

## ECG and ECHO Changes in CKD.

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### ABSTRACT

**Background:** Cardiovascular causes contribute towards the large proportion of increased morbidity and mortality, in patients of Chronic renal failure. Cardiac disease is the major cause of death in dialysis population. **Methods:** The present study was undertaken for documentation of various cardiovascular abnormalities in sixty patients with Chronic Kidney Disease at Government Medical College Patiala, using Electrocardiography and Echocardiography as investigation procedures. The present study is a descriptive – cross sectional study and data collected was analysed by frequency, percentage, chi-square test and by using p value. **Results:** ECG was normal in 15 out of 60 cases of CKD (25%), LVH present in 20 out of 60 (33.33%), Left axis deviation in 9 out of 60 (15%), Conduction disturbances in 10 out of 60 (16.67%), Ischemia in 12 out of 60 (20%), Arrhythmias in 2 out of 60 (3.33%) and P-mitrale was found in 4 out of 60 cases (6.67%). The most common ECG change associated with cases with CKD was LVH (33.33%). The most common abnormality found on echo in CKD cases under study was LVH (56.67%) followed by Diastolic Dysfunction (38.33%). **Conclusion:** Left ventricular hypertrophy is the commonest abnormality observed in CKD both on ECG and Echocardiography. Echocardiography is a more sensitive diagnostic procedure to detect left ventricular hypertrophy. After LVH most common abnormality found on Echocardiography is Left ventricular diastolic dysfunction. Pericardial effusion and conduction abnormalities are more common in patients of CKD on hemodialysis.

**Keywords:** ECG, Echocardiography, CKD.

### INTRODUCTION

Chronic renal failure (CRF) 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 towards the 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.<sup>[1]</sup> Chronic Kidney Disease (CKD) is defined as either (1) kidney damage for > 3 months, as confirmed by kidney biopsy or markers of kidney damage, with or without a decrease in glomerular filtration rate (GFR), or (2) GFR < 60 mL / min per 1.73 meter square for > 3 months, with or without kidney damage.<sup>[2]</sup> Patients with end-stage renal disease (ESRD) are at a much higher risk of CV disease than the general population.

There is growing evidence suggesting that prevalence of Cardiovascular disease among End Stage Renal Disease patients is already high by the time renal replacement treatment is initiated. Cardiovascular disease is the leading cause of death in renal transplant recipients.<sup>[3,4,5]</sup> The traditional risk factors for cardiovascular diseases such as hypertension, dyslipidemia, diabetes and obesity are highly prevalent in Chronic Kidney Disease populations. In the cardiovascular system, left ventricular hypertrophy (LVH) is the most frequent finding.<sup>[6]</sup> Echocardiogram allows for the evaluation of ventricular mass and volume, and has an excellent accuracy for 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.<sup>[7]</sup>

Left Ventricular hypertrophy (LVH) is highly prevalent in Chronic Kidney Disease (CKD) and is associated with a clearly unfavorable prognosis;

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therefore, it is a major target for intervention. The incidence of Left Ventricular Hypertrophy increases with a progressive decline in renal function.<sup>[8]</sup>

Left Ventricular systolic dysfunction is a powerful indicator of unfavorable prognosis in patients on Hemodialysis.<sup>[9]</sup>

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 subjacent cause may be. Small studies have reported a prevalence of Left Ventricular diastolic dysfunction in Chronic Kidney Disease (CKD) patients varying from 50 to 65%, including pre-dialysis, dialysis and post-transplant populations.<sup>[10]</sup> Among the diagnostic procedures, Electrocardiography (ECG) and different types of Echocardiography (2-D, stress echocardiography) findings should provide the most important details.

#### Stages of Chronic Kidney Disease <sup>[2]</sup>

Stage	Description	GFR, mL/min per 1.73 m <sup>2</sup>
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

## MATERIALS AND METHODS

#### Source of data

Patients admitted to Govt. Medical College/Rajindra Hospital Patiala with chronic kidney disease during 2014 to 2016

#### Method of collection of data

**Methods:** A minimum of 60 patients with feature suggestive of chronic kidney disease will be 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 investigation will be carried along with detailed clinical evaluation of patients with feature suggestive of CKD

1. Urine complete examination which includes: pH, Specific gravity, Protein, Sugar, Microscopy
2. Blood tests: HB%, FBS/PPBS, Blood Urea, Serum Creatinine, Serum Electrolytes, Serum Calcium, Phosphorus, Lipid profile
3. X rays Chest, X rays Abdomen including KUB region
4. Ultrasound Abdomen

5. Electrocardiography (12 lead ECG)
6. Echocardiography will be done on patients with chronic kidney disease.

#### Study Type

Descriptive-Cross sectional study

#### Inclusion Criteria

1. Random selection of cases with CKD without considering the etiology.
2. Patient with chronic kidney disease on dialysis.

#### Exclusion Criteria

1. Documented ischemic heart disease.
2. Congenital heart disease.
3. Valvular heart disease.
4. Primary Cardiomyopathies
5. Age less than 18 years

#### Data Analysis

Data collected was analyzed by using tests like Chi-square, Anova and represented in the form of frequency tables, Bar diagrams and Pie charts.

## RESULTS

**Table 1: Age distribution of study group.**

Age in years	Number of cases	Percentage
18-40	07	11.67
41-60	28	46.67
61-80	23	38.33
>80	02	03.33
Total	60	100

**Table 2: Sex distribution of cases.**

Sex	No. of cases	Percentage
Male	45	75
Female	15	25
Total	60	100

**Table 3: Distribution of cases according to Serum Creatinine.**

Ser. creatinine (mg/dl)	No. of cases	Percentage
2.1-4	18	30
4.1-6	14	23.33
6.1-8	10	16.67
8.1-10	13	21.67
10.1-12	01	1.66
>12	01	6.67
Total	60	100

**Table 4: Distribution of cases according to eGFR.**

GFR (ml/min)	No of Cases	Percentage
16-30	25	41.66
<=15	35	58.33

**Table 5: Distribution of cases on basis of whether on Hemodialysis (HD) or not.**

Hemodialysis	No. of Cases	Percentage
Yes	23	38.33
No	37	61.67

**Table 6: Electrocardiographic (ECG) changes in cases of CKD.**

Particulars	No of cases	Percentage
Normal	15	25.00
Left ventricular	20	33.33
LAD	9	15
Conduction disturbances	10	16.67
Ischemia	12	20
Arrhythmias	2	3.33
P-mitrale	4	6.67

**Table 7: ECG changes in Patients on Hemodialysis (Total-23).**

Particulars	No of cases	Percentage
Normal	06	26
Left ventricular hypertrophy	07	30.43
LAD	2	8.7
Conduction disturbances	7	30.43
Ischemia	2	8.7
Arrhythmia	1	4.3
P-mitrale	2	8.7

**Table 8: ECG changes in Patients without Hemodialysis (Total-37).**

Particulars	No of cases	Percentage
Normal	9	24.32
Left ventricular hypertrophy	13	35.13
LAD	7	19
Conduction disturbances	3	8.1
Ischemia	10	27
Arrhythmia	1	2.7
P-mitrale	2	5.4

**Table 9: Echocardiographic changes in CKD cases.**

Particulars	No of cases	Percentage
Normal study	14	23.33
Left ventricular hypertrophy	34	56.67
Ischemia	9	15
Pericardial effusion	5	8.33
Diastolic dysfunction	23	38.33
Systolic dysfunction	13	21.67

**Table 10: Echocardiographic changes in CKD patients on Hemodialysis (Total-23).**

Particulars	No of cases	Percentage
Normal study	5	21.73
Left ventricular hypertrophy	15	65.21
Ischemia	1	2.83
Pericardial effusion	5	21.73
Diastolic dysfunction	10	43.47
Systolic dysfunction	5	21.73

**Table 11: Echocardiographic changes in patients without Hemodialysis (Total-37).**

Particulars	No of cases	percentage
Normal study	9	24.32
Left ventricular hypertrophy	19	51.35
Ischemia	8	21.62
Pericardial effusion	0	0
Diastolic dysfunction	13	35.13
Systolic dysfunction	8	21.62

## DISCUSSION

Chronic Kidney Disease (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 towards the 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, left ventricular hypertrophy (LVH) is the most frequent finding. Electrocardiography (ECG) and different types of Echocardiographic findings provide the most important details regarding cardiovascular morbidities.

**Table 12: Comparison of mean age in our study with other studies.**

Study	Age in years
Foley et al <sup>[11]</sup> (1995)	51±17
Ramanan et al <sup>[12]</sup> (2005)	47.5±12.26
Ladha et al <sup>[16]</sup> (2014)	53.3±12.8
Goornavar et al <sup>[13]</sup> (2015)	47.58±15.3
Singal et al <sup>[14]</sup> (2016)	47.7± 15.10
Present Study	57.62±13.7

**Table 13: Comparison of ECG changes in CKD cases with other studies.**

ECG Change	Soman et al <sup>[15]</sup> (2002)	Ramanan et al <sup>[12]</sup> (2005)	Present Study
Normal	-	14%	25%
LVH	18%	30%	33.33%
Lad	-	12%	15%
Conduction disturbances	15%	16%	16.67%
Ischemia	32%	16%	20%
Arrhythmias	05%	04%	3.33%
P-mitrale	-	10%	6.67%

**Table 14: Comparison of Echocardiographic changes in CKD cases with other studies.**

Echo change	Ramanan et al <sup>[12]</sup> (2005)	Ladha et al <sup>[16]</sup> (2014)	Goornavar et al <sup>[13]</sup> (2015)	Singal et al <sup>[14]</sup> (2016)	Present study
Normal	32%	-	14%	-	23.33%
LVH	42%	74.3%	58%	73%	56.67%
Ischemia	12%	12.9%	16%	-	15%
Pericardial effusion	06%	24.3%	6%	06%	08.33%
LVSD	-	24.3%	-	23%	21.67%
LVDD	-	61.4%	-	50%	38.33%

## CONCLUSION

We conducted a study in Rajindra Hospital, Patiala where 60 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 57.62±13.7 years. Most patients in this study were those who have been diagnosed with CKD in 0-6 months, accounting 51.67 % of total study population. 35 out of 60 patients had GFR less than 15ml/min accounting for 58.33% while rest had GFR between 16-30 ml/min. 23 out of 60 cases were on hemodialysis (38.33%). ECG was normal in 15 out of 60 cases of CKD (25%), LVH present in 20 out of 60 (33.33%), LAD in 9 out of 60 (15%), Conduction disturbances in 10 out of 60 (16.67%), Ischemia in 12 out of 60 (20%), Arrhythmias in 2 out of 60 (3.33%) and P-mitrale was found in 4 out of 60 cases (6.67%). The most common ECG change associated with cases with CKD was LVH (33.33%). Echo was Normal in 14 cases (23.33%), LVH in 34 cases (56.67%), Ischemia in 9 cases (15%), Pericardial Effusion in 5 cases (8.33%), Diastolic Dysfunction in 23 cases (38.33%) and Systolic Dysfunction in 13 cases (21.67%). The most common abnormality found on echo in CKD cases under study was LVH (56.67%) followed by Diastolic Dysfunction (38.33%). Left ventricular hypertrophy is the commonest abnormality observed in CKD both on ECG and Echocardiography. Echocardiography is a more sensitive diagnostic procedure to detect left ventricular hypertrophy. After LVH most common abnormality found on Echocardiography is LVDD. LVH prevalence on

Echocardiography in CKD patients on HD (65.21%) and not on HD (51.35%). The difference in the LVH prevalence between two groups was not significant ( $p=0.2962$ ). LVDD prevalence on Echocardiography in CKD patients on HD (43.47%) and not on HD (35.13%). The difference in the LVDD prevalence between two groups was not significant ( $p=0.5218$ ). LVSD prevalence on Echocardiography in CKD patients on HD (21.73%) and not on HD (21.62%). The difference in the LVSD prevalence between two groups was not significant ( $p=0.9920$ ). Ischemic changes on Echocardiography in CKD patients on HD (2.83%) and not on HD (21.62%). The difference in Ischemic changes occurrence between two groups was statistically significant ( $p=0.0457$ ). Ischemic changes on ECG in HD (8.7%) and in Non-HD group (27%). The difference in Ischemic changes occurrence between two groups was not significant ( $p=0.0874$ ). Pericardial effusion and conduction abnormalities are more common in patients of CKD on hemodialysis. During the evaluation of potential candidates for kidney transplantation, a special attention should be paid to the presence of Cardiovascular morbidity.

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