

A Study of Clinical Profile in Chronic Kidney Disease with Special Reference to Echo and Electrocardiography

¹MV Krishna, ²Ashish Jindal, ³Saurav Das

ABSTRACT

Introduction: Cardiovascular causes contribute toward a large proportion of increased morbidity and mortality in patients with chronic kidney disease (CKD). Cardiac disease is the major cause of death in the CKD population.

Materials and methods: The present study was undertaken for documentation of various cardiovascular abnormalities in 50 patients with CKD at RajaRajeswari Medical College & Hospital, Bengaluru, Karnataka, India, using electrocardiography (ECG) and echocardiography as investigation procedures. The present study is a descriptive cross-sectional study and data collected were analyzed by frequency, percentage, chi-squared test, and p-value which is the left ventricular (LV) diastolic dysfunction. Pericardial effusion and conduction abnormalities are more common in patients of CKD.

Results: The ECG was normal in 12 out of 50 cases of CKD (24%), left ventricular hypertrophy (LVH) present in 14 out of 50 (28%), left axis deviation in 8 out of 50 (16%), conduction disturbances in 11 out of 50 (22%), ischemia in 10 out of 50 (20%), arrhythmias in 1 out of 50 (2%), and P mitrale was found in 3 out of 50 cases (6%). The most common ECG change associated with cases with CKD was LVH (28%). The most common abnormality found on echocardiography in CKD cases under the study was LVH (56%) followed by diastolic dysfunction (38%).

Conclusion: The LVH is the commonest abnormality observed in CKD both on ECG and echocardiography. Echocardiography is a more sensitive diagnostic procedure to detect LVH. After LVH other most common abnormalities found on Echocardiography in CKD patients on haemodialysis were pericardial effusion and conduction abnormalities.

Keywords: Chronic kidney disease, Echocardiography, Electrocardiography.

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INTRODUCTION

Chronic kidney disease is a global public health problem with a rising prevalence. Low glomerular filtration rate

(GFR) is associated with higher risk for kidney failure requiring dialysis, as well as is associated with cardiovascular disease (CVD), hypertension, anemia, and other metabolic complications. The last decade has seen a significant increase in the incidence, prevalence, and complications of CKD mostly because of the development of wider definitions for CKD by the National Kidney Foundation Kidney Disease Outcomes Quality Initiative.¹

The CVD is the most important cause of mortality in patients with CKD. Prevalence of cardiovascular-related death, especially in patients with end-stage renal disease (ESRD), has been recognized as accounting for more than 50% of overall mortality in these patients. Patients with CKD have a 3 to 30-fold risk for CVD compared with the general population. Staging of chronic kidney disease is shown in Table 1.²

This was clearly shown by Keith et al³ who analyzed outcomes of 27,998 patients with evidence of CKD, and found that the 5-year mortality rates for CKD stages 2, 3, and 4 were 19.5, 24.3, and 45.7% respectively, whereas the proportions of patients with these stages who progressed to ESRD were much lower at 1.1, 1.3, and 19.9%. Similarly, CVD is very common in dialysis patients and accounts for almost 50% of deaths, a rate that is 20 to 30-fold higher than that of age-, sex-, and race-matched controls.³

Echocardiography is an established method for the assessment of LV and right ventricular function. The LV diastolic dysfunction (LVDD) is an important cause of cardiac morbidity in ESRD patients. Diastolic dysfunction appears to be the initial LV dysfunction and might even precede LVH.⁴

A number of factors may alter cardiovascular dynamics in renal failure, including anemia, hypertension, volume overload, electrolyte imbalance, edema, and arteriovenous fistulas. In chronic uremia, cardiomyopathy

Table 1: Stages of CKD

Stage	Description	GFR, mL/min per 1.73 m ²
1	Kidney damage with normal or increased GFR	>90
2	Kidney damage with mildly decreased GFR	60–89
3	Moderately decreased GFR	30–59
4	Severely decreased GFR	15–29
5	Kidney failure	<15 or dialysis

¹Professor and Head, ^{2,3}Postgraduate Student

¹⁻³Department of General Medicine, RajaRajeswari Medical College & Hospital, Bengaluru, Karnataka, India

Corresponding Author: Ashish Jindal, Postgraduate Student Department of General Medicine, RajaRajeswari Medical College & Hospital, Bengaluru, Karnataka, India, e-mail: ashishjindal.dr@gmail.com

manifests as systolic dysfunction, concentric LVH, or LV dilatation.^{5,6}

Echocardiogram allows for the evaluation of ventricular mass and volume, and has an excellent accuracy in the detection of hypertrophy, definition of its geometric pattern (concentric or eccentric), and quantification of systolic function. In addition, Doppler-derived techniques can generate information regarding ventricular relaxation and its dynamics of filling, as well as concerning the presence of abnormalities in the cardiac valves and the pericardium.⁷

The LVH is highly prevalent in CKD and is associated with a clearly unfavorable prognosis; therefore, it is a major target for intervention. The incidence of LVH increases with a progressive decline in renal function.⁸

Left ventricular systolic dysfunction (LVSD) is a powerful indicator of unfavorable prognosis in patients on HD.⁹

Diastolic dysfunction is characterized by alteration in ventricular relaxation and compliance, frequently followed by a compensatory increase in filling pressure in more advanced stages. The later phenomenon is usually responsible for the manifestations of cardiac failure, whatever the cause may be. Small studies have reported a prevalence of LVDD in CKD patients varying from 50 to 60%.¹⁰

Among the diagnostic procedures, ECG and different types of echocardiography (two-dimensional, stress echocardiography) findings should provide the most important details.

MATERIALS AND METHODS

Source of Data

Patients admitted to RajaRajeswari Medical College & Hospital, Bengaluru, Karnataka, India, with CKD during 2015 to 2017.

Data Collection

A minimum of 50 patients with features suggestive of CKD were taken.

Selection Criteria

- Azotemia for more than 3 months
- Symptoms or signs of uremia
- Reduced kidney size bilaterally
- Broad casts in urinary sediment
- Symptoms or signs of renal osteodystrophy.

Following investigations were carried out along with detailed clinical evaluation of patients with features suggestive of CKD:

- Urine complete examination which includes: pH, specific gravity, protein, sugar, microscopy.
- Blood tests: hemoglobin (Hb%), fasting blood sugar/postprandial blood sugar, blood urea, serum creatinine,

serum electrolytes, serum calcium, phosphorus, lipid profile.

- X-rays chest, X-rays abdomen including kidney, ureter, and bladder region.
- Ultrasound abdomen
- 12-lead ECG
- Echocardiography.

Study Type

Descriptive and cross-sectional study.

Inclusion Criteria

- Random selection of cases with CKD without considering the etiology
- Patients with CKD on dialysis.

Exclusion Criteria

- Documented ischemic heart disease
- Congenital heart disease
- Valvular heart disease
- Primary cardiomyopathies
- Age less than 18 years.

Data Analysis

Data collected were analyzed by using tests like chi-squared, analysis of variance, and represented in the form of frequency tables, bar diagrams, and pie charts.

RESULTS

A total of 50 cases of CKD were studied in RajaRajeswari Medical College & Hospital, Bengaluru to find out ECG and Echocardiographic changes most commonly found in CKD; 52.5 ± 11.8 years was the mean age of the cases studied (Table 2). 68% of the study population comprised of male patients and 32% were females (Table 3). Serum creatinine was between 2.1 and 6 mg/dL in 27 patients

Table 2: Age distribution of study group

Age (in years)	Cases	
	Number	Percentage
18–20	3	6
21–30	4	8
31–40	8	16
41–50	16	32
51–60	14	28
>60	5	10
Total	50	100

Table 3: Sex distribution of study group

Sex	No. of cases	Percentage
Male	34	68
Female	16	32
Total	50	100

and 26 patients had serum creatinine levels between 6.1 and 12 mg/dL and only 1 patient had creatinine level of > 12 mg/dL (Table 4). 51.67 % of total study population in this study were diagnosed with CKD in 0 to 6 months, constituting. 27 (54%) patients had eGFR less than 15 mL/min, while the rest (46%) had eGFR between 16 and 30 mL/min (Table 5). 13 cases (26%) were on regular HD (26%) (Table 6). Electrocardiography was found to be normal in 12 cases (24%), LAD was seen in 8 cases (16%), LVH was found to be present in 14 out of 50 (28%), Conduction disturbances were observed in 11 cases (22%), Ischemic changes in 10 cases (20%), Arrhythmias was

Table 4: Distribution of cases according to serum creatinine

Serum creatinine (mg/dL)	No. of cases	Percentage
2.1–4	15	30
4.1–6	12	24
6.1–8	9	18
8.1–10	11	22
10.1–12	2	4
>12	1	1
Total	50	100

Table 5: Distribution of cases according to eGFR

Estimated GFR	No. of cases	Percentage
16–30	23	46
<15	27	54
Total	50	100

Table 6: Distribution of cases based on whether on HD or not

HD	No. of cases	Percentage
Yes	18	36
No	32	64
Total	50	100

Table 7: Electrocardiographic changes in CKD cases

Particulars	No. of cases	Percentage
Normal	12	24
LVH	14	28
Left axis deviation	8	16
Conduction abnormalities	11	22
Ischemic changes	10	20
Arrhythmias	1	2
P mitrale	3	6

Table 8: Electrocardiography changes in patients on HD (n = 18)

Particulars	No. of cases	Percentage
Normal	4	22.23
LVH	5	27.8
Left atrial dilatation	1	5.6
Conduction abnormalities	5	27.5
Ischemic changes	1	5.6
Arrhythmias	1	5.6
P mitrale	1	5.6

Table 9: Electrocardiography changes in patients not on HD (n = 32)

Particulars	No. of cases	Percentage
Normal	8	25
LVH	9	28.13
Left atrial dilatation	7	21.9
Conduction abnormalities	6	18.8
Ischemic changes	9	28.13
Arrhythmias	0	0
P mitrale	2	6.25

Table 10: Two-dimensional echocardiographic changes in CKD cases

Particulars	No. of cases	Percentage
Normal	11	22
LVH	26	56
Ischemic	7	14
Pericardial effusion	4	8
Diastolic dysfunction	19	38
Systolic dysfunction	11	22

Table 11: Two-dimensional echocardiographic changes in patients on HD (n = 18)

Particulars	No. of cases	Percentage
Normal	3	16.67
LVH	13	72.23
Ischemic	1	5.56
Pericardial effusion	4	22.23
Diastolic dysfunction	9	50
Systolic dysfunction	5	10

seen in 1 case (2%) and P-mitral was found in 3 cases (6%). The most common ECG change seen in study population was LVH (28%) (Tables 7 to 9). ECHO was normal in 11 cases (22%), LVH was seen in 28 cases (56%), Ischemic changes in 7 cases (14%), Pericardial Effusion was found in 4 cases (8%), Diastolic Dysfunction was observed to be present in 19 cases (38%) and 11 cases (22%) was found to have Systolic Dysfunction. LVH (56%) was the most commonly associated abnormality observed in CKD case, followed by Diastolic Dysfunction (38%) (Tables 10 to 12).

DISCUSSION

The CKD is associated with significantly increased morbidity and mortality. Chronic renal failure affects almost every system of the body and results in various functional and structural abnormalities. Among the various causes, infections and cardiovascular causes contribute toward a large proportion of increased morbidity and mortality. Cardiac disease is the major cause of death in dialysis population accounting for 40% of deaths in international registries. In the cardiovascular system, LVH is the most

Table 12: Two-dimensional echocardiographic changes in patients not on HD (n = 32)

Particulars	No. of cases	Percentage
Normal	8	25
LVH	15	46.88
Ischemic	6	18.76
Pericardial effusion	0	0
Diastolic dysfunction	10	31.25
Systolic dysfunction	6	18.75

Table 13: Comparison of mean age in our study with other studies

Studies	Mean age in years
Foley et al ¹¹	51 ± 17
Ramanan et al ¹²	47.5 ± 12.26
Laddha et al ¹³	53.3 ± 12.8
Goornavar et al ¹⁴	47.58 ± 15.3
Singal et al ¹⁵	47.7 ± 15.10
Sachdeva et al ¹⁶	57.62 ± 13.7
Present study (2017)	52.5 ± 11.8

frequent finding. The ECG and different types of echocardiographic findings provide the most important details regarding cardiovascular morbidities

CONCLUSION

We conducted a study in RajaRajeswari Medical College & Hospital, Bengaluru, Karnataka, India, where 50 cases of CKD were taken to find out ECG and echocardiographic changes commonly associated with CKD. The mean age of the cases in our study was 52.5 ± 11.8 years. Most patients in this study were those who have been diagnosed with CKD in 0 to 6 months, accounting for 51.67% of the total study population. Totally, 27 out of 50 patients had estimated GFR (eGFR) less than 15 mL/min accounting for 54%, while the rest had eGFR between 16 and 30 mL/min. Totally, 13 out of 50 cases were on HD (26%). The ECG was normal in 12 out of 50 cases of CKD (24%), LVH present in 14 out of 50 (28%), left anterior descending in 8 out of 50 (16%), conduction disturbances in 11 out of 50 (22%), ischemia in 10 out of 50 (20%), arrhythmias in 1 out of 50 (2%), and P mitrale was found in 3 out of 50 cases (6%). The most common ECG change associated with cases with CKD was LVH (28%). Echocardiogram was normal in 11 cases (22%), LVH in 28 cases (56%), ischemia in 7 cases (14%), pericardial effusion in 4 cases (8%), diastolic

Table 14: Comparison of ECG changes in CKD cases with other studies

Particulars	Soman et al ¹⁷	Ramanan et al ¹²	Sachdeva et al ¹⁶	Present study (2017)
Normal	–	14%	25%	24%
LVH	18%	30%	33.33%	28%
Left atrial dilatation	–	12%	15%	16%
Conduction abnormalities	15%	16%	16.67%	22%
Ischemic changes	32%	16%	20%	20%
Arrhythmias	5%	4%	3.33%	2%
P mitrale	–	10%	6.67%	6%

dysfunction in 19 cases (38%), and systolic dysfunction in 11 cases (22%). The most common abnormality found on echo in CKD cases under study was LVH (56%) followed by diastolic dysfunction (38%). The LVH is the commonest abnormality observed in CKD both on ECG and echocardiography. Echocardiography is a more sensitive diagnostic procedure to detect LVH. After LVH, the most common abnormality found on echocardiography is LVDD. The LVH prevalence on echocardiography in CKD patients on HD was 72.23% and not on HD was 46.88%. The difference in the LVH prevalence between two groups was not significant ($p = 0.2942$). The LVDD prevalence on echocardiography in CKD patients on HD was 50% and not on HD was 31.25%. The difference in the LVDD prevalence between two groups was not significant ($p = 0.5327$). The LVSD prevalence on echocardiography in CKD patients on HD was 27.78% and not on HD was 18.75%. The difference in the LVSD prevalence between two groups was not significant ($p = 0.9940$). Ischemic changes on echocardiography in CKD patients on HD were 5.56% and not on HD were 18.75%. The difference in ischemic changes occurrence between two groups was statistically significant ($p = 0.0468$). Ischemic changes on ECG in HD were 5.6% and in non-HD groups were 28.13%. The difference in ischemic changes occurrence between two groups was not significant ($p = 0.0883$). On comparison with studies done earlier by various researchers showed similar results (Tables 13 to 15). Pericardial effusion and conduction abnormalities are more common in patients of CKD on HD. The ECG and echocardiography are the noninvasive tools, which can

Table 15: Comparison of two-dimensional echocardiographic changes in CKD cases with other studies

Particulars	Ramanan et al ¹²	Laddha et al ¹³	Goornavar et al ¹⁴	Singal et al ¹⁵	Sachdeva et al ¹⁶	Present study (2017)
Normal	32%	–	14%	–	23.33%	22%
LVH	42%	74.3%	58%	73%	56.67%	56%
Ischemic	12%	12.9%	16%	–	15%	14%
Pericardial effusion	6%	24.3%	6%	6%	8.33%	8%
LVSD	–	24.3%	–	23%	21.67%	22%
LVDD	–	61.4%	–	50%	36.33%	38%

be used to identify CVD early in the course of CKD. During the evaluation of potential candidates for kidney transplantation, special attention should be paid to the presence of cardiovascular morbidity.

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