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LEFT VENTRICULAR HYPERTROPHY AND DYSFUNCTION IN PATIENTS OF CHRONIC KIDNEY DISEASE

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ABSTRACT

Introduction: CKD prevalence is still growing worldwide confers a higher risk of coronary artery disease, chronic heart failure and/or death independent of conventional cardiovascular risk factors. This study was undertaken to study about left ventricular hypertrophy and dysfunction in patients of CKD, to aid the future efforts that should concentrate on calculation of these well-known contributing factors & to make strategies to prevent cardiovascular problems in CKD patients.

Aim: To study about left ventricular hypertrophy and dysfunction in patients of Chronic Kidney Diseases.

Material and Method: This cross sectional, hospital based study was performed on 50 CKD patients admitted in the Department of General Medicine at Rohilkhand Medical College, Bareilly, UP . Detailed clinical examination and routine investigations including 2D-ECHO were done. The data was collected, computed and was statistically analyzed.

Results: 50 cases were included in our study with the mean age 42.1±16.01 years. The chief complaint was oliguria followed by puffiness of face, weakness, nausea, breathlessness and palpitation. The majority of patients were having severe (stage 5) CKD with 68.0% patients followed by stage 4 CKD with 22.0% patients and the least were of stage 3 CKD with 10.0% patients. Out of 50 patients 28 (56.0%) patients had left ventricular-hypertrophy on echocardiography while 26 (52.0%) on ECG and it was found that LVH showed a progressive rise with increase in severity of renal failure. Hemoglobin was significantly lower in the severe CKD group when compared to the moderate and mild categories. 15 hypertensive patients had LVH while 10 hypertensive patients had no LVH. There was no statistically major difference seen in the age, blood pressure and serum calcium between the three categories of CKD patients while urea (mg/dl), serum bilirubin direct (mg/dl), serum creatinine (mg/dl), serum sodium (m mol/L) and serum phosphate (mg/dl) were statistically significant ($p<0.05$) . 15 diabetic patients had LVH while 12 diabetic patients had no LVH. ECHO parameters like IVS and PWd could be used independently as predictors of LVH.

Conclusions: LVH has a high prevalence in CKD and is a typical feature of CKD-related cardiopathy. The LVH and LV dysfunction progressively increases with increasing severity of chronic kidney disease. Adequate control of blood pressure and anemia is important to forestall the development and progression of CKD, related LVH and other end organ damage. Echocardiography provides a simple, non-invasive investigation that can identify even asymptomatic patients at an earlier stage of CKD.

KEYWORDS :

INTRODUCTION

Chronic kidney disease (CKD) prevalence 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. [1,2,3,4] In CKD patients, left ventricular (LV) diastolic dysfunction occurs frequently and is associated with heart failure (HF) and higher mortality.[5] Other studies demonstrated that CKD severity was the most independent predictor of elevated LV filling pressure and could be responsible for impaired systolic and diastolic functions in predialysis CKD.[6] Left ventricular diastolic dysfunction is observed even in patients with early stages of chronic kidney dysfunction. It was estimated that 15% of patients starting dialysis therapy have systolic dysfunction of the left ventricle while the prevalence of diastolic dysfunction at dialysis inception is much higher. Either systolic or diastolic dysfunction can lead to clinically evident congestive heart failure.[8] Left ventricular systolic dysfunction is often associated with severe CAD and it is a major determinant of prognosis.[9]

The National Kidney Foundation Task Force about CVD in CKD has emphasized the high risk of CVD in patients with CKD, and has identified left ventricular hypertrophy (LVH) and coronary artery disease as the major targets for intervention.[10] LVH is an independent predictor of mortality in dialysis patients[11]. Its prevalence is very high among patients with ES-CKD starting hemodialysis,[12] which suggests that it might be present in a large percentage of patients with CKD since early stages.

LVH is an initially adaptive remodeling procedure normally compensating for the growth in cardiac work subordinate to pressure and/or volume overload. While molecular signals which is necessary, these procedures remain unclear, however, studies have exposed that development of the LVH in answer to increased cardiac workload is more prominent in elderly patients.[13]

Several studies have been carried out about the predialysis prevalence of LVH.[14,15] There were no report in the literature about that topic in the Indian population. Future efforts should concentrate on calculating these well-known contributing factors & to make strategies to prevent cardiovascular difficulties in CKD patients.

Multiple pathophysiologic mechanisms contribute to the development of LVH and CKD in the elderly. Given the negative prognostic impact of these conditions in the elderly, future research should be directed at implementing preventive strategies that interfere with this development and reduce the heavy burden of cardiovascular and renal disease in this growing population.

We hypothesized that LVH may be seen in a significant number of the CKD patients. The percentage of people who developed LVH kept growing with the severity of CKD even though there was no important increase in the BP. Present study is done with purpose to study about left ventricular hypertrophy and dysfunction in patients of Chronic Kidney Diseases (CKD)

MATERIALAND METHOD

This cross sectional, hospital-based study was performed in Department of General Medicine at Rohilkhand Medical College, Hospital, Bareilly, UP on chronic kidney disease (CKD) patients those were found fit according to inclusion criteria were enrolled in our study during the study period.

Inclusion Criteria -

- All patients of chronic kidney disease
- Both male and female patients
- Above 18years of age.

Exclusion criteria –

- Patients below 18 years of age
- Pregnant women
- All cases of acute renal failure
- All known case of Ischemic Heart Disease, Congestive Heart Failure, Rheumatic Heart Disease, Cardiomyopathies and any other cardiac disorders.

Detailed history and clinical examination were performed and laboratory investigations were done after explaining the nature of study and informed written consent taken from the patients. The following investigations were done:

- Blood glucose
- Renal function tests
- Electrolytes
- Urine routine and microscopy
- Electrocardiography (ECG)
- Chest x-ray
- Echocardiography
- Liver Function Test

Microsoft Excel was used in creating the database and producing graphs, while the data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 23 for Windows. Mean and standard deviation (±SD) were used to describe quantitative data meeting normal distribution. Association among the parameters was tested by calculating Pearson's co-efficient of correlation (r) and significance of difference between the groups was tested by unpaired Student's t- test. p values less than 0.05 ($p<0.05$) was considered statistically significant. Risk factors of Left ventricular hypertrophy and dysfunction in patients of Chronic Kidney Diseases was assessed by odd ratio. The sensitivity, specificity and accuracy of diagnostic tools for LVH were done by ROC analysis. A two-sided P-value of <0.05 was considered to indicate statistical significance.

RESULTS

The majority of the patients in present study were of age ranging from 41-66 years with the mean age 42.1±16.01 years with majority of patients being males (32) and remaining females (18). The chief complaint was oligouria (92.0%) followed by swelling (90.0%), weakness (86%), nausea (84%), breathlessness (70%) and palpitation (34%).

In the present study, the majority of patients were having severe (stage 5) CKD (68.0%) followed by stage 4 CKD with 22.0% patients and the least were of stage 3 CKD with 10.0% patients.

Table 1: CKD Stages and their frequency in this study

CKD Stages	GFR Range	Frequency (%)
Stage 1	Signs of mild kidney disease with normal or better GFR; GFR>90%	0 (0.0)
Stage 2	Mild kidney disease with reduced GFR, GFR60-89%	0 (0.0)
Stage 3	Moderate chronic renal insufficiency; GFR 30-59% with proteinuria	5 (10.0)
Stage 4	Severe chronic renal insufficiency; GFR 15-29% with proteinuria	11 (22.0)
Stage 5	End stage renal disease; GFR <15%) with proteinuria	34 (68.0)

In the present study, out of 50 patients 28 (56.0%) patients had left ventricular-hypertrophy on echocardiography while 26 (52.0%) on ECG.

Table 2: Data comparing with severity of CKD with presence of LVH or not on ECHO and ECG

On ECG	LVH (%)	No LVH (%)
Stage 1	0 (0.0)	0 (0.0)
Stage 2	0 (0.0)	0 (0.0)
Stage 3	0 (0.0)	5 (10.0)
Stage 4	6 (12.0)	5 (10.0)
Stage 5	20 (40.0)	14 (28.0)

On ECHO	LVH (%)	No LVH (%)
Stage 1	0 (0.0)	0 (0.0)
Stage 2	0 (0.0)	0 (0.0)
Stage 3	0 (0.0)	5 (10.0)
Stage 4	5 (10.0)	6 (12.0)
Stage 5	23 (46.0)	11 (22.0)

In the present study, it was found that LVH showed a progressive rise with increase in severity of renal failure. It was observed that the LVH progresses with the severity of CKD as total 28 out of 50 patients shown by ECHO to have LVH and out of those 28, 23 were having stage 5 CKD while only 5 were having stage 4 CKD. Similarly, it was observed that the LVH progresses with the severity of CKD as total 26 out of 50 patients shown by ECG to have LVH and out of those 26, 20 (40.0%) were having stage 5 CKD while only 6 (12.0%) were having stage 4 CKD.

Clinical profile correlation with the severity of CKD is described in following table.

Table No. 3 Clinical profile correlation with the severity of CKD

Clinical Profile	Stage 3	Stage 4	Stage 5	p-value
Hemoglobin	9.2±1.38	7.93±2.0	7.35±1.97	0.125
SBP	128.0±43.24	145.45±14.72	146.06±30.88	0.446
DBP	74.0±20.74	83.64±9.24	85.00±21.59	0.507
RBS	177.0±70.04	118.73±79.91	158.59±44.90	0.291
Serum bilirubin TOTAL (mg/dl)	0.73±0.383	1.71±2.59	1.79±3.09	0.738
Serum bilirubin direct (mg/dl)	7.05±15.07	.755±1.26	1.01±1.78	0.028
SGPT (IU/l)	59.8±30.98	140.00±244.21	62.47±70.99	0.214
serum protein	5.54±0.59	5.62±0.564	5.58±0.63	0.962
serum albumin	2.44±0.43	2.58±0.41	2.64±0.50	0.661
SGOT (IU/l)	59.8±44.43	121.36±191.13	54.44±45.69	0.146
Serum alkaline phosphatase (mg/dl)	133.8±47.65	124.45±45.12	119.50±50.10	0.816
Urea (mg/dl)	88.6±27.82	123.82±16.98	255.79±105.68	<0.001
Serum creatinine (mg/dl)	2.4±0.35	3.83±0.95	11.53±4.73	<0.001
Serum sodium (m mol/L)	121.0±7.38	134.36±6.62	131.45±7.58	0.006
Serum potassium (m mol/L)	4.9±1.13	5.25±0.48	4.76±0.86	0.243
Serum Calcium (mg/dl)	7.16±0.55	7.53±0.49	8.90±10.63	0.858
Serum Phosphate (mg/dl)	5.56±0.54	5.73±1.12	7.20±1.77	0.010

The above table shows the association of clinical profile of the studied patients with the stages of CKD and the association was found to be statistically significant in the cases of Urea (mg/dl), Serum bilirubin direct (mg/dl), Serum creatinine (mg/dl), Serum sodium (m mol/L) and Serum Phosphate (mg/dl) ($p<0.05$) . There was no statistically major difference seen in the age, blood pressure and serum calcium between the three categories of CKD patients.

In the present study hemoglobin was significantly lower in the severe CKD group when compared to the moderate and mild categories. There was a higher occurrence of anemia as CKD progresses; Hemoglobin was found to be > 7 gm/dl in all patients in stage 3 CKD and < 7gm/dl in 28% patients in stage 5.

Mean SBP was 144.12±29.58mmHg and DBP was 83.6±19.43mmHg. 15 hypertension patients had LVH while 10 hypertensive patients had no LVH. In our study it was not found statically significant (p value =0.569).

Mean RBS was 167.06±56.81 mg/dl; 15 diabetic patients had LVH while 12 diabetic patients had no LVH, it our study it was not found statically significant (p value =0.945).

In our study the association between ECG (26 out of 50 cases) findings and ECHO (28 out of 50 cases) findings to predict sensitivity; where the sensitivity was found to be 82.14%, specificity 86.36 %, PPV as 88.46% and NPV as 79.17 % with accuracy 84.0%.

Following table shows the Echocardiographic parameters in the study population

Table No. 4: Echocardiographic parameters in the study population

Variables	Mean±SD
EF (%)	49.9±9.92
FS (%)	24.74±5.15
LDID diastolic	4.69±0.29
LDID systole	2.68±0.44
IVS (end diastolic)	1.1±0.19
PWd (end diastolic)	1.1±0.19

left Atrium (cm)	3.08±0.37
Mitral E wave (cm/s)	0.71±0.14
Mitral A wave (cm/s)	0.75±0.07
Mitral E/A	0.96±0.28

In our study we observed that IVS and PWd above 1.05 could be used as cut off to predict the occurrence of LVH in patients with sensitivity 60.7 and specificity 87.4 whereas the cutoff value of left atrium was found to be 2.95 with sensitivity 64.3 and specificity 72.7 while that of ES, FS, LDID systole, LDID diastole, Mitral A wave, Mitral E wave and Mitral E/A wave cut offs to predict the occurrence of LVH were 47.5, 26.0, 2.65, 4.65 and 0.75, 0.70 and 1.01 respectively with sensitivity as 57.1, 46.4, 50.0, 42.9, 53.6, 46.4 and 46.4 respectively. This implies that these parameters other than IVS and PWd could not be used independently used as predictors of LVH.

DISCUSSION

Cardiovascular disease is a main reason of death in the patients with chronic kidney disease (CKD). According to literature the mortality due to cardiovascular events is 10 to 20 times greater than in common population. The left ventricular hypertrophy (LVH) is an independent predictor of mortality in the CKD patients.10 Though there are several studies on cardiovascular illness in the CKD patients, there are rare studies which have looked at cardiovascular disease in Indian CKD patients.

Table 6: Other similar studies for comparison

Study	Year	Sample Size	Inference
Kumar S et al[16]	2014	100	Significant number of CKD patients had LVH and the highest numbers of LVH were found in the severe CKD group
Franczyk-Skóra B et al[17]	2014	118	Many indexes of contractility are used and each of them has imperfections. It appears that TVI, E, E/A and E/E are good tools for the early finding of left ventricular hypertrophy and diastolic dysfunction.
Behera BK et al and Sanjay M[18]	2017	100	Patients with CKD have LVH, which is more marked in patients with severe CKD.
Poulikakos D et al[19]	2014	30	The first time a connection of vascular endothelial dysfunction (ED) with LVH in non-dialysis CKD patients; suggesting but not proving a cause–effect connection.
Dharamraj C et al[20]	2017	100	CKD patients with hypertension and anemia will have more severe LV dysfunction.
Mitsnefes MM et al[21]	2006	25	LVH progresses in children during early stages of CKD.

The majority of the patients in present study were of age ranging from 41-66 years with the mean age 42.1±16.01 years. Minimum age of patient was 18years and maximum age was of 65years. CKD is usually occurred in elder peoples mainly of 5th and 6th decades which shows that as the age increases the prevalence of CKD also increases.

In our study the majority of patients were males (64.0%) followed by females (36.0). This implies that the males are more exposed to the CKD in comparison to females this may be because they are more exposure to outer atmosphere and are more used to smoking and alcohol products.

In the present study, out of 50 patients 28 (56.0%) patients had left ventricular-hypertrophy on echocardiography while 26 (52.0%) on ECG.

In the present study, it was found that LVH showed a progressive rise with increase in severity of renal failure. This is in concordance with the study done by **Dangiri P et al**[22], **Agarwal S etal**[22] **Levin A et al**[23]

In the present study hemoglobin was significantly lower in the severe CKD group when compared to the moderate and mild categories. There was a higher occurrence of anemia as CKD progresses; Hemoglobin was found to be > 7 gm/dl in all patients in stage 3 CKD and < 7gm/dl in 28% patients in stage 5.

There was no statistically major difference seen in the age, blood pressure and serum calcium between the three categories of CKD patients. Similar observation was found by **Kumar S et al**[16] and **Behera BK et al and Sanjay M**[18] in their respective studies. **Dharamaraj C et al**[20] reported that the association was found to be statistically significant.

The parameters other than IVS and PWd could not be used independently used as predictors of LVH.

The high occurrence of the left ventricular hypertrophy in these populations on echocardiography suggests that these patients need proper cardiovascular evaluation despite disappearance of symptoms & also that various efforts aimed at prevention and control of left ventricular hypertrophy should be started early during the course of renal-insufficiency, such as effective control of hypertension and anemia.

CONCLUSION

LVH has a high prevalence in CKD and is a typical feature of CKD-related cardiopathy. The LVH and LV dysfunction progressively increases with increasing severity of chronic kidney disease. Adequate control of blood pressure and anemia is important to forestall the development of CKD, related LVH and other end organ damage. Echocardiography provides a simple, non-invasive investigation that can identify even asymptomatic patients at an earlier stage of CKD.

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