

Left Ventricular Systolic Dysfunction in Patients with Chronic Kidney Disease

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ABSTRACT

Cardiovascular disease including left ventricular systolic dysfunction is a common complication in patients with chronic kidney disease. However, frequency of left ventricular systolic dysfunction in patients with chronic kidney disease in local population is not known. All patients with chronic kidney disease between ages of 20-80 years who were not yet on hemodialysis or peritoneal dialysis and who were admitted to a tertiary care facility over a 6 month period were included in the study. Left ventricular systolic dysfunction was assessed by 2 D echocardiography. A total of 110 patients were included in the study. Mean age of patients was 50.4±14.2 years. Of all patients, 65(59.1%) were males and 45(40.9%) were females, 94(87%) had hypertension and 74(69.8%) had diabetes mellitus. Mean serum creatinine and mean eGFR were 7.3±3.5 mg/dl and 10.6±9.3 ml/min/1.73 m² respectively. Mean ejection fraction was 54.5±12.9%. Left ventricular systolic dysfunction (EF<55%) was found in 35 (32.4%) patients. Our study showed that a third of patients with chronic kidney disease had left ventricular systolic dysfunction.

Keywords: Left ventricular systolic dysfunction, Chronic Kidney Disease

INTRODUCTION

Chronic kidney disease (CKD) is being increasingly recognized as a leading public health problem worldwide. It is considered to be an under-recognized public health problem in third-world countries like Pakistan^{1,2}. Similarly, the risk factors and the conditions associated with CKD are also under-reported in Pakistan.

Cardiovascular disease contributes towards large proportion of the complications of CKD with left ventricular systolic dysfunction as a common finding³. Left ventricular dysfunction contributes to significant mortality in CKD patients³. Literature regarding its frequency shows wide variation ranging from 8.8% to 30%^{4,5,6,7,8}. There is limited information in local population, with one small study in hemodialysis patients showed a frequency of left ventricular systolic dysfunction as 56%⁹. Patients with CKD in Pakistan seek medical advice at a much later stage due of lack of education, awareness, medical facilities and financial constraints². Therefore; frequency of left ventricular systolic dysfunction in CKD patients in Pakistan may be different compared to the reported literature.

The objective of this study is to determine the frequency of left ventricular systolic dysfunction among patients with CKD presenting to a tertiary care hospital of Lahore.

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METHODS

The study design was cross-sectional in nature. All patients between ages of 20-80 years with CKD not previously on renal replacement therapy (hemodialysis or peritoneal dialysis) and who were admitted to nephrology ward at Sharif Medical City Hospital over a 6 month period were included. Informed consent was obtained from patients. CKD was defined as estimated GFR (eGFR) of less than <60ml/min/1.73m² or persistent proteinuria by urinary dipstick for 3 or more months¹⁰. eGFR was calculated by CKD-EPI formula as follows: $GFR = 141 \times \min(Scr/k, 1)^{\alpha} \times \max(Scr/k, 1)^{-1.209} \times 0.993^{Age} \times 1.018$ [if female], Where Scr is serum creatinine (mg/dL), k is 0.7 for females and 0.9 for males, α is -0.329 for females and -0.411 for males, min indicates the minimum of Scr/k or 1, and max indicates the maximum of Scr/k or 1¹¹. Patients were excluded if they had known valvular heart disease, congenital heart disease, active or recent infection.

Sampling technique was non-probability consecutive sampling. Sample size of 100 was calculated with 95% confidence level, 8% margin of error and taking expected percentage of CKD patients with left ventricular systolic dysfunction as 20%. The study was approved by institutional review board.

Patient's history, medical records and laboratory information were reviewed to obtain data on patient's age, sex, history of hypertension, diabetes mellitus, cardiovascular disease, heart rate, blood pressure, blood hemoglobin, serum creatinine, eGFR and urine protein to creatinine ratio. Cardiovascular disease was defined as known prior history of coronary artery

disease, cerebrovascular disease or peripheral vascular disease based on history and review of prior medical records. 2 D echocardiogram was performed by a cardiologist using Sonoace R7 machine by Samsung. Left ventricular systolic dysfunction was defined as ejection fraction < 55%. Other echocardiographic abnormalities and measurements were recorded as documented by performing cardiologist. A valvular abnormality was defined as presence of either mitral, tricuspid, aortic or pulmonic valve stenosis or regurgitation. Pulmonary hypertension was defined as pulmonary arterial pressure greater than 25mmHg.

Statistical Analysis: Continuous parametric variables were reported as means \pm standard deviation; and categorical variables were expressed as percentages. Categorical variables were compared using the chi-square test, and continuous variables were compared using t-test. All statistical analyses were performed using SPSS 20.0. For all tests, p values of <0.05 were considered statistically significant.

RESULTS

A total of 110 patients were included in the study. Mean age of patients was 50.4 \pm 14.2 years. Of all patients, 65 (59.1%) were males and 45 (40.9%) were females, 94 (87%) had hypertension, 74

(69.8%) had diabetes mellitus, 27 (25.5%) were smokers and 13 (12.4%) had known cardiovascular disease. Mean heart rate, systolic and diastolic blood pressures were 90.4 \pm 13.4 beats/min, 129.8 \pm 29.5 mm Hg and 86.7 \pm 15.9 mm Hg respectively. Mean serum creatinine, mean eGFR and mean urine protein to creatinine ratio were 7.3 \pm 3.5 mg/dl, 10.6 \pm 9.3 ml/min/1.73 m² and 3.8 \pm 4.0 g/g respectively. Of all patients, 90 (84.9%) had stage V CKD, 8 (7.5%) had stage IV CKD and 7 (6.6%) had stage III CKD. Mean ejection fraction was 54.5 \pm 12.9%. Left ventricular systolic dysfunction (EF<55%) was found in 35(32.4%) patients.

Table 1 shows comparison of characteristics of patients with and without left ventricular systolic dysfunction. Patients with left ventricular systolic dysfunction were more likely to be smokers and had lower hemoglobin levels compared to patients with normal left ventricular systolic function.

Table 2 shows frequency of echocardiographic abnormalities other than systolic dysfunction. Segmental wall motion abnormalities and valvular lesions were found in 13.6% of all patients.

Table 3 shows various echocardiographic dimensions in patients with CKD. Mean left ventricular posterior wall diameter was high other dimensions were in normal range.

Table 1: Comparison of characteristics of patients with and without Left ventricular systolic dysfunction (LVSD)

	n=without LVSD (n=75)	n= LVSD (n=35)	P value
Mean Age (years)	51.1 \pm 14.3	48.4 \pm 13.9	0.4
Males (%)	54.8	71.4	0.09
Hypertension (%)	88.7	82.9	0.39
Duration of Hypertension (months)	47.8 \pm 47	62.6 \pm 64.8	0.21
Diabetes Mellitus (%)	71.7	64.7	0.49
Duration of Diabetes Mellitus (months)	110.6 \pm 81.8	107.3 \pm 90.8	0.88
Smokers (%)	18.8	37.1	0.04
History of cardiovascular disease (%)	15.7	5.7	0.21
Mean systolic blood pressure (mm Hg)	131.1 \pm 31.8	127.8 \pm 24.7	0.59
Mean diastolic blood pressure (mm Hg)	88.7 \pm 17.1	83.8 \pm 11.6	0.13
Mean serum hemoglobin (g/dl)	9.2 \pm 1.8	8.3 \pm 1.9	0.02
Mean serum creatinine (mg/dl)	7.6 \pm 3.6	7.3 \pm 3.3	0.72
Mean eGFR (ml/min/1.73m ²)	10.5 \pm 8.4	12.3 \pm 11.6	0.43
Mean urine protein to creatinine ratio (g/g)	3.8 \pm 4	3.8 \pm 4	0.99

Table 2: Frequency of echocardiographic abnormalities other than systolic dysfunction in patients with chronic kidney disease

Echocardiographic abnormalities	Frequency (%)
Valve abnormality	17 (13.6)
Segmental wall motion abnormalities	17 (13.6)
Pericardial effusion	9 (7.2)
Pulmonary hypertension	5 (4)

Table 3: Mean values of echocardiographic dimensions in patients with chronic kidney disease

Echocardiographic dimensions with normal values	Mean values \pm SD (mm)
Left atrium diameter (20-40 mm)	34.9 \pm 8.8
Left ventricular internal systolic dimension (22-37 mm)	22.9 \pm 3.2
Left ventricular internal diastolic dimension (46-55 mm)	46.1 \pm 8.9
Left ventricular posterior wall diameter (7-12 mm)	14.5 \pm 10.6
Right ventricular diameter (9-25 mm)	13 \pm 11.5

DISCUSSION

Our study showed that a third of patients with CKD not on dialysis and who presented to a tertiary care facility had left ventricular systolic dysfunction. To our knowledge, this is likely the first study in Pakistan which has reported the frequency of left ventricular systolic dysfunction in patients with CKD not yet on hemodialysis.

Our study results are consistent with other regional studies. A study by Avijit et al. found that left ventricular systolic dysfunction was found in 30% of patients with CKD (6). Laddha et al. showed a frequency of 24.3% but study was done in exclusively hemodialysis patients (7). Osmani et al found a frequency of 56% in 25 patients, but sample size was small and study was done in hemodialysis patients (9). On the other hand, Nitin et al. showed a frequency of left ventricular systolic dysfunction as 18% in his study of 50 CKD patients (8). Our study has larger number of patients and significantly more patients with advanced CKD which may explain the difference in results.

Pathogenesis of left ventricular systolic dysfunction in patients with CKD is complex and multifactorial (8). Left ventricular hypertrophy and reduced left ventricular systolic function has been attributed to traditional risk factors such as diabetes mellitus, obesity, coronary artery disease and hypertension (12). In addition, non-traditional risk factors including anemia, activation of renin-angiotensin aldosterone axis (13) and sympathetic nervous system (14), inflammation, abnormalities of bone and mineral metabolism (15) and proteinuria (16) also contribute to pathogenesis of reduced left ventricular systolic dysfunction.

In our study, we found that patients with left ventricular systolic dysfunction have more severe anemia and were more likely to be smokers which is its self a risk factor for coronary artery disease. We couldn't find an association between other risk factors like hypertension, diabetes mellitus and proteinuria and left ventricular systolic dysfunction. This may be attributed to higher number of patients with advanced CKD and limited sample size in our study.

Our study has highlighted that left ventricular systolic dysfunction, which is an important predictor mortality in CKD patients, is quite common in our CKD population (3). Our study has several limitations including relative small sample size, single center and cross-sectional study design. In addition, our study included large number of patients with advanced chronic kidney disease who were hospitalized. This may have resulted in over-estimation of frequency of left ventricular systolic dysfunction as hospitalized patients with advanced CKD are more likely to have underlying

cardiovascular disease. However, our study population's characteristics are reflective of patient's profiles in tertiary care facilities in Pakistan.

CONCLUSION

In summary, left ventricular systolic dysfunction is common in hospitalized CKD patients. Clinicians taking care of such patients should consider evaluating them for left ventricular systolic dysfunction. Further studies are needed to see whether early identification and management of CKD patients with left ventricular systolic dysfunction helps in improving outcomes of these patients.

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