Journal of Cardiovascular Disease Research
ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

A STUDY ON DIAGNOSTIC EVALUATION OF ECG AND ECHO RESULTS IN CKD PATIENS

Dr. Sanath Kumar [1], Dr. Bandi Suman [2], Dr. Chiluka Kiran [3]
1,2&3. Assistant Professors, Department of General Medicine, Kakatiya Medical College/MGM Hospital, Warangal, Telangana, India.

Corresponding author: Dr. Chiluka Kiran

AIMS AND OBJECTIVES

The evaluation of echocardiographic parameters in patients of CKD can help to determine the risk and prognosis of CVD in patients of CKD. In the present study, we evaluated the echocardiographic and ECG findings in patients of CKD on maintenance haemodialysis.

METHODS

This cross-sectional study was conducted in the nephrology unit of MGM Hospital,Warangal between January 2021 to May 2022. A total of 90 patients who were on maintenance for more than one year were included in the analysis. Echocardiography and ECG was done in each patient forthe determination of cardiac structural and functional parameters such as LV hypertrophy, ST-T changes, LBBB, LVC, VPC, ischemia and LV diastolic dysfunction.

RESULTS

The mean age of the patients was 45.8±9.8 years. There was male dominance with male/female ratio 58/32.There were 45.55% individuals with both DM+HTN, 13.33% were hypertensive and the prevalence of anaemia is 64.44% in CKD patients with Hb < 10 g/dl. LV dysfunction was diagnosed in 31% of patients, LV diastolic dysfunction in 47% patients, and left ventricular hypertrophy (LVH) in 55% of patients. LVHwas found in 20%, ischemia 32.22%, ST-T changes 22.22%.

CONCLUSION

There is a high frequency of cardiac functional and structural abnormalities in CKD patients on HD especially in patients having concomitant hypertension. LVH is the most common structural defect and LV diastolic dysfunction is the most common functional cardiac defect in CKD patients on haemodialysis.

Keywords: CKD, Hemodialysis, LVH, LV, Hypertension, DM

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

INTRODUCTION:

Chronic kidney disease (CKD) carries a significant association with cardiac diseases, which suggests a minor reduction in the glomerular filtration rate (GFR) can act as an independent risk factor for causing cardiovascular abnormalities[1]. The combination of risk factors accelerates the progression of arterial disease and is associated with a greater prevalence of ventricular hypertrophy, myocardial fibrosis, valvopathy, arrhythmia, ischemia and sudden death[2]. Most of the recent advances in the understanding of CKD-related CVD have focused on atherosclerosis and arteriosclerosis, and much less effort has been dedicated to unveil and evaluate the mechanisms and the impact of interventions related to myocardial dysfunction. Hence, echocardiographic evaluation plays a pivotal role in establishing the diagnosis of myocardiopathy as well as in stratifying risk and defining the impact of interventions. Chronic kidney disease(CKD) is characterized by a decrease in glomerular filtration rate (less than 60 ml /min for three months or longer) and histological evidence of decrease in nephron numbers. The clinical course is typically one of a progressive and continuous loss of nephron function ultimately leading to end stage renal disease.There are many causes of kidney injury that lead to the final common pathway of End stage renal disease (ESRD), and this state is characterized by hypertension, anemia, renal osteodystrophy, nutritional impairment, neuropathy, impaired quality of life, and reduced life expectancy[3]. CKD is a silent epidemic of the modern world. Surveys have suggested that as many as 16% of the adult population may have CKD. Its occurrence is not confined to developed countries; it's distribution is universal. Every year over one lakh people in India are diagnosed with CKD needing a kidney transplant or continue hemodialysis[4,5]. There is solid evidence that prevalence of cardiovascular disease(CVD) among End Stage Renal Disease(ESRD) patients is very high by the time renal replacement treatment is started. Cardiovascular diseases are the leading causes of death in renal transplant recipient patients[6-8]. The common risk factors for cardiovascular diseases such as hypertension, type 2 diabetes mellitus, dyslipidemia and obesity are highly prevalent in Chronic Kidney Disease populations. In the cardiovascular system, left ventricular hypertrophy (LVH) is the most frequent finding[9]. Echocardiogram allows for the evaluation of ventricular wall thickness, IVS thickness, chamber volume, and has an excellent accuracy for the detection of hypertrophy, detection of its geometric 9 pattern (concentric or eccentric), and assessment of systolic function. In addition, Doppler derived techniques can generate information regarding ventricular relaxation and its dynamics of filling and emptying, as well as concerning the presence of abnormalities in the cardiac valves like stenosis or regurgitation and the pericardium[10]. Changes similar to cardiac remodeling like Left Ventricular hypertrophy (LVH) are highly prevalent in Chronic Kidney Disease (CKD) and is associated with unfavorable cardiovascular prognosis; incidence of Left Ventricular Hypertrophy increases with a progressive reduction in renal function[11]. Left Ventricular systolic dysfunction is a strong indicator of poorprognosis in patients on renal replacement therapy[12]. Diastolic dysfunction is characterized by alteration inventricular relaxation and compliance, mostly followed by a compensatory increase in filling pressure in advanced stages. The later phenomenon is usually responsible for the manifestations of congestive cardiac failure, whatever the immediate cause may be. Small studies have also reported a presence of Left Ventricular diastolic dysfunction in Chronic Kidney Disease (CKD) patients varying from 50-65%, including pre-dialysis, dialysis and post-transplant populations[13]. Both, Electrocardiogram (ECG) and 2D Echocardiograph remains essential investigations for

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

evaluating cardiovascular disease[14,15]. Echocardiographic studies play an important role in evaluating cardiac functions especially for the evaluation of left ventricular and right ventricular function[16,17]. The present study thus aimed to evaluate the electrocardiogram (ECG) and 2-D echocardiographic changes in CKD patients of various stages.

OBJECTIVE OF THE STUDY

To study the Electrocardiographic and Echocardiographic changes in patients withChronic Kidney Disease.

MATERIALS AND METHODS

The present cross sectional observational study was started after being approved by the ethical committee of institution. Detailed information of all the participants regarding demographic status and detailed clinical history were obtained. The present study included 90 patients of CKD admitted in Department of Medicine and Department of Nephrology at Kakatiya Medical College/MGM HospitaL period January 2021- May 2022.

INCLUSION CRITERIA:

Patients with chronic kidney diseases with eGFR < 60ml/min/1.73m^2. The patients were classified into five stages of CKD, as per National Kidney Foundation (NKF) – Kidney Disease Outcome Quality Initiative (KDOQI) based on the eGFR. CKD EPI formula was used in calculating eGFR CKD stages as per NKF- KDOQI.

Stages	**Egfr**
Stage 1	> 90 ml/min/1.73 m^2
Stage 2	60-89 ml/min/1.73 m^2
Stage 3	45-59 ml/min/1.73 m^2
Stage 4	15–45 ml/min/1.73 m^2
Stage 5	< 15 ml/min/1.73 m^2

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

EXCLUSION CRITERIA:

- Documented ischemic heart disease
- Valvular heart disease
- Documented Congenital heart disease
- Patients who are on Chronic alcoholism
- Patients with acute kidney injury
- Patients who are Hepatitis B Surface antigen (HBsAg) Positive, Human Immuno-dificiency Virus (HIV) positive and Hepatitis C Viral (HCV) antibody positive.

The history, physical findings on examination with special emphasis on cardiovascularfindings and investigations were noted.

RESULTS

TABLE-1: AGE DISTRIBUTION AMONG CKD CASES

S.NO	AGE GROUPin YEARS	NUMBER OFCASES	PERCENTAGE
1.	21 – 30	3	3.33%
2.	31 – 40	12	13.33%
3.	41 – 50	36	40%
4.	51 – 60	22	24.44%
5.	61 – 70	17	18.88%

Cardiovascular manifestations are mostly prevalent among 41 – 50 years of age with thefrequency of 40% (36 cases) followed by 51-60 yr, 61-70 yr, 31-40 yr and 21-30 yr with the
incidence of 24.44% (22 cases), 18.88%(17 cases), 13.33%(12 cases) and 3.33% (3 cases)

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

respectively (Table 1).

TABLE-2: SEX DISTRIBUTION AMONG CKD CASES

S.NO	SEX	NUMBER OF CASES	PERCENTAGE
1.	MALE	58	64.44%
2.	FEMALE	32	35.55%

Cardiovascular manifestations are mostly prevalent among male patients64.44% (58 cases) followed by females with the prevalence of 35.55% (32 cases) (Table 2).

TABLE-3: CKD STAGEWISE DISTRIBUTION AMONG CASES

S.NO	STAGE	NO. OF CASES	PERCENTAGE
1.	II	6	6.66%
2.	III A	10	11.11%
3.	III B	28	31.11%
4.	IV	24	26.66%
5.	V	22	24.44%

In our study group, stage III B CKD patients are more prevalent with 31.11% cases followed by 26.66% of stage IV, 24.44% of stage V, stage IIIA cases were of 11.11% and stage II were of 6.66% incidence (Table3).

TABLE-4: HB LEVELS AMONG CKD PATIENTS

S.NO	Hb level (g/dl)	No of cases	Percentage
1.	<6	2	2.22%
2.	6-7.9	11	12.22%

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

3.	8-9.9	58	64.44%
4.	10-11.9	12	13.33%
5.	12-13.9	6	6.66%
6.	14-16	1	1.11%

In our study the incidence of anemia is most prevalent in 64.44% in CKD patients with Hb <10g/dl. Only 1.11% of cases were with Hb >14 g/dl (Table 4).

TABLE-5: UREA LEVELS AMONG CKD PATIENTS

S. No	Urea level(mg/dl)	No of cases	Percentage
1.	<50	6	6.66%
2.	50-99	10	11.11%
3.	100-149	27	30%
4.	150-199	25	27.77%
5.	**200&more**	**22**	**24.44%**

In our study group, 30% patients shown more prevalent with serum urea level 100-149mg/dl followed by 27.77% of 150-199mg/dl urea level, > 200 mg/dl urea level were with 24.44% cases, 11.11% cases were with urea levels of 50-99mg/dl and 6.66% cases were shown <50 mg/dl of serum levels of urea (Table 5).

TABLE-6: CREATININE LEVELS AMONG CKD PATIENTS

S. No	Creatinine (mg/dl)	No. of cases	Percentage
1.	<2	13	14.44%
2.	2-3.9	32	35.55%
3.	4-5.9	19	21.11%

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

4.	6-7.9	11	12.22%
5.	>8	15	16.66%

Out of 90 cases in our study predominantly 35.55% cases were shown serum creatinine in the range of 2- 3.9mg/dl followed by 4-5.9 mg/dl, >8 mg/dl, <2 mg/dl, 6-7.9 mg/dl serum creatinine in 21.11%, 16.66%,
14.44% 12.22% of cases respectively (Table 6).

TABLE-7: DURATION OF RENAL ILLNESS

S. No	Duration (in months)	No. of cases	Percentage
1.	<6 months	5	5.55%
2.	6-12 months	12	13.33%
3.	12- 24 months	18	20%
4.	24- 36 months	21	23.33%
5.	>36 months	34	37.77%

In the present study predominantly 37.77% of the cases were suffering with diagnosed CKD over three years (table 7) and out of which 58.88% (53 cases) were on regular hemodialysis and 41.11% (37 cases)

were on medication without HD (Table 8).

TABLE-8: INCIDANCE OF HEMODIALYSIS

S.NO		No of cases	Percentage
1.	On HD	53	58.88%
2.	Not on HD	37	41.11%

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

TABLE-9: ETIOLOGY OF CKD

S. No	Etiology	No. of cases	Percentage
1.	Diabetes mellitus	24	26.66%
2.	Hypertension	12	13.33%
3.	Chronic glomerulonephritis	9	10%
4.	DM + HTN	41	45.55%
5.	Others	4	4.44%

In 45.55% (41) cases DM + HTN is the most common etiology in CKD succeeded by DM alone in 26.66% cases, HTN was the only etiology in 13.33% cases and chronic glomerulonephritis and otherswere in only 10% and 4.44% cases respectively.

TABLE-10: ECG CHANGES AMONG CKD PATIENTS

S.NO	ECG CHANGE	NO OF CASES	PERCENTAGE
1.	LVH	18	20%
2.	ST-T CHANGES	20	22.22%
3.	LBBB	8	8.88%
4.	LVC	9	10%
5.	VPC	6	6.66%
6.	ISCHEMIA	29	32.22%

Out of 90 subjects mostly 32.22% cases shown ischemic changes succeeded by 22.22% with ST-T changes,

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

20% with LVH changes and 10%, 8.88%, 6.66% cases shown ECG changes of LVC, LBBB, VPCrespectively.

Table-11: ECHO CHANGES AMONG CKD PATIENTS

S. No	Findings	No of cases	Percentage
1.	Pericardial effusion	12	13.33%
2.	Calcified valves	20	22.22%
3.	Diastolic Dysfunction	18	20%
4.	Regurgitation	14	15.55%

Out of 90 cases 28.88% cases shown LVH ECHO changes followed by 22.22%, 20%, 15.55%, 13.33% cases with calcified valves, diastolic dysfunction, regurgitation and pericardial effusion type of ECO changes respectively.

TABLE-12: EF % DISTRIBUTION AMONG CKD PATIENTS

S. No	Systolic dysfunction	EF %	No of cases	Percentage
1.	Normal	55-80	18	20%
2.	Mild	45-55	39	43.33%
3.	Moderate	35-45	21	23.33%
4.	Severe	<35	12	13.33%

Out of included individuals mostly 43.33% cases were with mild systolic dysfunction with 45-55 EF% succeeded by moderate systolic dysfunction 23.33% and severe systolic dysfunction 13.33% cases with EF% of 35-45% and <35% respectively. Only 20% of individuals with normal range of systolic dysfunctionwith EF% with 55-80%.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

DISCUSSION:

CKD patients have higher proportions of congestive heart failure that is associated with a higher mortality rate in these patients[18]. Echocardiography is a valuable tool to assess the assess changes in function and structure of the heart that result from CKD. Abnormal LV geometry, reduction in interventricular septum strength, and changes in LV mass index are important parameters that are affected by CKD in patients with preserved EF[19]. Previous studies have reported anaemia, volume overload, electrolyte abnormalities oedema, and hypertension as risk factors that alter the risk of CVD in CKD patients[20,21]. In the present study, anaemia was diagnosed in 64.44% of patients, hypertension in 13.33%, and diabetes mellitus in 26.66% of patients. A study by Tsilonis et al. reported diabetes mellitus in 24% of patients and hypertension in 22% of patients of CKD patients on HD[22]. The current study reports the most common cardiac abnormality was LVH, found in 28.88% of patients, followed by LV diastolic dysfunction in 20% patients and LV systolic dysfunction in 10% of patients. A study conducted by Shivendra et al. reported LVH in 48% of patients, diastolic dysfunction in 51.42% patients, and systolic dysfunction in 28.57% patients of CKD on maintenance HD[23]. Agarwal et al. reported LV diastolic dysfunction in 53.2% patients and LV systolic dysfunction in 30% of patients having severe CKD[24]. Another study by Laddha et al. reported LVH in 74.3% patients, LV diastolic dysfunction in 61.4% patients, and systolic dysfunction in 24.3% patients[25].A similar study by Ahmed et al. LVH in 80% of patients, LV diastolic dysfunction in 53.3% patients, and LV systolic dysfunction in 36.3% patients[26]. Some studies have reported LV systolic dysfunction in all patients of HD[27,28], which is very high as compared to our study and the above-mentioned studies. The possible reason for this high proportion may be that these studies used the positron emission tomography scan for determination of systolic dysfunction that uses contrast-induced ischemic changes for diagnosis of ischemia and is superior to echocardiography for determination of cardiac dysfunction. Barre et al. reported LVH in 64.47% hypertensive patients and in 33.3% non-hypertensive patients. Shivendra et al. also reported similar findings; they reported LVH in 51% hypertensive versus in only 8.57% normotensive patients. In summary, cardiac abnormalities are common in patients of CKD on maintenance HD. So echocardiography should be performed at regular intervals in these patients especially those having hypertension along with CKD. A timely diagnosis of cardiac abnormalities can help in the early management of these complications and can help to reduce cardiac induced morbidity and mortality in CKD patients.

Acknowledgment

The author is thankful to Department of General Medicine for providing all the facilities to carry out this work.

Conflict of Interest

None

Funding Support

Nil

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

CONCLUSIONS

There is increasing evidence of the pivotal role of echocardiography in the improvement of quality of global clinical evaluation of advanced CKD patients. Current literature and clinical practice have emphasized the usefulness of the method for the diagnosis of clinical and subclinical cardiac dysfunction, the prediction of cardiovascular risk, and in the orientation and follow-up of treatment strategies. Guidelines recommend the echocardiogram for all dialysis patients 1–3 months after the start of renal replacement therapy and in intervals of 3 years subsequently, despite the symptoms. Our opinion is also that all patients starting dialysis therapy should have a comprehensive echocardiogram; however, follow-up with serial studies at closer intervals of 12–18 months seems to add prognostic value and should be considered for most dialysis patients. In addition, we believe it is a reasonable approach to repeat an echocardiogram in each patient with changes in symptoms, new clinical event, or a treatment likely to affect cardiac function. The exam should be scheduled on a non-dialysis day (days between, not the longest day), preferably between 12 and18 h .

REFERENCES

1. Luft FC. Baa, Baa, black sheep, are your kidneys full? J Physiol [Internet]. 2003;549-55.

2. Bucher L, Lewis SL, Dirkson SR, Harding MM, Heitkempermargaret M. Medical-Surgical Nursing:Assessment and Management of Clinical Problems. 2007. 376-390.

3. Mani M.K Prevention of chronic renal failure at the community level. Kidney International 2003; 63:586-9.

4. Agarwal SK, Srivastava RK, Chronic Kidney Disease in India - Challenges and Solutions, NephronClin Pract, 2009, 111, 197-203.

5. Prabahar MR, Chandrasekaran V, Soundarajan P, Renal Data from the Asia-Africa, Soudi Journal ofKidney Diseases and Transplantation, 2008, 19, 847-53.

6. Pisoni R, Aros C, Ruggenenti P, Remuzzi G. Mechanisms of progression of chronic renal disease. Saudi J Kidney Dis Transpl. 2002 Jul-Sep;13(3):250-6.

7. Remuzzi G, Bertani T. Pathophysiology of progressive nephropathies. N Engl J Med. 1998 Nov 12;339(20):1448-56.

8. El-NahasAM. Plasticity of kidney cells: role in kidney remodeling and scarring. Kidney Int. 2003 Nov;64(5):1553- 63.

9. Sarnak MJ, Levey AS, Schoolwerth AC, Coresh J, Culleton B, Hamm LL,et al. Kidney

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

disease as a risk factor for development of cardiovascular disease: A statement from the American Heart Association Councils on Kidney in Cardiovascular Disease, High Blood Pressure Research, Clinical Cardiology, and Epidemiology and Prevention. Circulation. 2003 Oct 28;108(17):2154-69.

10. Moe S, Drucke T, Cinningham. Definition, Evaluation and Classification of renal osteodystrophy a positive statement from kidney disease; Improving Global Outcome (KDIGO). Kidney Int. 2006;69: 1945-53.

11. Levin A,:Anaemia and left ventricular hypertrophy in chronic kidney disease population:A reviewof current state of knowledge. Kidney Int suppl. 2002; 80: 35-38.

12. Dhangri P, Agarwal S, Kalra OP, Rajpal S. Echocardiographic assessment of left ventricular hypertrophy in patient of chronic renal failure. Indian J Nephrol. 2003;13:92-7.

13. Cice G, Ferrara L, Di Benedetto A, Russo PE, Marinelli G, Pavese F et al; Dilated cardiomyopathyin dialysis patientsbeneficial effects of carvedilol; a double blind, placebo – controlled trial. J Am Collcardiol. 2001 Feb;37(2):407-11.

14. Prutkin JM. ECG tutorial: Basic principles of ECG analysis. UpToDate. 2013.

15. Salman shafi, Mahammad Saleem, Roshina Anjum, Wajid Abdullah Tahir Shafi. ECG abnormalities in patients with chronic kidney disease. j Ayub Med Coll Abbottabad 2017;29(1).

16. Agarwal S, Dangri P, Kalra OP, Rajpal S. Echocardiographic assessment of cardiac dysfunction inpatients of chronic renal failure. J Indian Acad Clin Med 2003; 4:296–303.

17. Nagueh SF, Appleton CP, Gillebert TC, Marino PN, Oh JK, Smiseth OA, Waggoner AD, Flachskampf FA, Pellikka PA, Evangelisa A. Recommendations for the evaluation of left ventricular diastolic function by echocardiography. European Journal of Echocardiography. 2009 Mar 1;10(2):165-93.

18. Renal insufficiency and heart failure: prognostic and therapeutic implications from a prospective cohort study. McAlister FA, Ezekowitz J, Tonelli M, Armstrong PW. *Circulation.* 2004;109:1004– 1009. [PubMed] [Google Scholar]

19. Association between renal function and cardiovascular structure and function in heart failure with preserved ejection fraction. Gori M, Senni M, Gupta DK, et al. *Eur Heart J.* 2014;35:3442–3451. [PMCfree article] [PubMed] [Google Scholar]

20. Comparative study of the effect of high-flux versus low-flux dialysis membranes on metabolic abnormalities in chronic hemodialysis patients. El Arbagy AR, Koura MA, El Barbary HS, Abou El Nasr AE. *Menoufia Med J.* 2014;27:677–682. [Google Scholar]

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

21. Left ventricular function in patients with chronic kidney disease evaluated by colour tissue Doppler velocity imaging. Hayashi SY, Rohani M, Lindholm B, et al. *Nephrol Dial Transplant.* 2005;21:125–
132. [PubMed] [Google Scholar]

22. Echocardiographic parameters during long and short interdialytic intervals in hemodialysis patients. Tsilonis K, Sarafidis PA, Kamperidis V, et al. *Am J Kidney Dis.* 2016;68:772–781. [PubMed] [GoogleScholar]

23. Echocardiographic changes in patients with ESRD on maintenance hemodialysis-a single centre study. Shivendra S, Doley PK, Pragya P, Sivasankar M, Singh VP, Neelam S. *J Cardiovasc Dis Diagn.* 2014;2:4. [Google Scholar]

24. Echocardiographic assessment of cardiac dysfunction in patients of end stage renal disease on haemodialysis. Laddha M, Sachdeva V, Diggikar PM, Satpathy PK, Kakrani AL. https://www.japi.org/s2646454/echocardiographic-assessment-of-cardiac-dysfunction-in-
patients-of-end-stage-renal-disease-on-haemodialysis *J Assoc Physicians India.* 2014;62:28–
32. [PubMed] [Google Scholar]

26. Study of echocardiographic changes among adult patients on maintenance hemodialysis. Ahmed HA, Yassein YS, Zaki SA, Al Qersh AM, Fahim FS. *Menoufia Med J.* 2016;29:44–51. [Google Scholar]

27. Hemodialysis-induced cardiac dysfunction is associated with an acute reduction in global and segmental myocardial blood flow. McIntyre CW, Burton JO, Selby NM. *Clin J Am SocNephrol.* 2008;3:19–26. [PMC free article] [PubMed] [Google Scholar]

28. Echocardiographic parameters as cardiovascular event predictors in hemodialysis patients [Article in Spanish] Siqueira TMA, Ferreira PAM, Monteiro FDC Jr, et al. *Arq Bras Cardiol.* 2012;99:714– 723.