	0.000
	Cases	100	35.8300	4.69269	.46927	
Left ventricular posterior wall diameter (LVPW) mm	Controls	100	7.5500	1.91419	.19142	0.729
	Cases	100	7.6400	1.75534	.17553	
Left ventricular internal dimension in diastoly (LVIDd) mm	Controls	100	48.7900	5.00564	.50056	.007
	Cases	100	52.0100	10.58348	1.05835	
Left ventricular internal dimension in systoly (LVIDs) mm	Controls	100	32.2900	4.42284	.44228	.000
	Cases	100	38.7900	10.94088	1.09409	
Ejection fraction (%)	Controls	100	63.1000	6.37942	.63794	.000
	Cases	100	52.5500	11.43923	1.14392	
E/A ratio	Controls	100	1.2000	.28427	.02843	.660
	Cases	99	.8616	.38537	.03873	
Fractional shortening	Controls	100	30.1100	4.62294	.46229	.339
	Cases	100	29.4000	5.78399	.57840	

Table 2: Echocrdiographic findings in patients with chronic renal failure.

Echocardiographic diagnosis	No.	%
Aortic regurgitation & mitral regurgitation	1	1.0
Calcified aortic valve	5	5.0
Mitral and aortic valve calcification	4	4.0
Mitral valve calcification	4	4.0
Congestive cardiac failure	8	8.0
Dilated myocardiomyopathy	7	7.0
Ischemic heart disease	32	32.0
Left ventricular hypertrophy	8	8.0
Mital regurgitation	2	2.0
Mital stenosis	5	5.0
Normal	7	7.0
Pericardial effusion	7	7.0
Pulmonary hypertension	9	9.0
Restrictive cardiomyopathy	1	1.0
Total	100	100.0

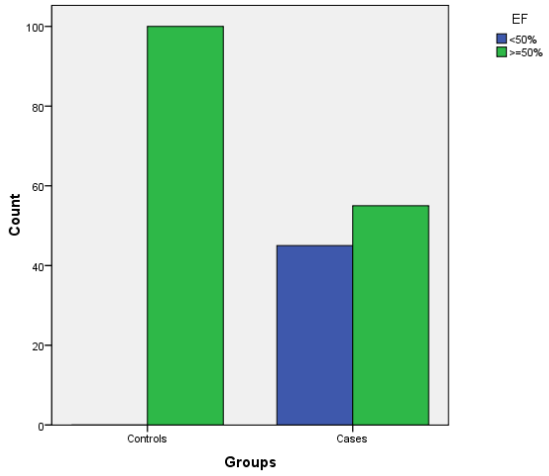

Fig. 1: Ejection fraction in percentage.

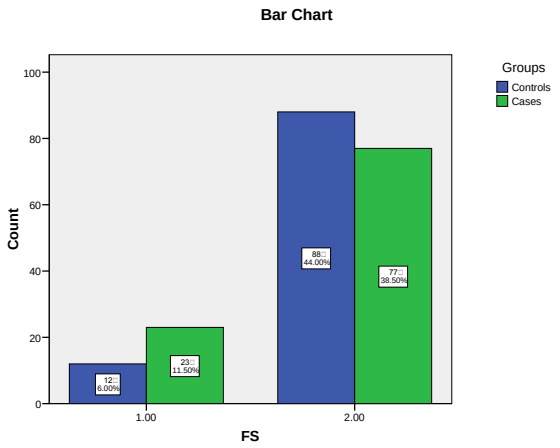

Fig. 2. Fractional shortening.

DISCUSSION

Echocardiographic abnormalities are very common in patients with renal failure. Valvular abnormalities due to uremic toxins, calcification, higher blood pressure, and volume overload and coronary artery disease are seen frequently in many end-stage renal disease patients.[2] Various pattern of heart disease is observed in patients with chronic renal failure. Pericardium myocardium and endocardium may be involved in patients with chronic renal failure. Calcification of myocardium, valves or cardiac skeleton is found in most of patients with end stage renal disease and is caused by derangement in calcium and phosphorus metabolism.[6]

Premature cardiovascular disease is a significant cause of morbidity and mortality among patients with CRF. In a previous study it was found that predialysis mean left ventricular ejection fraction in end stage renal disease (ESRD) patients was 56±2%.[2] In our study it was 52±11%.[7] Thus, these studies suggest that mean left ventricular ejection fraction is well maintained in patients with CRF which was also observed in the present study. They found that left ventricular hypertrophy is common in moderate to severe renal failure, but left ventricular systolic function is generally preserved. Thus, all these studies also show that fractional shortening as a function of left ventricular systolic function is well maintained in patients. It is because of compensatory mechanism to maintain normal mechanical performance within normal limits.[9] Another study showed that 13% of dialysis patients had left ventricular hypertrophy with normal systolic dysfunction.[10] In present study, systolic function was well preserved in patients with chronic renal failure which is in concordance with the previous studies done.[9,10] Diastolic heart function is influenced by numerous factors such as myocardial relaxation and compliance, transvalvular pressure gradient, atria contraction, pre-load, heart rate, passive elastic properties, respiratory variant, the restraint of pericardium and thoracic wall.[11] In the present study, the mean E/A ratio were 0.8. Among the various factors that contribute to diastolic and systolic dysfunction, uncontrolled hypertension and anaemia, which are usually present in CRF, play a significant role. Presence of anaemia and hypertension was also a contributory factor in diastolic dysfunction. In this study, the most frequent valvular abnormality was mitral stenosis observed in 9% of patients while in another study aortic regurgitation was the common abnormality.[8]

The frequency of mild to moderate pericardial effusion was 7%, which is slightly lower to that of previous study in which it was 11%.[20] Pulmonary hypertension was seen in 10% our cases, while 15-20% prevalence is reported by other studies.[13,14] A study in dogs showed pulmonary calcification, increased pulmonary vascular resistance, and right ventricular hypertrophy only in dogs with intact parathyroid glands and with experimental ESRD.[15,16] Endothelin-1, a potent pulmonary vasoconstrictor shown to be involved in primary and secondary pulmonary hypertension, is increased in patients with chronic renal failure.[17,18,19] The frequency of left ventricular systolic dysfunction was higher in patients requiring more hemodialysis sessions per week which might be due to the toxic effect of hemodialysis membrane on myocardial function, or myocardial hibernation. A study provided evidence that uremic serum had a net depressant effect on myocardium.[17] Evidence suggests that subclinical myocardial ischemia develops during hemodialysis. Transient myocardial ischemia may lead to left ventricular systolic dysfunction that can persist despite the return of normal perfusion.[21,22,23] The decrease in left

ventricle end diastolic diameter after haemodilysis result from early decrease in early filling without compensatory increase in atrial contribution to filling.[24] Presence of LVH was associated with an increased risk for future CVE.[21]. A significant reduction in E/A ratio is observed in haemodialysis patients as compared to controls.[2]

CONCLUSION

Echocardiographic abnormalities are very common in patients suffering from renal disease, so periodic echocardiographic examination for diagnosis and treatment of cardiac abnormalities is highly recommended.

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