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STUDY OF CARDIOVASCULAR ABNORMALITIES IN PATIENTS WITH CHRONIC KIDNEY DISEASE USING ELECTROCARDIOGRAPHY & ECHOCARDIOGRAPHY

Medicine

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ABSTRACT

Background: Chronic Kidney Disease is defined as structural and functional kidney abnormalities lasting over three months and affects about 10% of the population. Patients with chronic kidney disease (CKD) and end-stage renal disease (ESRD) often experience structural and functional abnormalities in the left ventricle, including left ventricular hypertrophy, dilation, and systolic dysfunction. Left ventricular hypertrophy is linked to a higher risk of mortality and sudden cardiac death. Hyperphosphatemia is associated with higher BP and diastolic dysfunction, while excess angiotensin II and high serum aldosterone can lead to cardiac hypertrophy, interstitial fibrosis and arrhythmias.

Objectives

1. To study the Clinical profile and risk factors in patients of chronic kidney disease.
2. To study electrocardiographic findings in chronic renal failure patients.
3. To study the 2D Echocardiographic profile in chronic kidney disease.

Methodology: Hospital based cross-sectional study of 100 patients were done. Chronic kidney disease was diagnosed by detailed history and clinical examination was done in patients, along with following investigations - Urine - PH, Specific gravity, Protein, Sugar, Microscopy. Blood – Hb % , Urea, Creatinine, Electrolyte, Calcium, phosphorous. Ultrasound Abdomen using 3.5 mHz transducer. Specific investigation as Electrocardiography (12 lead ECG) and 2D Echocardiography. **Results:** The commonest finding on ECG was left ventricular hypertrophy noted in 47% of the cases. Echocardiography Concentric LVH was major finding (51%) in the study population. **Conclusion:** The high prevalence of left ventricular hypertrophy in CKD as seen on echocardiography suggests that these patients need thorough cardiovascular testing even in the absence of symptoms. The most commonly available tool electrocardiography is also found useful in screening of the CKD cases for further cardiac evaluation.

KEYWORDS

Chronic kidney disease(CKD) , Cardiovascular disease , Echocardiography, Electrocardiography

INTRODUCTION

Cardiovascular disorders are a leading cause of mortality and morbidity in patients with chronic kidney disease (CKD), particularly those with systemic inflammatory issues like atherosclerosis. CKD is defined as structural and functional kidney abnormalities lasting over three months and affects about 10% of the population. There is a dose-response relationship between CKD and cardiovascular disease (CVD), with all stages of CKD classified as "highest risk" for CVD.(1) While end-stage renal disease (ESRD) patients were previously thought to be 20-30 times more likely to die from CVD, this increased risk now applies to all CKD stages, with higher mortality observed in dialysis patients. The global prevalence of CKD is estimated at 11% to 13%, and its mortality ranking rose from 27th in 1990 to 18th in 2010. Factors contributing to the rising prevalence include aging populations, increased incidence of type 2 diabetes and hypertension, and inadequate early detection and treatment (2). In India, Stage III CKD has the highest prevalence. (3)

Patients with CKD and end-stage renal disease often experience structural and functional abnormalities in the left ventricle, including left ventricular hypertrophy, dilation, and systolic dysfunction. Left ventricular hypertrophy is linked to a higher risk of mortality and sudden cardiac death. This condition reduces capillary density, leading to an imbalance between oxygen supply and demand, which can result in ischemia which triggers a cascade of events, including myocardial apoptosis and interstitial fibrosis, resulting in left ventricle stiffness and diastolic dysfunction.

Myocardial fibrosis further exacerbates ischemia and increases the risk of ventricular arrhythmias and sudden cardiac death. Additionally, coronary artery disease is common among CKD and ESRD patients. Non-hemodynamic factors also contribute to cardiomyopathy and left ventricular hypertrophy in these patients. For instance, hyperphosphatemia is associated with higher blood pressure and diastolic dysfunction, while excess angiotensin II and high serum aldosterone can lead to cardiac hypertrophy, interstitial fibrosis, and arrhythmias.(4)

MATERIAL AND METHODS

Study Design:

For 24 months Prospective observational Study was conducted at OPD/IPD patients of General Medicine & Nephrology Department of Vishwaraj hospital (tertiary care hospital) Pune , who are willing to give consent were enrolled during the study period.

A) Inclusion Criteria:

1. Cases with CKD (2012 KDIGO DEFINITION) irrespective of the etiology.
2. Patient with chronic kidney disease on conservative management and on dialysis.
3. Age more than 18 years.
4. Either Gender
5. Willing to sign an informed consent document

B) Exclusion Criteria

1. Congenital heart disease
2. Renal allograft recipients
3. Primary Cardiomyopathy
4. Pregnancy
5. Use of cocaine, amphetamines or anabolic steroids
6. Use of some chemotherapy drugs and radiation to treat cancer
7. Connective tissue disorders

Study Procedure -

1. Detailed history and clinical examination were undertaken in patients and the following investigations were done with chronic kidney disease

Urine - PH, Specific gravity, Protein, Sugar, Microscopy. Blood – Hb % , Urea, Creatinine, Electrolyte, Calcium, phosphorous. Ultrasound Abdomen using 3.5 mHz transducer. Specific investigation as Electrocardiography (12 lead ECG) and 2D Echocardiography

Sample Size: N = 100

Statistical Analysis:

Data was collected in a predesigned proforma later tabulated in a Microsoft excel sheet and analysed using SPSS software version 20, IBM Corporation .For asymmetric data non parametric tests shall be

used. Chi square test for qualitative data was applied. P value < 0.05 was considered as statistically significant.

RESULTS

1. The commonest finding on ECG was left ventricular hypertrophy noted in 47% of the cases. It was followed by left axis deviation which was noted in 43% cases. ST-T changes were observed in 26 % cases. Atrial flutter and atrial fibrillation were noted in 4% cases each. Pericardial effusion was observed in 1 case whereas 2 % cases showed premature ventricular contraction.

Table No 1 : Findings Of ECG In Study Population.

Finding on ECG	Number	%
Left Ventricular Hypertrophy LVH	47	47
left axis deviation (LAD)	43	43
ST-T changes	26	26
Atrial Flutter	4	4
Atrial Fibrillation	4	4
Pericardial effusion	1	1
Premature Ventricular Contraction	2	2

2. Concentric LVH was major finding (51%) in the study population. 60 % cases presented with diastolic dysfunction whereas 25 % had systolic dysfunction. Pericardial effusion was noted in 4 % cases. Aortic regurgitation was noted in 22 cases while aortic stenosis was found in 6 cases. Mitral regurgitation was noted in 20 cases while mitral stenosis was found in 6 cases. 8 cases were reported to have tricuspid regurgitation.

Table No 2 : Distribution Of Echo Cardio Finding In Study Population.

Finding on ECHO	Frequency	%
Diastolic dysfunction	60	60
Concentric LVH	51	51
Systolic dysfunction	25	25
Aortic regurgitation	22	22
Mitral regurgitation	20	20
Eccentric LVH	16	16
Tricuspid regurgitation	8	8
Aortic stenosis	6	6
Mitral stenosis	6	6
Pericardial effusion	4	4

3. Left ventricular hypertrophy was found to be significantly higher in grade 5 CKD compared to grade 4 and grade 3. (p<0.01)

Left axis deviation was found to be significantly higher in grade 5 CKD compared to grade 4 and grade 3 (p<0.05)

Table No 3 : Comparing The Findings Of ECG Parameters Among The Stages Of CKD

		Grade 5 (n=49)	Grade 4 (n=20)	Grade 3 (n=31)	P
		Number (%)	Number (%)	Number (%)	
Finding on ECG	LVH (N=47)	37 (75.5)	6 (30)	5 (16.1)	<0.01
	LAD (N=43)	20 (46.5)	6 (13.9)	17 (39.5)	<0.05
	Premature Ventricular Contraction (N=2)	2 (4.1)	0 (0)	0 (0)	>0.05
	Pericardial effusion (N=1)	1(2.1)	0 (0)	0 (0)	>0.05
	Atrial Flutter (n=4)	2 (4.1)	2(10)	0 (0)	>0.05
	Atrial Fibrillation (n=4)	2 (4.1)	2(10)	0 (0)	>0.05
	ST-T changes (n=26)	14(28.6)	5(20)	7(22.6)	>0.05

Table No 4: Comparing The Findings Of Echocardiography Diagnoses Among The Stages Of CKD.

Particulars	Grade 5 (n=49)	Grade 4 (n=20)	Grade 3 (n=31)	P
	Number (%)	Number (%)	Number (%)	
Concentric LVH (N=51)	37(75.5)	10 (50)	4 (12.9)	<0.01
Eccentric LVH (N=16)	8(16.3)	3(15)	5(16.1)	>0.05
Diastolic dysfunction (N=60)	33(67.3)	11(55)	16 (51.6)	>0.05
Systolic dysfunction (N=25)	14(28.7)	5 (25)	6 (19.4)	>0.05
Pericardial effusion (N=4)	3 (6.1)	1(5)	0 (0)	>0.05
Aortic regurgitation (N=22)	14 (28.6)	5 (25)	3 (9.7)	<0.05
Aortic stenosis (N=6)	4 (8.1)	0 (0)	2 (6.4)	>0.05
Mitral regurgitation (N=20)	15 (30.6)	3(15)	2 (6.4)	<0.05
Mitral stenosis (N=6)	4 (8.1)	0 (0)	2 (6.4)	>0.05
Tricuspid regurgitation (N=8)	6 (12.2)	1(5)	1 (3.2)	>0.05

4. Concentric Left ventricular hypertrophy was found to be significantly higher in grade 5 CKD. (p<0.01) however eccentric LVH was comparable.

Aortic regurgitation (N=22) and Mitral regurgitation (N=20) were significantly higher in grade 5

DISCUSSION

- In our study, we found that 60% of patients had diastolic dysfunction, 25% had systolic dysfunction, 51% of patients had concentric LVH and 4% patients had pericardial effusion.
- A common sign of CKD-related cardiopathy is LVH 51(51%). Patients with interventricularseptal thickness more than 1.1 cm and the Relative wall thickness [RWT = PWD + IVSD / LVIDD], greater than 0.45 was taken as the criteria to diagnose concentric left ventricular hypertrophy.
- LVH causes left ventricular dysfunction, which constricts the renal arteries, reduces blood flow to the glomeruli, alters the glomerular membrane filtration coefficient, and induces tubular reabsorption. The LVH-related inflammatory response also hastens the development of CKD. (10) Therefore, it seems that LVH is a kind of unfavourable cardiac remodelling that raises the chance of developing CKD.
- Eccentric left ventricular hypertrophy (LVH) is primarily caused by increased filling pressure in the left ventricle, often seen in conditions like aortic or mitral regurgitation and dilated cardiomyopathy. Key factors contributing to this condition include intravascular volume expansion from salt and fluid overload, secondary anemia, and arteriovenous fistulas, which lead to myocardial cell lengthening and asymmetric remodeling of the left ventricle.
- In our study the commonest finding on ECG was left ventricular hypertrophy noted in 47% of the cases. It was followed by left axis deviation which was noted in 43% cases. ST-T changes were observed in 26 % cases. Atrial flutter and atrial fibrillation were noted in 4% cases each. Pericardial effusion was observed in 1 cases whereas 2 % cases showed premature ventricular contraction.
- In this study, the diagnosis of left ventricular hypertrophy (LVH) in 67 cases through echocardiography, as opposed to only 47 cases via ECG, underscores echocardiography's superiority for assessing cardiovascular abnormalities in chronic kidney disease patients; however, despite its specificity, echocardiography is deemed insensitive, with potentially inadequate criteria for excluding LVH, and its accuracy is influenced by the operator's skills, the patient's acoustic windows, and imaging errors, especially in cases of asymmetric left ventricular geometry.
- While on Echocardiography Concentric LVH was major finding (51%) in the study population. 60 % cases presented with diastolic dysfunction whereas 25 % had systolic dysfunction. Pericardial effusion was noted in 4 % cases.

CONCLUSION

The high prevalence of left ventricular hypertrophy in chronic kidney disease cases as seen on echocardiography suggests that these patients need thorough cardiovascular testing even in the absence of symptoms. Additionally, early intervention in the course of renal insufficiency is recommended for a number of initiatives aimed at preventing and controlling left ventricular hypertrophy, including effective management of hypertension and anemia. Echocardiography was found superior diagnostic tool in identifying various anatomical and functional abnormalities in CKD patients. However the most commonly available tool electrocardiography is also found useful in screening of the CKD cases for further cardiac evaluation.

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