

**Electroencephalographic and Echocardiographic Evaluation in Cases with Chronic Kidney Disease (CKD)****P. Aswini Kumar<sup>1</sup>, K. Krishna Prabhakar<sup>2</sup>, S. Ananth Kumar<sup>3</sup>**<sup>1</sup>Associate Professor, Department of General Medicine, Apollo Institute of Medical Sciences and Research, Jubilee Hills, Hyderabad<sup>2</sup>Associate Professor, Department of General Medicine, Apollo Institute of Medical Sciences and Research, Jubilee Hills, Hyderabad<sup>3</sup>Associate Professor, Department of General Medicine, Apollo Institute of Medical Sciences and Research, Jubilee Hills, Hyderabad

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**Abstract:****Introduction:** Cardiovascular abnormalities, including left ventricular hypertrophy (LVH), dilatation, and impaired systolic and diastolic functioning of the left ventricle, are the main factors leading to illness and mortality in people with chronic kidney disease (CKD). Cardiovascular issues are the leading cause of mortality in individuals with chronic kidney disease, accounting for around 50% of deaths. The objective of this study was to identify changes in electrocardiograms and echocardiograms in persons with chronic renal disease.**Materials and Methods:** A source of 60 adults, aged 21 years and above, who had clinical symptoms characteristic of chronic renal illness, were included. Each participant underwent electroencephalogram (EEG) and echocardiography to assess cardiac structural and functional parameters**Results:** The majority of participants were between the ages of 51 and 60 (35%), with a higher number of males. 35% of patients had left ventricular hypertrophy on ECG results, whereas 30% showed ischemia, 8.33% had conduction abnormalities, 6.67% had left atrial dysfunction, 3.33% had arrhythmia, and 1.66% had ventricular fibrillation. Echocardiography identified left ventricular hypertrophy in 38.33% of cases, pericardial effusion in 11.67%, diastolic dysfunction in 10%, calcified valves in 6.67%, regurgitation in 6.67%, systolic dysfunction in 3.33%, and ischemia in 3.33%.**Conclusion:** Electrocardiography (ECG) and echocardiography (Echo) are crucial in assessing the cardiac structural and functional aspect, as well as determining the level of risk for future prognosis. Regular echocardiographic screening is strongly advised for the detection and treatment of cardiac abnormalities in individuals with chronic kidney disease.**Keywords:** Electrocardiography, Echocardiography, Chronic kidney disease, Left ventricular hypertrophy.This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Chronic kidney disease (CKD) affects almost 700 million people worldwide, making it a significant but sometimes overlooked source of illness and premature deaths [1,2]. CKD often presents with no symptoms and lacks obvious clinical signs, particularly during the early stages of the illness. The burden of morbidity is greatly increased by delayed diagnosis and poor patient identification of the disease [3,4].

Timely identification has the ability to alter the course of the illness. Hypertension and diabetes are the primary aetiologies of chronic kidney disease, and they may potentially be ameliorated or managed. Timely identification of CKD is important to prevent the need for renal replacement treatment [5,6]. Left ventricular hypertrophy is a

prevalent structural cardiac abnormality seen in people with chronic kidney disease. LVH greatly raises the likelihood of myocardial ischemia, heart failure, and serves as a powerful indicator of mortality in individuals with chronic kidney disease (CKD) [7].

Performing laboratory analysis on serum and urine is a non-invasive approach to diagnosing CKD. Electrocardiograms are affordable, non-intrusive, easily accessible, and quick diagnostic procedures that are often performed at regular check-ups, before physical activity, before surgery, and for individuals with a higher likelihood of developing cardiovascular disease [8]. Abnormalities of ECG that occur in late-stage CKD patients can be independently estimate future CVD and risk of

sudden death. Echocardiography is a gold standard diagnostic modality for the determination of cardiac structural and functional abnormalities [9].

Echocardiogram allows for the evaluation of ventricular wall thickness, IVS thickness, chamber volume, and has an excellent accuracy for the detection of hypertrophy, and assessment of systolic function [10]. Therefore, the present study was designed to evaluate ECG and echocardiographic parameters in patients of chronic kidney disease.

### Materials and Methods

This cross-sectional research was undertaken at the Department of General Medicine at Apollo Institute of Medical Sciences and Research, located in Jubilee Hills, Hyderabad. The study took place from January 2023 to December 2023.

A total of 60 individuals exhibiting clinical symptoms indicative of chronic renal disease were included in the study. Included in the study were individuals who were 21 years of age or older, had chronic kidney disease and were undergoing dialysis, and had a glomerular filtration rate ranging from 30 to 59 ml/min. Patients who had Valvular Heart disease, congenital heart disease, coronary artery disease, pulmonary problems, were

on medication for systemic hypertension, and were not willing to participate were excluded from the study. Research participants provided written informed permission and the research procedure was approved by the institutional ethics committee.

All patients had abdominal ultrasonography (USG) and a comprehensive hemogram, which included fasting blood sugar (FBS), peripheral blood smear (PBS), haemoglobin (Hb), serum creatinine, blood urea, electrolytes, and other relevant laboratory procedures. The individual had a 12-lead ECG and a comprehensive transthoracic echocardiography (ECHO) and Doppler assessment utilising the Vivid S5 High Performance Echocardiography equipment from GE Medical System. The Modified Simpson's approach was used to calculate the end-diastolic volume (EDV), end-systolic volume (ESV), and ejection fraction (EF). An ejection fraction (EF) below 50% was considered abnormal. The collected data was analysed by using SPSS version 29.0. Categorical variables were represented in frequency and percentages. Comparative analysis was performed by Chi-square test and  $p < 0.05$  was considered as statistically significant.

### Results

**Table 1: Demographic and clinical profile of study participants**

Demographic variables	Total no of cases (n=60)	
	Frequency	Percentage
<b>Age</b>		
21-30	04	6.66%
31-40	09	15%
41-50	16	26.6%
51-60	21	35%
>60	10	16.6%
<b>Gender</b>		
Female	16	26.7%
Male	44	73.3%
<b>CKD stage</b>		
Stage II	02	3.33%
Stage III	36	60%
Stage IV	14	23.3%
Stage V	08	13.3%
<b>Duration of condition (in months)</b>		
<12	10	16.6%
13-36	38	63.3%
>36	12	20%
<b>Associated comorbidities</b>		
Hypertension	30	50%
Diabetes mellitus	14	23.33%
IHD	16	26.67%

**Table 2: Laboratory profile of study participants**

Parameters	Total no of cases (n=60)	
	Frequency	Percentage
<b>Hemoglobin (g/dl)</b>		
<10	23	38.33%
11-14	34	56.67%
>14	03	0.5%
<b>Creatinine (mg/dl)</b>		
<2.5	16	26.67%
2.6-5.0	31	51.67%
>5	13	21.66%
<b>Total cholesterol (mg/dl)</b>		
<200	07	11.67%
200-300	48	80%
>300	05	8.33%
<b>Urea (mg/dl)</b>		
<50	04	6.67%
51-100	24	40%
101-150	19	31.67%
>150	13	21.66%
<b>Triglycerides</b>		
<100	-	-
100-200	21	35%
>200	39	65%

**Table 3: Electrocardiographic findings of study participants**

ECG findings	Total no of cases (n=60)	
	Frequency	Percentage
Left ventricular hypertrophy (LVH)	21	35%
LAD	04	6.67%
Conduction disturbances	05	8.33%
Ischemia	18	30%
Arrythmia	02	3.33%
VPC	01	1.66%
Normal	09	15%

**Table 4: Echocardiographic changes in the study participants**

Echo findings	Total no of cases (n=60)	
	Frequency	Percentage
Left ventricular hypertrophy (LVH)	23	38.33%
Pericardial effusion	07	11.67%
Diastolic dysfunction	06	10%
Systolic dysfunction	02	3.33%
Ischemia	02	3.33%
Calcified valves	04	6.67%
Regurgitation	04	6.67%
Normal	12	20%

**Table 5: Comparison of ECG and Echo changes among study participants**

Changes	Stages of CKD				p-value
	Stage II (n=2)	Stage III (n=36)	Stage IV (n=14)	Stage V (n=08)	
<b>ECG</b>					
Present	01 (1.66%)	31 (51.67%)	12 (20%)	07 (11.67%)	0.001
Absent	01 (1.66%)	05 (8.33%)	02 (3.33%)	01 (1.66%)	
<b>Echo</b>					
Present	01 (1.66%)	31 (51.67%)	10 (16.67%)	06 (10%)	0.001
Absent	01 (1.66%)	05 (8.33%)	04 (6.67%)	2 (3.33%)	

## Discussion

Patients with renal failure often exhibit subclinical cardiac abnormalities, including myocardial fibrosis and left ventricular hypertrophy, even in cases of moderate impairment [11]. Within a cohort of individuals from a specific community, there was a clear correlation between decreased estimated glomerular filtration rate (eGFR) and the presence of albuminuria.

This correlation was shown to be linked to an elevation in the levels of cardiac biomarkers, including troponin T and I, which are indicative of cardiac injury [12]. Within the same group, variations in these cardiac biomarkers were linked to ECG abnormalities that indicate potential injury to the heart [13]. Cardiovascular mortality was shown to be associated with ECG abnormalities in the later stages of CKD [14]. This study was designed to assess the ECG and Echo changes in cases with chronic kidney disease.

According to Kaliya M et al., 68% of the patients were between the ages of 40 and 80, with a higher number of males [15]. In a study by Pathak A et al., the researchers noted that the average age of the participants was 69.1 years, and there was a higher percentage of males (56%) in the study group [16]. A study by Lahariya D et al., noted that the majority of patients were between the age ranges of 51-60 years, accounting for 23% of the total [17]. In the current research, the majority of participants fell within the age range of 51-60 years, accounting for 35% of the total.

This was followed by the age range of 41-50 years, which accounted for 26.6% of the participants. The prevalence of men (73.3%) was higher than that of females. The majority of individuals were found to have stage III chronic kidney disease (CKD), accounting for 60% of the total. This was followed by stage IV CKD, which was reported in 23.3% of participants, and stage V CKD, which was seen in 13.3% of people. Approximately 63.3% of patients had chronic kidney disease (CKD) for duration of 13-36 months, while 20% had CKD for more than 36 months. The remaining 16.6% of cases had CKD for less than 12 months. The most often seen comorbidity was hypertension, affecting 50% of the cases. This was followed by ischemic heart disease (IHD) at 26.67% and diabetes mellitus at 23.33% (Table 1).

Sachdeva S et al. discovered that out of 60 instances of chronic kidney disease (CKD), 25% had a normal electrocardiogram (ECG), 33.33% had left ventricular hypertrophy, 15% had left axis deviation, 16.67% had conduction problems, 20% had ischemia, 3.33% had arrhythmias, and 6.67% had percutaneous mitral valve. Left ventricular hypertrophy (LVH) was the most common electrocardiogram (ECG) abnormality seen in

patients with chronic kidney disease (CKD), occurring in 33.33% of cases.

Left ventricular hypertrophy (LVH) was the most common abnormality seen on echocardiography in the CKD patients analysed (56.67%), followed by diastolic dysfunction (38.13%) [18]. Jameel FA et al. found that hypertrophy, left ventricular dysfunction, and diastolic dysfunction were present in a large percentage of patients [19]. Mulia Eka PB et al. discovered that out of 191 patients, 74.9% were anaemia, 58.1% were hypertensive, and 39.3% were diabetic. The most prevalent abnormalities seen in electrocardiograms (ECGs) were a prolonged QTc interval (36.6% of cases), a fragmented QRS complex (29.8% of cases), inadequate R wave progression (24.6% of cases), a peaked T wave (22.0% of cases), and left ventricular hypertrophy (16.7% of cases) [20]. In a similar vein, the electrocardiogram results revealed left ventricular hypertrophy in 35% of cases, ischemia in 30%, conduction abnormalities in 8.33%, left atrial dysfunction in 6.67%, arrhythmia in 3.33%, and ventricular fibrillation in 1.66% of cases. On the other hand, 15% of instances had normal results (Table 3).

In this study, the echocardiography revealed the left ventricular hypertrophy in 38.33% of the patients: followed by pericardial effusion (11.67%), diastolic dysfunction (10%), calcified valves (6.67%), regurgitation (6.67%), systolic dysfunction (3.33%), and ischemia, (3.33%). However, 20% of the participants had normal Echo results. In 42% of subjects, Agarwal S et al. found LVH, and in 40%, they found diastolic dysfunction [21]. Echo alterations were also more common in the severe CKD group than in the mild/moderate CKD group. Echocardiography showed left ventricular hypertrophy (LVH) in 17 patients (48%), systolic dysfunction in 10 patients (28.57%), and pericardial effusion in 6 patients (17.14%), according to the research by Shivendra S et al. [22].

Another study by Ahmed HA et al. found that a significant number of haemodialysis patients had echocardiographic alterations, with left ventricular hypertrophy being the most common at 80% and diastolic dysfunction at 53.3% [23].

Patients with chronic kidney disease can have heart problems. Therefore, these patients, particularly those with diabetes, hypertension, and CKD, should have ECG and Echo scans at regular intervals. Reducing cardiac-induced morbidity and mortality in CKD patients may be achieved by early detection and treatment of cardiac abnormalities.

## Conclusion

Electrocardiography and echocardiography are non-invasive diagnostic techniques that may be used to detect cardiovascular illness at an early

stage in chronic kidney disease (CKD). The most often seen anomaly was left ventricular hypertrophy, with diastolic dysfunction being present in almost one-third of the cases.

Based on the aforementioned results, the current research suggests that patients with CKD should have frequent electrocardiographic and echocardiographic examinations to diagnose and treat cardiac problems in a timely manner.

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