

## THE STUDY OF ELECTROCARDIOGRAPHIC AND ECHOCARDIOGRAPHIC CHANGES IN CHRONIC KIDNEY DISEASE PATIENTS

<sup>1</sup>Dr. Ajeet Kumar Singh, <sup>2</sup>Dr. Barun Kumar Kundu

<sup>1</sup>Associate Professor, Department of General Medicine, Madhubani Medical College, Madhubani, Bihar

<sup>2</sup>Assistant Professor, Department of General Medicine, Madhubani Medical College, Madhubani, Bihar

### Corresponding Author

**Dr. Barun Kumar Kundu** Assistant Professor, Department of General Medicine, Madhubani Medical College, Madhubani, Bihar

Article Received:02-04-2025

Article Accepted:18-05-2025

©2025 Biomedical and Biopharmaceutical Research. This is an open access article under the terms of the Creative Commons Attribution 4.0 International License.

### ABSTRACT

**BACKGROUND:** In people with CKD, cardio-vascular disease (CVD) is the primary risk factor for morbidity and mortality. This elevated CVD risk may begin in the initial stages of CKD, well before renal failure develops. **AIMS & OBJECTIVE:** Our study aim is to identify Echocardiography changes in patients with chronic kidney disease. **MATERIALS AND METHODS:** After obtaining institutional ethical committee clearance from the institute, study was carried out in out-patient department of General Medicine in Madhubani Medical College, Madhubani, Bihar were included in the study. The study was done for a period of 1 year from November 2022 to October 2023. Study population: A pre-designed study pro-forma was filled in relevant investigations and clinical assessments were carried out in all cases. A total of 112 subjects were included by random sampling method. All patients had a 12 lead ECG as well as comprehensive Trans-thoracic echocardiography (ECHO) and 2d Doppler evaluation by using GE Medical System's Vivid S5 High Performance Echocardiography machine. The end diastolic volume (EDV), end systolic volume (ESV), and ejection fraction (EF) were calculated using Modified Simpson's approach. An EF of 50% was considered abnormal. **RESULTS:** In this study, ECG abnormalities were found in 24 patients (48%). LVH was seen in 10 patients (20%). 5 patients had a left axis deviation (10 percent). In 5 patients (10%) conduction abnormalities were observed. 6 patients showed signs of ischemia (12 percent). One patient had an arrhythmia (2 percent). Hypertension was present in all LVH patients. In 3 individuals, left axis deviation (LAD) was associated to LVH (6 percent). Two individuals (4 percent) with serum potassium levels  $>5.5\text{mEq/L}$  showed signs of hyperkalemia. One patient had atrial fibrillation. Three patients (6 percent) had left bundle branch block, whereas two had right bundle branch block (4 percent). **CONCLUSION:** From our study it can be concluded that the most prevalent morphological abnormality was left ventricular hypertrophy. Patients on hemodialysis were vulnerable to conduction abnormalities. The most prevalent cardiovascular abnormality observed was left ventricular dysfunction. Conduction disturbances were more easily spotted with ECG. Myocardial ischemia was more detected with echocardiography. To diagnose LVD, 2d-ECHO was more reliable than any other diagnostic method.

**Keywords:** Chronic kidney disease, electrocardiography and left ventricular hypertrophy.

### BACKGROUND

CKD has emerged as a major public health problem globally in the past decade [1]. The major reasons being rapidly increasing worldwide incidence of diabetes and hypertension [2,3]. Presence of CKD or multiple risk factors associated with it has been shown to confer an increased propensity of developing cardiovascular (CV) diseases, thus leading to increased morbidity, mortality and rate of hospitalization. ECG abnormalities are quite common in patients with CKD and they independently predict future CV events [4]. Though the prevalence of different ECG abnormalities varies widely in different studies described in literature, of them concluded that resting ECG abnormalities are common in hospitalized CKD patients [5-7]. Also, sudden cardiac death has been accounted for approximately 60% of cardiac-related deaths in patients undergoing dialysis [6]. Common ECG parameters that are automatically recorded during standard ECG acquisition can be considered as independent risk markers for CV death and thus increases the chance of predicting fatal outcomes in CKD patients. Also ECG bears a low cost and the facility is widely available, even at most

of the primary care centres. Thus, prior and regular use of ECGs amongst individuals with CKD may positively impact the outcome of CV risk reduction strategies in CKD patients [4]. With this background, it appeared logical and essential to study ECG changes and their comparison in different stages in CKD patients, which was lacking in western Indian population.

#### **AIMS and OBJECTIVE:**

Our study aim is to identify Electrocardiographic and Echocardiography changes in patients with chronic kidney disease.

#### **MATERIALS AND METHODS:**

The study is cross sectional study and was conducted in patients with CKD admitted in Madhubani Medical College and Hospital, Madhubani, Bihar.

This single centre prospective observational study included adult patients admitted in Medicine Wards or Intensive Care Units in a Tertiary Care Centre and diagnosed to have Chronic Kidney Disease (CKD) over a period of one year. Approval from the Institutional Ethics Committee was obtained prior to initiation of the study.

**SAMPLES OF THE STUDY-** The study was carried out among 112 patients of age 25 years and above up to the age of 55years.

**STUDY DURATION:** November 2022 to October 2023

**Inclusion criteria:** This study is cross sectional study.

All individuals aged between 25 to 55 years, of either gender, who fulfilled the definition of Chronic Kidney Disease as laid down by KDIGO (Kidney Disease Improving Global Outcome) 2012 guidelines or were diagnosed as a case of chronic kidney disease as per history, clinical examination and available investigations.

- Patient or his/her Legally Accepted Representative (LAR) willing to give written informed consent.

The following criteria were used in the selection of cases.

- 1) Patients with GFR of 30-59 ml/min and/or
- 2) On abdominal ultrasound, patients with bilateral contracted kidneys and poor cortical medullary differentiation.
- 3) Patients with established chronic kidney disease, regardless of the aetiology.
- 4) Patients with known valvular heart disease, coronary artery disease, or systemic hypertension on regular medication were excluded, as were those with impaired pulmonary function.

All patients underwent a detailed history of illness, with a particular emphasis on cardiovascular symptoms, and a comprehensive clinical examination. Blood biochemical analyses, electrocardiograms, abdominal ultrasonography, and a complete hemogram were conducted. To minimize observer variation, all patients underwent echocardiography by a single echocardiography

#### **• Exclusion criteria**

- Individuals with valvular Heart Disease, Congenital Heart Disease, Acute Coronary Syndrome or known case of Ischemic Heart disease.

**STATISTICAL ANALYSIS:** The collected data was analyzed using the Statistical Package for Social Sciences (SPSS) version 20.0. Appropriate statistical tests were used.

#### **RESULTS:**

In the study, majority of patients were in CKD stage 1 (33.03%), followed by those in stage 4 (27.68%) and 2 (25.0%). Very few patients were in stage 5(6.26%).

**Table 1: Distribution of patients as per stage of kidney disease**

Stage of kidney disease	Frequency	percentage
1	37	33.03
2	28	25.0
3	09	8.03
4	31	27.68
5	07	6.26
<b>TOTAL</b>	<b>112</b>	<b>100</b>

In all patients, ECG abnormalities were present in (58.5%) patients. The most common ECG abnormality observed in CKD patients was left ventricular hypertrophy seen in 42 (21.8%) patients followed by ST depression in 38 (19.7%) patients, while the least observed ECG abnormality was QRS duration >120 ms in 4 (2.1%) patients.

**Table 2: ECG abnormalities in all CKD patients**

ECG abnormality	Frequency	Percentage
Left ventricular hypertrophy	42	37.5
ST depression	36	32.14
Primary T wave inversion	34	30.35

Ventricular rate increased with increase in CKD stage. Atrial fibrillation was observed in 2 (4%), 5 (21.7%) and 2 (2.8%) patients in CKD stages 2, 4 and 5, respectively. VPCs or APCs were observed in 4 (9.3%), 3 (13%) and 17 (23.9%) patients in CKD stages 1, 4 and 5, respectively. P wave morphology was normal in all patients, except in patients with atrial fibrillation in whom P wave was absent. Low QRS voltage was observed in 6 (26.1%) and 5 (7%) patients in CKD stages 4 and 5, respectively.

## DISCUSSION

Chronic renal failure is a group of signs and symptoms referred to as uremia. It can manifest with symptoms consistent with involvement of any organ in the body. The current study focuses on cardiac involvement in chronic kidney disease. In 65% of cases, electrocardiograms revealed evidence of LVH with or without strain pattern. In 18% of cases, low voltage complexes are present. In 23% of cases, there are isolated ventricular premature complexes. In 29% of cases, there is no specific ST – T changes. The electrocardiogram will reveal the presence of left ventricular hypertrophy and previous ischemic events. It is a sensitive indicator of hyperkalemia's cardiac effects. Echocardiography is required for a more precise assessment of LV function and hypertrophy. In the case of cardiac arrhythmias, their episodic nature complicates their identification and characterization. 24 hour Holter monitoring and serial 12-lead ECGs is ideal for detecting ECG changes and cardiac arrhythmias in patients with chronic kidney disease. Sustaining supraventricular tachyarrhythmia's is uncommon, but ventricular premature complexes and ventricular tachycardia are common. In all cases, echo revealed cardiac abnormalities.

### Chamber Dilatation

- 24% of patients showed dilated LVH.
- 46% of patients showed concentric LVH. In our study patients who have had long standing H/O Hypertension, show concentric LVH.
- The only major determinant of LVH in our study was the blood pressure burden.
- It correlates with the Hartnett et al study on impact of hypertension on cardiomyopathy, morbidity, mortality in ESRD.
- The concentric LVH includes Intra ventricular septal thickness in End Diastole. Anaemia is an important determinant of End Diastolic Diameter.
- In our study the average Haemoglobin level was relatively 6 -7 gm%. LA enlargement was not a frequent finding in our study. It is thought to be due to diastolic dysfunction due to LVH.
- Valves • Aortosclerosis and Calcification of the Posterior Mitral Annulus are found in 22% of patients in our study group.
- Age, duration, and hyperparathyroidism have been cited as prime determinants of valvular calcification.
- Myocardial fibrosis and cardiac calcification have been reported due to metastatic calcification.
- LV Function • Systolic dysfunction - 30.5% of cases • Diastolic dysfunction - 54% of cases

In our study, patients with moderate LV dysfunction showed features of volume overload, anaemia and long-standing history.

- All our patients revealed type I relaxation abnormality of diastolic dysfunction.
- LV Contraction • Global LV Hypokinesia reflects Dilated Cardiomyopathy.
- Pericardial Effusion • 24% of cases has pericardial effusion.
- Indeed, it can result in pericardial tamponade, a potentially fatal condition. Pericardial disease is a life-threatening condition that requires prompt dialysis. Sachdeva et al reported 75% patients with abnormal ECG finding [9].
- Yadla et al reported 72.5% patients with ECG abnormality [10].
- While Chijioke reported 86% patients with abnormality.
- Ramanan et al observed 86% patients with abnormal ECG [8].

These differences in present study as compared to previous studies can be explained as a result of long lists of comorbidities excluded, in present study, which might contribute to ECG changes directly or indirectly. In the present study, LVH was the most common ECG abnormality seen in 21.8% patients. Shafi et al also reported LVH as the most common ECG finding in 40.8% CKD patients.

- Sachdeva et al reported LVH in 33.33% CKD patients [9].
- LVH was the most common finding reported by Yadla et al in 50% patients.
- Chijioke et al reported a prevalence of 27.6% patients with LVH on ECG [11].
- LVH was reported in 30% CKD patients by Ramanan et al. [8]
- Reddy et al reported LVH in 62.5% CKD patients [12].
- In a study by Bignotto et al, LVH was found in 36.3% patients on ECG [13].
- Dutta et al reported LVH has the most common ECG abnormality present in 66% patients in pre dialytic CKD stages 3, 4 and 5 [14].

Left ventricular hypertrophy (LVH) represents a key feature to provide an accurate picture of

systolic/diastolic left heart involvement in CKD patients. As a consequence of LVH, myocardial apoptosis, and intermyocardial fibrosis, the decrease in myocardial capillary density occurs together with diastolic (impaired diastolic filling of the ventricle to increased myocardial stiffness) and systolic dysfunction, disturbances in intra-ventricular conduction, and chamber dilation. Progressively, we might observe more compensatory hypertrophy, dilation and dysfunction of the heart. The severity and persistence of LVH are strongly associated with mortality risk and cardiovascular events in CKD and ESRD patients as reported by Zoccali et al. and London et al. who observed how a 10% decrease in Left Ventricular Hypertrophy was translated into a 28% decrease in cardiovascular mortality risk in a cohort of patients on hemodialysis [15-17]. Though many of the previous studies have combined the findings of ECG abnormalities in all stages of kidney.

## CONCLUSION

To conclude, resting ECG abnormalities are common in CKD patients. The most common ECG abnormality observed in CKD patients was left ventricular hypertrophy followed by ST depression. It was observed that almost all of the abnormal ECG findings occurred mostly in the later stages of CKD. i.e., stage 4 and 5. Hence, it is imperative to monitor regularly the patients of CKD to assess the changes in ECG. Progression of CKD stage increases the occurrence of abnormal ECG findings, especially in the later stages.

## REFERENCES

- 1 Ruggenti P, Schieppati A, Remuzzi G. Progression, remission, regression of chronic renal diseases. *Lancet*. 2001; 357(9268):1601-8.
- 2 Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care*. 2004; 27(5):1047- 53.
- 3 Mills KT, Bundy JD, Kelly TN, et al. Global Disparities of Hypertension Prevalence and Control: A Systematic Analysis of Population Based Studies from 90 Countries. *Circulation*. 2016; 134: 441-50.
- 4 Deo R, Shou H, Soliman EZ, Yang W, Arkin JM, Zhang X, et al. Electrocardiographic Measures and Prediction of Cardiovascular and Non- Cardiovascular Death in CKD. *J Am Soc Nephrol*. 2016; 27(2):559-69.
- 5 Kestenbaum B, Rudser KD, Shlipak MG, Fried LF, Newman AB, Katz R, et al. Kidney function, electrocardiographic findings, and cardiovascular events among older adults. *Clin J Am Soc Nephrol*. 2007; 2(3):501-8.
- 6 Bignotto LH, Kallas ME, Djouki RJ, Sasaki MM, Voss GO, Soto CL, et al. Electrocardiographic findings in chronic hemodialysis patients. *J Bras Nefrol*. 2012; 34(3):235-42.
- 7 Shafi S, Saleem M, Anjum R, Abdullah W, Shafi T. ECG Abnormalities In Patients With Chronic Kidney Disease. *J Ayub Med Coll Abbottabad*. 2017; 29(1):61-4.
- 8 Sachdeva S, Khurana T, Kaur S, Kamalpreet, Aggarwal R, Kaur A, Singh B. ECG and ECHO Changes in CKD. *Ann Int Med Den Res* 2017; 3(5):ME10-ME14.
- 10 Yadla M, Poosa K. Resting ECG Abnormalities in Patients on Maintenance Hemodialysis – A Clinical Study. *IOSR Journal of Dental and Medical Sciences*. 2017;16(8):62-64.
- 11 Chijioke A, Makusidi AM, Kolo PM. Electrocardiographic abnormalities among dialysis naïve chronic kidney disease patients in Ilorin Nigeria. *Ann Afr Med* 2012; 11(1):21–6.
- 12 Reddy BS. Assessment of ECG and Echo Findings among With Chronic Kidney Disease Patients. *Sch J App Med Sci* 2017; 5(9A):3475-3480.
- 13 Bignotto LH, Kallas ME, Djouki RJ, Sasaki MM, Voss GO, Soto CL, et al. Electrocardiographic findings in chronic hemodialysis patients. *J Bras Nefrol* 2012; 34(3):235-42.
- 14 Dutta PK, Das S. Value of electrocardiogram in predialytic chronic kidney disease patient without known coronary artery disease. *IJMRHS* 2014; 3(4): 967-974.
- 15 Ritz E, Wanner C. The challenge of sudden death in dialysis patients. *Clin J Am Soc Nephrol* 2008; 3: 920– 929.
- 16 Gross ML, Ritz E. Hypertrophy and fibrosis in the cardiomyopathy of uremia – beyond coronary heart disease. *Semin Dial* 2008; 21: 308–318.
- 17 Ritz E. Left ventricular hypertrophy in renal disease: beyond preload and afterload. *Kidney Int* 2009; 75: 771– 773