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Cardiac changes in patients of chronic kidney disease

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Abstract

Uremic Cardiomyopathy thought to be the pathological cardiac hypertrophy, indicating the influence of impaired renal function on the myocardium. It is the result of pressure overload, volume overload, and the uremic state itself. LV pressure overload occurs frequently from hypertension and arteriosclerosis, and occasionally from aortic stenosis; LV volume overload occurs as a result of the presence of an arteriovenous fistula, anemia, and hypervolemia. Cardiovascular complications are a major cause of morbidity and mortality in CKD patients, accounting for approximately 50% of deaths. Written informed consent was obtained from all the subjects included in the study. In the present study, 36 cases presented with systolic dysfunction. Among them 6% cases had mild systolic dysfunction, 18% had moderate systolic dysfunction and 12% had severe systolic dysfunction. In the present study 09 cases presented with diastolic dysfunction and 05 cases constituted grade 1 diastolic dysfunction, 04 cases constituted grade II diastolic dysfunction.

Keywords: Cardiac changes, chronic kidney disease, LV pressure

Introduction

The Sympathetic Nervous System activity is increased in CKD, as was demonstrated almost 20 years ago. Afferent signals from the diseased kidney are transmitted to the vasomotor control center in the brain increasing the blood pressure. In addition, increased plasma noradrenaline levels are often high in CKD patients. Evidence for the role of sympathetic nervous system is provided by the fall of blood pressure after renal sympathetic denervation or after bilateral nephrectomy. Dopamine, a precursor of noradrenaline, has a natriuretic effect by inhibiting Na-K-ATPase in proximal tubular segments. Patients with CKD have reduced urinary excretion of dopamine and decreased activity of the renal dopaminergic system, which correlates well with the degree of renal dysfunction. Dyslipidemia is a major risk factor for cardiovascular morbidity and mortality and is common among patients with CKD. Lipid profiles vary widely in these patients, reflecting the level of kidney function and the degree of proteinuria. The prevalence of hyperlipidemia increases as renal function declines, with the degree of hypertriglyceridemia and elevation of LDL cholesterol being proportional to the severity of renal impairment. In the general population, high total cholesterol (TC), high low-density lipoprotein (LDL) cholesterol, high triglyceride, and low high-density lipoprotein (HDL) cholesterol are all well-established risk factors for CVD development. However, CKD, with both dialysis and transplantation, is associated with specific qualitative and quantitative lipid abnormalities, resulting in specific dyslipidemia. Specific abnormalities in the lipoprotein metabolism, caused by an inappropriate activity of some key enzymes and metabolic pathways, develop in the early stage of renal failure and result in dyslipidemia which presents a risk factor for the atherosclerosis development. Along with CKD progression, metabolic abnormalities may progress further, contributing to atherosclerotic changes and adversely affecting renal function. Dyslipidemia is a common complication of CKD and lipoprotein metabolism alteration and is associated with the decline in GFR; hence, lipid profile depends on the level of kidney function and the degree of proteinuria.

Chronic kidney disease (CKD) encompasses a spectrum of different pathophysiologic processes associated with abnormal kidney function and a progressive decline in glomerular filtration rate (GFR) ^[1,2].

Uremic Cardiomyopathy thought to be the pathological cardiac hypertrophy, indicating the influence of impaired renal function on the myocardium. It is the result of pressure overload, volume overload, and the uremic state itself.

LV pressure overload occurs frequently from hypertension and arteriosclerosis, and occasionally from aortic stenosis; LV volume overload occurs as a result of the presence of an arteriovenous fistula, anemia, and hypervolemia [3]. Cardiovascular complications are a major cause of morbidity and mortality in CKD patients, accounting for approximately 50% of deaths.

The three lesions constitutive of the structural remodeling of the myocardium (e.g., cardiomyocyte hypertrophy, myocardial fibrosis, and thickening of the intramural arteries and arterioles) are a constant finding in heart biopsies and necropsy studies in patients with chronic kidney disease (CKD), namely in those with arterial hypertension and left ventricular (LV) hypertrophy [4].

Methodology

- The study was approved by the Institutional Ethics Committee.
- Written informed consent was obtained from the all the subjects included in the study
- Study design: cross sectional study
- Sample size – 100
- Sampling procedure – Simple Random Sampling.

Special investigations

- Special investigations were done on patients with chronic kidney disease.
- Electrocardiography (12 lead ECG): Evidence of left ventricular hypertrophy, low voltage complexes, ischemic changes were looked for in electrocardiogram.
- Echocardiogram done for the evaluation of ventricular mass and volume, and has an excellent accuracy for the detection of hypertrophy, definition of its geometric pattern (concentric or eccentric), and quantification of systolic function

Echocardiography 2D ECHO: and looked for

- Chamber dilation,
- Chamber hypertrophy,
- Ejection fraction,
- Diastolic dysfunction,
- Regional wall motion abnormalities,
- Left atrial enlargement,
- Pericardial effusion,
- Valvular calcification

Results

Table 1: Electrocardiography

ECG Findings	Total	Percentage
Normal	06	06%
Left ventricular hypertrophy	59	59%
LAD	06	06%
Conduction disturbances	16	16%
Ischemia	24	24%
Arrhythmias	10	10%
P-mitrale	05	05%

- In the present study 59% cases showed LVH on ECG.
- Ischemia in 24% cases, Conduction disturbances in 16% cases.
- Arrhythmias in 10% cases, P-mitrale in 05 cases.
- And 6% cases were showing normal study.

Table 2: Echocardiographic abnormalities

2D ECHO	Total	Percentage
Pericardial effusion	06	6%
LVH	59	59%
Dilated LV	09	9%
Dilated LA	03	3%
Systolic dysfunction	36	36%
Diastolic dysfunction	09	9%
RWMA	06	6%
Valvular calcifications	20	20%
NORMAL	06	6%

- In the present study 2D ECHO findings showed LVH as most common abnormality in 59% of cases.
- Next common abnormality noted was Systolic dysfunction in 36% cases.
- Valvular calcifications were seen in 20% cases.
- Diastolic dysfunction and Dilated LV in 9% cases each.
- Pericardial effusion and RWMA in 6% cases each.
- Dilated LA in 3% cases.

Table 3: Systolic dysfunction

Grading of Systolic dysfunction	No. of cases	Percentage
Mild	06	16.6%
Moderate	18	50%
Severe	12	33.3%
Total	36	99.9%

- In the present study, 36 cases presented with systolic dysfunction.
- Among them 6% cases had mild systolic dysfunction, 18% had moderate systolic dysfunction and 12% had severe systolic dysfunction.

Table 4: Diastolic dysfunction

Diastolic dysfunction	No. of cases	Percentage
Grade I	05	55.5%
Grade II	04	44.4%
TOTAL	09	99.9%

- In the present study 09 cases presented with diastolic dysfunction. and 05 cases constituted grade I diastolic dysfunction, 04 cases constituted grade II diastolic dysfunction.

Table 5: Management

Stages of CKD	Management		Total
	Conservative	Dialysis	
Stage II	06	-	06
Stage III	54	-	54
Stage IV	25	05	30
Stage V	-	10	10
Total	85	15	100

- Stage II CKD 06 cases treated by conservative management.
- Stage III CKD - 54 cases were managed conservatively.
- Stage IV CKD - 25 cases were managed conservatively and 05 cases underwent dialysis. Stage V CKD – 10 cases underwent dialysis.

Discussion

In the Present study 32% (32/100) had history of HTN, out of 32 cases. 15 (46.8%), had LVH. Jas Pal Dhamija *et al.*

study ^[5] Majority patients had hypertension 27 (77.14%). In hypertensive group LVH was present in 13 (51%) and 1 patient (8.57%) in normotensive group of 8 patients. Hypertension was present in 27 (77.14%) mainly in age group more than 40 years. Preety Motiyani *et al.* study ^[6] Hypertensive patients had significantly more LVH (74.66%) as compared to non hypertensive (12%) (P=0.012). Patients with Hypertension had higher percentage of diastolic dysfunction (88.67%), RWMA (55.33%) and pericardial Effusion (46%).

In the Present study 43% (43/100) had history of DM, LVH was observed in 37 cases (39.5%). Preety Motiyani *et al.* study ^[6] Non diabetes patients had higher percentage of LVH (60%) and diastolic dysfunction (29.33%) and as compared to diabetes whereas RWMA (40.67%) and Pericardial Effusion (32.67%) were higher among diabetes. Almost all patients in the study had Hemoglobin less than 12g/dl. The lowest value was 7g/dl and the highest was 12g/dl. Mean hemoglobin of 9.8g/dl. Datta *et al.* ^[7] had observed severity of anemia correlated to LVH in patients with CKD.

Present study anemia was observed in all the patients and severe anemia ie, Hb less than 7g/ dl was seen in 20% cases. LVH was present in 18 patients. Jas Pal Dhamija *et al.* study Anaemia was observed in all patients and haemoglobin of less than 10 g% was seen in 21 patients (60%). In a sub group of 21 patients with Hb <10g%, LVH was present in 15 patients (71.42%). Preety Motiyani *et al.* study ^[6] Patients with anemia had higher percentage of diastolic dysfunction (85.33%), LVH (82%), RWMA (54%) and pericardial Effusion (44.67%).

ECG showed evidence of Left ventricular hypertrophy in 59% cases. In a study done by. Satish Sachdeva ^[8] LVH present in 20 out of 60(33.33%). Sharma Manjur ^[9] Electrocardiography of patients revealed LVH in 76%.

Satish Sachdeva ^[8] normal ECG in 15 out of 60 cases of CKD (25%), Left axis deviation in 9 out of 60(15%), Conduction disturbances in 10 out of 60(16.67%), Ischemia in 12 out of 60(20%), Arrhythmias in 2 out of 60(3.33%) and P-mitral was found in 4 out of 60 cases(6.67%). Adarsh L LVH with pressure overload pattern – 90(36%) cases. Low voltage QRS complexes – 43(17.2%) cases. Sinus tachycardia- 135(54%) The mean ejection fraction as found to be 55.21 with standard deviation of 6.13 LVH (left ventricular hypertrophy) 106(42.4%) patients had LVH in echocardiography and ECG. in the present study on 2D echocardiography, LVH was found in 59% of the patients, Satish Sachdeva study ^[8] found LVH in 56.6% of the cases, Jas Pal Dhamija ^[5] has reported LVH in 48% cases, Sharma Manjur reported a incidence of LVH in 84% cases. in a study done by Preety Motiyani ^[6] revealed that LVH in 86.67% patients.

Pericardial effusion was present in 6% of patients in the present study which is comparable to Sharma Manjur *et al.* study ^[9] who found it to be in 20%. in a study done by Preety Motiyani revealed pericardial effusion in 46.67% patients.

Regional wall motion abnormalities suggestive of coronary artery disease (CAD) were found to be in 6 patients by 2D echo. In a study done by Preety Motiyani ^[6] revealed that RWMA in 57.3%.

In our study, diastolic dysfunction (DD) was seen in 9% of patients whereas left ventricular systolic dysfunction

(LVSD) was seen in 36% of patients. LV systolic dysfunction was more common in all stages of CKD.

In the study conducted Sharma Manjur ^[9] Left ventricular systolic dysfunction (LVSD) was found in 52% of patient of which 34% had mild dysfunction (LVEF= 45% -54%) and 18% had moderate dysfunction (LVEF= 35% -44%). Diastolic dysfunction was found in 54% of patient. In a study done by Preety Motiyani ^[6] revealed that diastolic dysfunction were present in 90.67% patients, LVH in 86.67, RWMA in 57.33 and pericardial effusion in 46.67% patients. In the present study 74% cases showed cardiomegaly on chest x ray. 20% cases showed Cardiomegaly with pulmonary interstitial edema. 6% cases were showing normal study on chest x ray. in a study conducted by Adarsh L *et al.* ^[10] chest radiography showed cardiomegaly in 75 patients and others were grossly normal.

Conclusion

- Cardiovascular complications are common in patients with chronic kidney disease, which is an important cause of morbidity and mortality in these patients. The most common morbidity found in this study was left ventricular hypertrophy. Proper cardiac evaluation should be done in all CKD patients so that early intervention can be initiated to decrease the incidence of complications.
- Cardiac structural as well as functional abnormalities are common in patients with ESRD, more so in those with hypertension and anaemia.
- LVH is the commonest cardiac abnormality in ESRD patients, followed by diastolic dysfunction. Both conditions are more marked in hypertensive patients and anaemic patients.

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