ORIGINAL ARTICLE

Study of Electrocardiographic Changes in Patients of Chronic Kidney Disease

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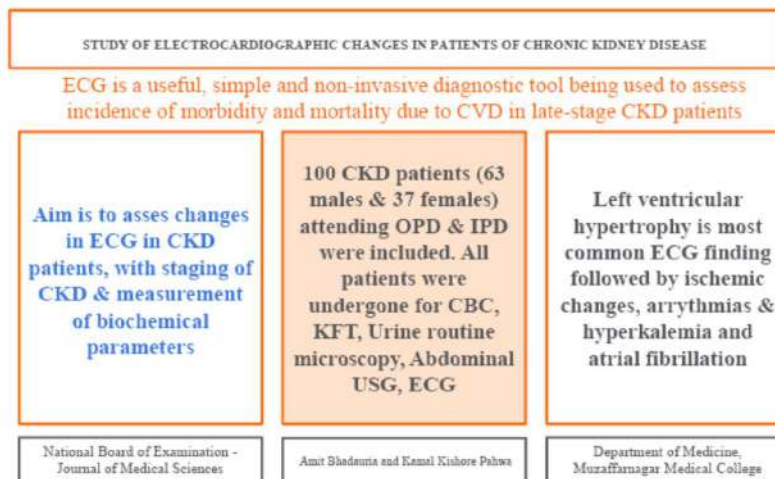
Abstract
CKD and its associated risk factors cause a rise in tendency to develop the cardiovascular (CV) diseases. The spectrum of CVD consists of left ventricular hypertrophy, congestive heart failure, ischemic heart disease, peripheral vascular disease and arrhythmias. The objective of the current investigation is to recognise electrocardiographic alterations in people with chronic diseases. A total of 100 CKD patients (63 males & 37 females) attending OPD & IPD were included. All patients were undergone for CBC, KFT, Urine routine microscopy, Abdominal USG, ECG. The present study shows subjects with electrocardiographic changes in chronic kidney disease. Maximum 36% cases were with LVH, followed by 22% cases being normal, 10% eachwere with ischemia and conduction abnormalities, Hyperkalemia 3%, Atrial fibrillation seen in 2% cases. To detect any early indication of CVD, regular ECG monitoring is necessary.

Keywords: CKD, CVD, ECG, LVH

Graphical Abstract

STUDY OF ELECTROCARDIOGRAPHIC CHANGES IN PATIENTS OF CHRONIC KIDNEY DISEASE

ECG is a useful, simple and non-invasive diagnostic tool being used to assess incidence of morbidity and mortality due to CVD in late-stage CKD patients

Aim is to asses changes in ECG in CKD patients, with staging of CKD & measurement of biochemical parameters

100 CKD patients (63 males & 37 females) attending OPD & IPD were included. All patients were undergone for CBC, KFT, Urine routine microscopy, Abdominal USG, ECG

Left ventricular hypertrophy is most common ECG finding followed by ischemic changes, arrythmias & hyperkalemia and atrial fibrillation

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Introduction

Chronic Kidney Disease (CKD) consists of various pathophysiologic processes that are linked with abnormal function of kidney, leading to decrease in the glomerular filtration rate [1]. CKD is being explained as abnormality in the different stages of kidney, affecting its function and structure, lasting for more than 3 monthsof time and having different health implications.[2] CKD is being categorised into five different stages. Stage 1 shows a slight disturbance in kidney function; having a normal or relatively high GFR ($\geq$90 ml/min/1.73m^2) with constant albuminuria. In Stage 2 CKD, mild reduction in GFR (60–89 ml/min/1.73m^2) is observed with damage to kidney. Stage 3 shows a moderate level of reduction in GFR (30–59 ml/min/1.73m^2). In stage 4 CKD, there is severe reduction in GFR (15–29 ml/min/1.73m^2), and in Stage 5, an established failure of kidney (GFR <15 ml/min/1.73m^2) is observed, that require a permanent renal replacement therapy [1].

The mortality rate among CKD patients has increased due to increased vulnerability to CVD more commonlyand even before time. In patients with CKD and ESRD, the spectrum of CVD consists of congestive heart failure, ischemic heart disease, peripheral vascular disease and arrhythmias. The incidence of CVD was found to be 20- 30times more in patients with ESRD, but now CVD risk is being observed in all CKD stages [2].

To detect any early indication of CVD, regular ECG monitoring is necessary [3] ECG also helps indetecting the signs of myocardial ischemia, disturbances in heart rhythm, abnormalities in chambers and cardiac conduction [4]. Thus, the current study has been conducted to analyze the electrocardiographic changes in CKD patients in Muzaffarnagar medical college and their significance with Stages of CKD.

Materials and Methods

Study design: Descriptive cross-sectional study

Study place: Department of General Medicine, Muzaffarnagar Medical College & Hospital,Muzaffarnagar, U.P.

Study Duration: One year (From 1st April 2021 to 31st March 2022)

Sample Size: 100 patients

Sample Technique: Outdoor and indoor patients of chronic kidney disease (undergoing dialysis also) attending department of General Medicine, Muzaffarnagar Medical College & Hospital, Muzaffarnagar, U.P. willbe evaluated before being taken up for the study.

Inclusion Criteria:

a) Selection of cases with CKD without considering the etiology.

b) Patients with chronic kidney disease on dialysis.

Exclusion Criteria:

a) Documented ischemic heart disease.

b) Congenital heart disease.

c) Valvular heart disease.

d) Age less than 18 years.

Study Method: The study was conducted in Muzaffarnagar Medical College and Hospital, Muzaffarnagar, U.P. on both indoor and outdoor patients of General Medicine department by following inclusion and exclusion criteria, history taking, general physical examination and relevant clinical examinations and interpretation of electrocardiograph by taking 12 lead ECG.

Data Collection Method: The data of the patients was collected in Case Record Form. The collecteddata was entered into Microsoft Excel spreadsheet.

Results

Table 1. Distribution of Study Subjects According to Gender

Gender	Number of patients (n)	Percentage (%)
Female	37	37.0
Male	63	63.0
Total	100	100.0

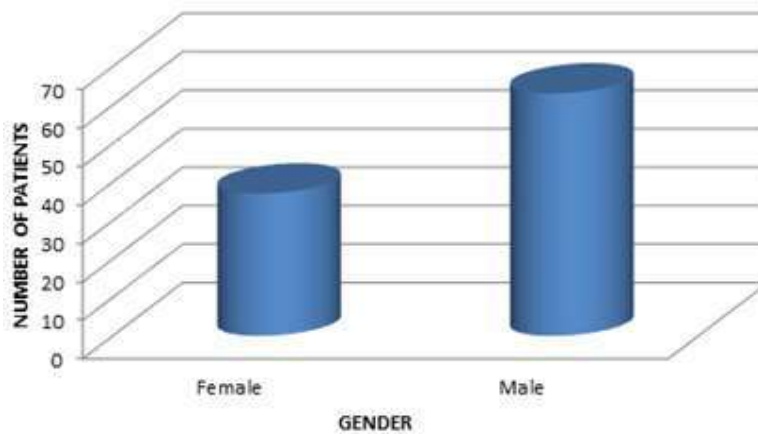Figure 1. Distribution of study subjects accordingto gender

Table 1 and Figure 1 shows the gender distribution amongst the study subjects. Out of 100 patients included in the study 63 were males and 37 females.

Table 2. Distribution of Study Subjects According to Stage of CKD

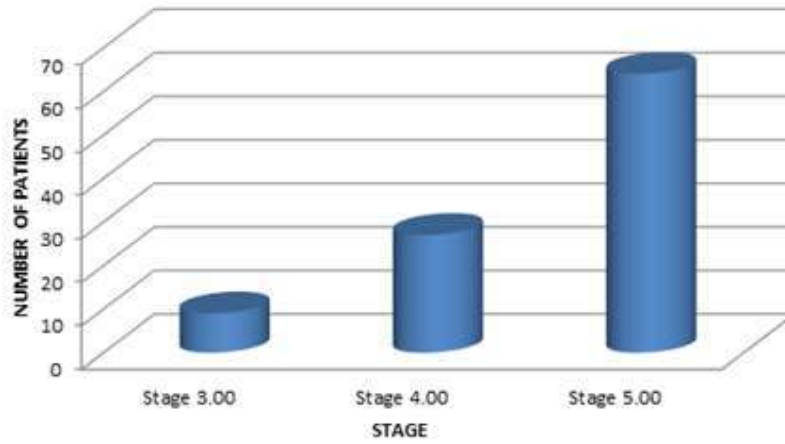| Stage	Number of patients (n)	Percentage (%)
Stage 3.00	9	9.0
Stage 4.00	27	27.0
Stage 5.00	64	64.0
Total	100	100.0

Figure 2. Distribution of Study Objects According to stage of CKD

Table 2 and Figure 2 displays the distribution of study subjects according to stage. Maximum 64% cases werehaving stage 5, followed by 27% subjects with stage 4 and 9% with stage 3.

Table 3. Mean Biochemical Parameters

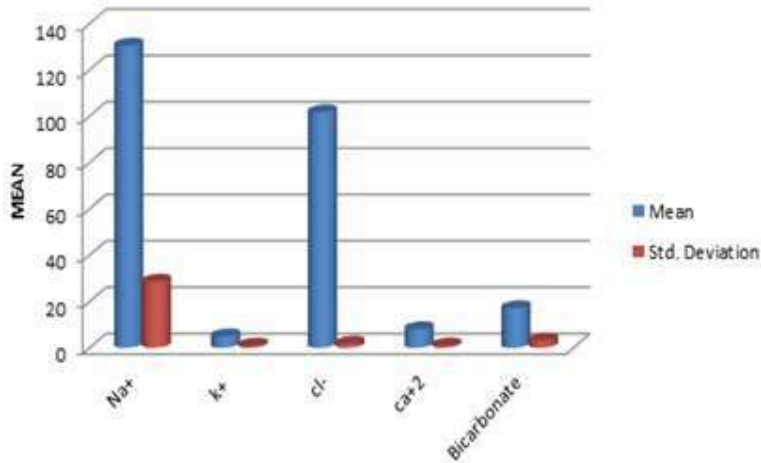|	Minimum	Maximum	Mean	Std. Deviation
Blood urea	46.00	467.00	159.8400	72.14320
Serum creatinine	1.20	20.70	6.8280	3.99657
Na+	116.00	142.00	130.35	28.491
K+	2.90	8.00	4.8910	.92301
Cl-	98.00	108.00	101.5800	1.74182
Ca+2	5.50	9.80	7.9770	.99512
Bicarbonate	8.00	23.00	17.04	3.123

Figure 3. Mean biochemical parameters

Table 3 and Figure 3 shows mean of various biochemical parameters. Mean Blood urea was 159.84±72.14, mean Serum creatinine was 6.82±3.99, mean Na+ levels was 130.35±28.4, mean K+ was 4.89±0.92, mean Chloride was 101.58±1.74, mean calcium was 7.97±0.99 and mean Bicarbonate levels was 17.04±3.12.

Table 4. Study of Electrocardiographic Changes in CKD

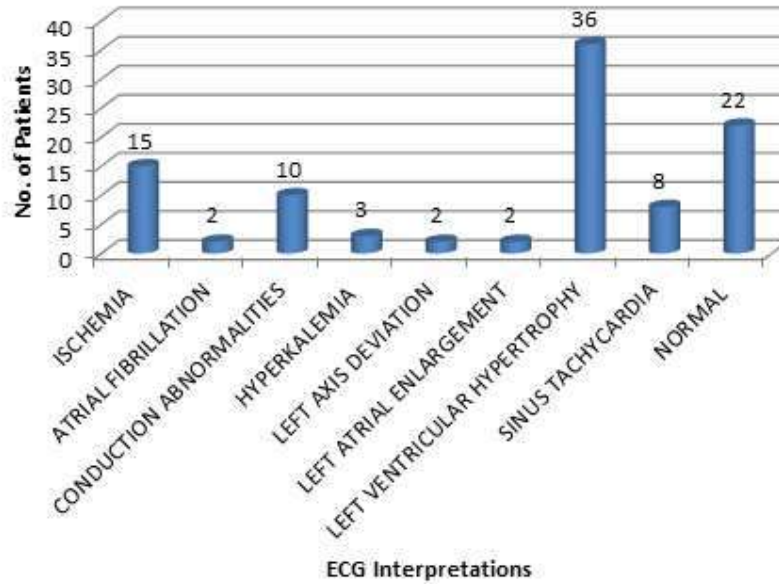| ECG CHANGES	FREQUENCY	PERCENTAGE (%)
ISCHEMIA	15	15
ATRIAL FIBRILLATION	2	2
CONDUCTION ABNORMALITIES	10	10
HYPERKALEMIA	3	3
LEFT AXIS DEVIATION	2	2
LEFT ATRIAL ENLARGEMENT	2	2
LEFT VENTRICULAR HYPERTROPHY	36	36
SINUS TACHYCARDIA	8	8
NORMAL	22	22
TOTAL (N)	100	100

Figure 4. ECG changes in study subjects

Table 4 and Figure 4 shows study subjects with electrocardiographic changes in chronic kidney disease. Maximum 36% cases were with LVH, followed by 22% cases being normal, 15% each were with ischemia and 10% conduction abnormalities.

Discussion

Mean Blood urea was 159.84±72.14, mean Serum creatinine was 6.82±3.99, mean Na+ levels was 130.35±28.4, mean K+ was 4.89±0.92, mean Chlorine was 101.58±1.74, mean calcium was 7.97±0.99 and mean Bicarbonate levels was 17.04±3.12. In accordance with our study, Singh et al. [5] found showed the average urea level in blood was 114.18±42.95 mg/dl which is comparable with the study of Singh et al [6] (121.2 ± 30.6), Foley et al. [7] (117 ± 15.3). The mean blood urea level in Chafekar et al. [8] was 77.0725.39 mg/dl, which is inconsistent with the results of the current study. Similar to our study, Singh et al. [5] found that mean serum creatinine level was 6.63±3.59 mg/dl. With respect to other studies, the mean serum creatinine level, for instance, varies Singh et al. [6] (3.5 ± 1.0) and Chafekar et al. [8] (5.75 ± 1.32). According to research studies, hyperkalemia is the most prevalent electrolyte imbalance in people with chronic renal disease. In Singh et al. [5] study 32% of patient had K+ level >5 meq/l, with the mean K+ level was 4.73±1.13 mEq/dl it is similar to the research on Singh et al. [6]

Similar to our study, Soren et al. [9] found that in 14.76% and 8.3% of patients, respectively, left ventricular hypertrophy (LVH) and left atrial enlargement (LAE) were observed. 4.3% of the patients had atrial fibrillation. Other ECG changes included atrial ectopics (2.6%), tall T waves (7.3%), left axis deviation (7%) and right axis deviation (RAD) (6%).

Singh et al. [5] cardiovascular problems that were identified by electrocardiogram in 72% of individuals. Thirty percent of patients had LVH, sixteen percent had ischemia, sixteen percent had intraventricular conduction disturbances, ten percent had p mitrale, and six percent had arrhythmia. 28 individuals (28%) had normal ECGs. The aforementioned finding is comparable to that of a study by Krivoshiev et al. [10], which found that the majority of patients had LVH in their ECG results, whereas studies by Soman et al. [11] and Menon et al. [12] found that the majority of patients had ischemia in their ECG results.

It was noted that stage 4 and stage 5 of CKD accounted for the majority of the aberrant ECG readings. Therefore, It is essential to regularly check on CKD patients to see if their ECG has changed. The likelihood of aberrant ECG readings rises with CKD stage progression, especially in the latter stages.

Conclusion

CKD has become a major public health concern, with a prevalence rate of 11–13% globally, and mainly stage 3 being most common. The main causes of increased prevalence are rise in cases suffering with diabetes and hypertension. The mortality rate among CKD patients has increased due to increased vulnerability to CVD more commonly and even before time. Although CVD is the main cause of mortality in CKD patients, but it has been observed that mortality rate is even higher in patients who are not undergoing dialysis.

When evaluating the incidence of morbidity and mortality from CVD in patients with late-stage CKD, an electrocardiogram (ECG) is a helpful, straightforward, and non-invasive diagnostic tool. The abnormalities noticed in ECG can be the predictor for diagnosing CVD independently ECG also helps in detecting the signs of myocardial ischemia, disturbances in heart rhythm, abnormalities in chambers and cardiac conduction.

Statements and Declarations

Conflicts of interest
The authors declares that they do not have conflict of interest.

Funding
No funding was received for conducting this study

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