Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 03, 2023

TO STUDY THE ELECTROCARDIOGRAPHIC AND ECHOCARDIOGRAPHIC CHANGES IN PATIENTS WITH CHRONIC KIDNEY DISEASE ON MAINTENANCE HEMODIALYSIS

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ABSTRACT

Aim: The present study was undertaken with the aim and objective to study the electrocardiographic and echocardiographic changes in patients with chronic kidney disease on maintenance hemodialysis.

Methods: A cross sectional study consisted of 100 patients with chronic kidney disease on maintenance hemodialysis in the Department of Medicine, Govt. Medical College, Patiala.

Results: In age group <30 years, 15% of patients were involved. In age group 41-50 years 22% patients were involved. In age group 51-60 years, 29% patients were involved. In age group 61-70 years, 17% patients were involved. In age group >70 years, 17% patients were involved. Out of 100 patients, there were 57% male and 43% females. 1% was having Autosomal dominant polycystic kidney disease, 8% having acute tubular necrosis, 18% having chronic glomerulonephritis, 23% having diabetes mellitus, 30% having diabetes Mellitus + hypertension, 15% having Hypertension, 2% having IGA nephropathy and 3% having obstructive uropathy. ECG was normal in 25% cases. LVH in 35% cases, LAD in 6%, conduction disturbances in 18%, Ischemic changes in 6%, Arrhythmia in 6% and P-mitrale in 4%. The most common ECG changes were 35% in LVH and 26% in conduction disturbance. The table shows echocardiographic changes in CKD cases on hemodialysis. Normal was found in 12 % of cases, left ventricular hypertrophy in 44% of patients, RWMA in 8%, pericardial effusion in 7%, diastolic dysfunction was found in 15% of patients and systolic dysfunction in 14% of patients.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 03, 2023

Conclusion: Left ventricular hypertrophy is the commonest abnormality observed in patient's chronic kidney disease on maintenance hemodialysis both on ECG and Echocardiography. Echocardiography is a more sensitive diagnostic procedure to detect left ventricular hypertrophy. After Left Ventricular Hypertrophy the next common abnormality found on Echocardiography is Left Ventricular Diastolic Dysfunction.

Keywords: CKD, ECG, hemodialysis

INTRODUCTION

Chronic kidney disease (CKD), ranges from asymptomatic to total kidney failure which is characterized by reduced estimated glomerular filtration rate (eGFR) <60ml/min/1.73m2 for more than 3 months and by structural or functional abnormalities.[1,2] Cardiovascular complications are commonly encountered symptoms in CKD or end stage renal disease (ESRD) patients including left ventricular hypertrophy (LVH), systolic and diastolic dysfunction. In addition, patients with CKD have a high prevalence of traditional and non-traditional risk factors such as diabetes mellitus, hypertension, dyslipidemia uremia, inflammation and oxidative stress.[3] With the advancement of technology, Electrocardiogram (ECG) and Echocardiograph remains an essential tool for evaluation of cardiovascular disease. [4,5] Cardiovascular risk factors are highly prevalent in patients with CKD. The prevalence of CVD is increased among all patients with CKD, not only those with end-stage renal disease (ESRD). That is, the prevalence of LVH increases as glomerular filtration declines, and as many as 30% of patients reaching ESRD already have clinical evidence of ischemic heart disease or heart failure.

Cardiovascular diseases are a leading cause of death in end stage renal disease largely as a result of the progressively increasing age of ESRD patient and the broad constellation of uremia associated factors that can adversely affect cardiac function. This increased risk of cardiovascular disease may begin during the earlier stages of CKD before the onset of kidney failure.

The anatomic and hemodynamic alteration of cardiovascular system in CKD is

- Increased total body and vascular volume.
- Increased blood pressure[6]
- Left ventricular hypertrophy.
- Increased pulmonary capillary permeability.
- Increased cardiac index.
- Increased left ventricular chamber size.
- Increased serosal membrane permeability.
- Increased total peripheral resistance.[7]
- Impaired left ventricular contractile function {decreased ejection fraction}

With the advancement of technology, Electrocardiogram (ECG) and Echocardiograph remains an essential tool for evaluation of cardiovascular disease. National Kidney Foundation (NKF) in their clinical guideline for CVD in dialysis patients recommended baseline electrocardiogram and echocardiograph at the onset of dialysis and at annual interval. ECG abnormalities may be

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 03, 2023

particularly strong predictors of CV events among people with CKD, as a result of their considerable baseline CV risk. Associations of resting ECG markers with clinical CV events could promote the 12-lead ECG as a useful clinical tool for CV risk stratification in the CKD setting. Echocardiogram has been a valuable tool, with marked accuracy in evaluating ventricular mass and volume, detection of hypertrophy, definition of its geometric pattern (concentric or eccentric), and quantification of systolic function.

The present study was undertaken with the aim and objective to study the electrocardiographic and echocardiographic changes in patients with chronic kidney disease on maintenance hemodialysis.

MATERIALS AND METHODS

A cross sectional study consisted of 100 patients with chronic kidney disease on maintenance haemodialysis in the Department of Medicine, Govt. Medical College, Patiala.

INCLUSION CRITERIA

Patient with CKD on maintenance haemodialysis irrespective of etiology

EXCLUSION CRITERIA

1. Congenital heart disease.
2. Valvular heart disease.
3. Primary Cardiomyopathies.
4. Age less than 18 years.
5. Pregnancy
6. HIV
7. Advanced Malignancy

All patients were subjected to 12 lead ECG and detailed Transthoracic Echocardiography (ECHO) was done and any abnormalities therein were noted. Various abnormalities found in ECG and Echocardiography was studied. Data was evaluated and statistically analyzed.

The data in the present study was compiled using MS-Excel (office-2019) and the data was analyzed in SPSS 26. For comparison of variables in ECG and Echo findings chi square test was used, mean and standard deviation was also measured. In present study we correlated the data using Pearson correlation. The value of correlation coefficient was calculated and interpreted accordingly. The value of < 0.05 was considered to be significant and < 0.001 was considered to be highly significant.

RESULTS

Table 1: Patient characteristics

Age group (years)	Frequency	Percent
<=30	15	15.0
41-50	22	22.0
51-60	29	29.0
61-70	17	17.0

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 03, 2023

>70	17	17.0
Gender		
Male	57	57.0
Female	43	43.0
Etiology		
Autosomal dominant polycystic kidney disease	1	1.0
Acute tubular necrosis	8	8.0
Chronic glomerulonephritis	18	18.0
Diabetes Mellitus	23	23.0
Diabetes Mellitus + hypertension	30	30.0
Hypertension	15	15.0
IGA- Nephropathy	2	2.0
Obstructive uropathy	3	3.0

In age group <30 years, 15% of patients were involved. In age group 41-50 years 22% patients were involved. In age group 51-60 years, 29% patients were involved. In age group 61-70 years, 17% patients were involved. In age group >70 years, 17% patients were involved. Out of 100 patients, there were 57% male and 43% females. 1% was having Autosomal dominant polycystic kidney disease, 8% having acute tubular necrosis, 18% having chronic glomerulonephritis, 23% having diabetes mellitus, 30% having diabetes Mellitus + hypertension, 15% having Hypertension, 2% having IGA nephropathy and 3% having obstructive uropathy.

Table 2: ECG changes in CKD patients on Maintenance Hemodialysis

Particulars	**Frequency**	**Percent**
Normal	25	25%
Left ventricular hypertrophy	35	35%
LAD	6	6%
Conduction disturbances	18	18%
Ischemia	6	6%
Arrhythmia	6	6%
P-mitrale	4	4%

ECG was normal in 25% cases. LVH in 35% cases, LAD in 6%, conduction disturbances in 18%, Ischemic changes in 6%, Arrhythmia in 6% and P-mitrale in 4%. The most common ECG changes were 35% in LVH and 26% in conduction disturbance.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 03, 2023

Table 3: Echocardiographic changes in CKD patients on Maintenance Hemodialysis

Particulars	Frequency	Percent
Normal Study	12	12%
Left ventricular hypertrophy	44	44%
RWMA	8	8%
Pericardial effusion	7	7%
Diastolic dysfunction	15	15%
Systolic dysfunction	14	14%

The table shows echocardiographic changes in CKD cases on hemodialysis. Normal was found in 12 % of cases, left ventricular hypertrophy in 44% of patients, RWMA in 8%, pericardial effusion in 7%, diastolic dysfunction was found in 15% of patients and systolic dysfunction in 14% of patients.

Table 4: Correlation between Conduction defect on ECG and Age group

	Age group					Total
Conduction defect	<=30	41-50	51-60	61-70	>70	
Absent	15	20	27	14	12	88
	100.0%	90.9%	93.1%	82.4%	70.6%	88.0%
Present	0	2	2	3	5	12
	.0%	9.1%	6.9%	17.6%	29.4%	12.0%
Total	15	22	29	17	17	100
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
P value	.080					

Conduction defect was found in .0% of patients in less than 30 years. In age group 41-50years, conduction defect was found in 9.1% of patients. In age group 51-60 years, conduction defect was found in 6.9% of patients. In age group 61-70 years, conduction defect was found in 17.6% of patients. In age group >70years, conduction defect was found in 29.4% of patients. The difference was not statistically significant as p value is more than 0.05.

Table 5: Correlation between Conduction defect on ECG and Gender

Conduction defect	Gender		Total
	Male	Female	
Absent	50	38	88
	87.7%	88.4%	88.0%
Present	7	5	12
	12.3%	11.6%	12.0%

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 03, 2023

Total	57	43	100
	100.0%	100.0%	100.0%
P value	1.0		

87.7% males and 88.4 % females have no conduction defect. 12.3% males and 11.6 % females have conduction defect. The difference was not statistically significant as p value is more than 0.05.

DISCUSSION

According to the KDIGO 2012 updated guideline, CKD is defined as abnormalities in kidney structure or function that have been evident for at least three months, which is consistent with the original definition of CKD from the NKF-KDOQI 2002 guideline. The thresholds are a GFR 60mL/min/1.73m^2 and urine albumin:creatinine ratio (ACR) 30mg/g (3mg/mmol) as criteria for CKD in both the original and 2012 amended guidelines. These cut-points were determined using extensive population research that looked at prognosis. An ACR of 30mg/g (3mg/mmol), which is more than three times the average value of 10mg/g (1mg/mmol) in young adult men and women, is linked to a higher risk of CKD complications.[8]

The age variation in the present study was 30 to 70 years. With the maximum number of the patients in the age group 51-60 years and 29% patients were involved in this group. The mean age of our study in males was 53.6± 12.9 and females were 56.1± 17.4. Age is main confounding factor. The mean age of the current study is comparable with the means of the previous studies, which were 41.1±12.1 years for N.P. Singh et al., 48.7±13.5 years for Michael Dahan et al., and 51.1±7.4 years for Foley et al.[9-11] In the present study the comparison of etiology previous studies. In our study the major etiology for chronic kidney disease was diabetes along with hypertension i.e. 30%. The etiology is comparable to previous studies like Foley et al (1995)[11] in which patients having diabetes mellitus in 26.8% patients, 29.1% patients having hypertension in 29.1%, glomerulonephritis in 30.9 % and others include 13.2%.

Our study shows that the most common ECG changes associated with CKD were LVH followed by conduction defect and then ischemic changes. Other studies conducted by Soman et al (2002)[12] is similar to our study that LVH is found in 18% of patients, conduction disturbances in 15 % of patients, Ischemia in 32 % patients and Arrythmias in .05% and Ramanan et al (2005)[13] also agree with our study that includes LVH in 30%, LAD in 12%, conduction disturbances in 16%, Ischemic changes in 16% and arrhythmias in 4%. Hemodialysis patients have frequent electrolyte abnormalities such as fluctuating levels of potassium, ionized calcium, magnesium, and other divalent ions. Due to the intermittent nature of the dialysis procedure, patients on HD have wide fluctuations in volume status, and potassium and bicarbonate levels, in between dialysis treatments. These fluctuations are partly driven by the level of potassium and calcium in the dialysate fluid used during the prior session of treatment, and wide variability in eating habits due to varying adherence to dietary modifications necessary to control the calcium-phosphate product. All these factors culminate in arrhythmogenic diathesis.[14,15]

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 03, 2023

The study shows echocardiographic changes in CKD cases with other studies. The study shows pericardial effusion is found in 5% of patients. Our study also showed regional wall motion hypertrophy is found in 5% of patients. Our study shows left ventricular hypertrophy is found in 60% of patients. Echo Diastolic dysfunction is found in 27% of patients. In our study systolic dysfunction is found in 12% of patients. The study also shows IHD is found in 10% of patients. Our study shows pericardial effusion is found in 6% of patients. Dilated cardiomyopathy is found in 2% of patients. The most common finding in our study is left ventricular hypertrophy followed by diastolic dysfunction. Other studies such as Ramanan et al (2005)[13] the similar findings are found i.e. 42% patients having LVH, 12 % having ischemia, and 6% having pericardial effusion, Ladha et al (2014)[16] 74.3 % patients having LVH, 12.9 % having ischemia, and 24.3% having pericardial effusion, LVSD in 24.3 % patients, and LVDD in 61.4 % patients. Patients with end-stage renal illness frequently get pericarditis and pericardial effusions. In addition to etiologies common to the general population, patients with kidney illness also have two etiologies specific to them: uremic and dialysis-associated pericarditis.[17] Pericardial effusion can alter renal hemodynamics in a variety of ways, including by increasing the secretion of renin and vasopressin as well as atrial natriuretic peptide and renal efferent nerve activity. Acute renal failure can happen even in cases of pericardial effusion that are not associated with uremia, despite the fact that this condition is a consequence of uremia.[18]

CONCLUSION

Left ventricular hypertrophy is the commonest abnormality observed in patients with chronic kidney disease on maintenance hemodialysis both on ECG and Echocardiography. Echocardiography is a more sensitive diagnostic procedure to detect left ventricular hypertrophy. After Left Ventricular Hypertrophy the next common abnormality found on Echocardiography is Left Ventricular Diastolic Dysfunction. Pericardial effusion, Left Ventricular Systolic Dysfunction and conduction abnormalities are also common in patients of chronic kidney disease on maintenance hemodialysis.

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