

Ecg Changes In Patients With Chronic Kidney Disease According To Stage Of Disease —A Tertiary Care Hospital Study

Dr Sania Sabir , Dr Hafiz Muhammad Sohaib Khalid , Dr Faran Alam

Rawalpindi Medical University And Allied Hospitals Rawalpindi

ABSTRACT

BACKGROUND : Chronic kidney disease describes the gradual loss of kidney function for more than 3 months . CKD is associated with an increased risk of cardiovascular disease and chronic renal failure. It can lead to end-stage kidney failure, which requires dialysis or transplant . It is estimated that the annual incidence of new cases of end-stage renal disease (ESRD) is >100 per million population in Pakistan. CKD is associated with wide range of ECG abnormalities .

OBJECTIVE :The purpose of our research was to study ECG abnormalities in patients with Chronic Renal failure presenting in Department Of Medicine Rawalpindi Medical University Allied Hospital Rawalpindi .

METHODOLOGY : This cross sectional study was carried out from August 2017 to November 2017 on patients presenting in Medicine departments of Allied hospital RMU Rawalpindi with features suggestive of CKD. According to our reference study And WHO sample size calculator keeping level of significance 5 % our study sample size came out to be 94 .Our inclusion criteria was all CKD patients between age of 15 to 80 years with exclusion criteria of all those patients who have preexisting cardiac disease or pacemaker implantation. Data was analyzed in SPSS version 24 .

RESULTS : Our total study comprised of 94 cases. Mean age was 48.6 .Out of which 49(52.1%) were males and 45 (47.9%) were females, 60(63.8%) had hypertension , 31(33%) had Diabetes, 15(16%) were smokers . Out of 60 hypertensive patients 27 were males while females were 33 . 20 females were diabetic while 11 males were. All smokers were males. 49 patients had blood transfusion.50(53.2%) patients were on dialysis. 37 (39.4%) had no ECG changes ,16 (17%) had Tall T waves ,heart rate changes in 8 (8.5%) 5 had tachycardia while 3 had bradycardia ,left ventricular hypertrophy in 7 (7.4 %) ,Prolong PR interval in 6 (6.4%) ,Prolong QT interval 4(4.3%) ,Broad QRS complex in 4 (4.3%) ,ST segment

depression in 4 (4.3%) ,inverted T wave in 3 (3.2%) ,ST segment depression and T wave inversion both were in 1 (1.1%) ,Short QT interval 1 (1.1%) ,ST segment elevation 1(1.1%) ,Right bundle branch block 1(1.1%) and premature beats in 1 (1.1%).

CONCLUSION : The most common ECG abnormality in CKD patients came out to be Tall T waves which shows electrolyte abnormalities are mostly evident in such patients.

KEYWORDS : ECG ,CKD ,mortality .

INTRODUCTION

Chronic kidney disease is defined as slowly progressive loss of kidney function or structure for more than 3 months . Kidney damage is defined by pathologic kidney abnormalities , persistent proteinuria , other urine abnormalities, eg, renal hematuria ,imaging abnormalities and eGFR of less than 60 mL/min/1.73 m² .The stage of CKD defines the disease treatment and management modality . Proper treatment and prevention can be useful to reduce complications and progression of disease ².

The overall prevalence of CKD in the general population is approximately 14 percent ^{3,4}. High blood pressure and diabetes are the main causes of CKD. More than 661,000 Americans have kidney failure. Of these, 468,000 individuals are on dialysis, and roughly 193,000 live with a functioning kidney transplant ⁵.It is estimated that the annual incidence of new cases of end-stage renal disease (ESRD) is >100 per million population in Pakistan⁶.

Electrocardiography is the recording of the electrical activity of the heart with the use of electrodes placed on the skin which detects these changes . It is a very commonly performed cardiology test. In a conventional 12-lead ECG, 10 electrodes are placed on the patient's limbs and on the surface of the chest ⁷. Coronary artery disease is the primary type of cardiovascular disease in CKD patients and a significant cause of death among renal transplant patients.

Major risk factors for CVD in CKD include diabetes ,hypertension and smoking .

PATIENTS AND METHODS

This cross sectional study was carried out from August 2017 to November 2017 on patients presenting in Medicine departments of Allied hospital RMU Rawalpindi diagnosed as CKD. According to our reference study And WHO sample size calculator keeping level of significance 5 % our study sample size came out to be 94⁹ .Our inclusion criteria was all CKD patients between age of 15 to 80 years. All those patients who had preexisting cardiac lesion or pacemaker implantation were excluded. Patient was considered to have CKD if they had estimated GFR less than 60ml/min/1.73m² or if there was persistant proteinurea for 3 or more months. EGFR was calculated by Davita GFR calculator. After informed consent data from patients data was collected from patients fulfilling our inclusion criteria keeping their privacy being assured by structured questionnaire . All patient underwent 12 lead ECG at time of their admission. ECG was interpreted by qualified cardiologist. Our sampling technique was non probability random sampling technique. Data was entered and analyzed in SPSS version 24 .Frequencies , percentages were calculated for categorical variables i.e

TABLE 1: GENDER DISTRIBUTION:

GENDER	FREQUENCY	PERCENTAGE
MALE	49	52.1
FEMALE	45	47.9
TOTAL	94	100

TABLE 2 : AGE DISTRIBUTION

AGE	FREQUENCY(n)	PERCENTAGE
0-25	7	7.4%
26-50	45	47.9%
51-75	40	42.6%
76-100	2	2.1%
TOTAL	94	100%

TABLE 3 : FREQUENCY OF SMOKING,DIALYSIS,HYPERTENSION AND DIABETES

	DIALYSIS	SMOKING		HYPERTENSION	DIABETES
YES	50(53.2%)	15(16%)	yes	60(63.8%)	31(33%)
NO	44(46.8%)	79(84%)	no	34(36.2%)	63(67%)
TOTAL	94(100%)	94(100%)	total	94(100%)	94(100%)

frequency of patients on dialysis, frequency of diabetes, hypertension, smoking and ECG changes in CKD patients.

RESULTS

Our total study comprised of 94 total cases. Mean age was 48.6 .Out of which 49(52.1%) were males and 45 (47.9%) were females,60(63.8%) had hypertension, 31(33%) had Diabetes, 15(16%) were smokers.49 patients had blood transfusion.50(53.2%) patients were on dialysis. 37 (39.4%) had no ECG changes ,16 (17%) had Tall T waves ,heart rate changes in 8 (8.5%) ,left ventricular hypertrophy in 7 (7.4 %) ,Prolong PR interval in 6 (6.4%) ,Prolong QT interval 4(4.3%) ,Broad QRS complex in 4 (4.3%) ,ST segment depression in 4 (4.3%) ,inverted T wave in 3 (3.2%) ,ST segment depression and T wave inversion both were in 1 (1.1%) ,Short QT interval ,ST segment elevation ,Right bundle branch block and premature beats in 1 (1.1%) . Serum Creatinine within 0 to 4 range were 38 (40.4%) ,5 to 8 36 (38.3%) ,9 to 12 were 12 (12.8%) ,13 to 16 and 17 to 20 range were 4 (4.3%) . GFR less than 15 62 patients (65.9%) ,15 to 30 26 (27.6%) and 31 to 60 6 (6.6%) . 4 patients had stage 3A, 4 had stage 3B ,27 had stage 4,and 57 had stage 5 CKD.

TABLE 4: SERUM CREATININE LEVELS :

	FREQUENCY	PERCENTAGE
0-4	38	40.4
5-8	36	38.3
9-12	12	12.8
13-16	4	4.3
17-20	4	4.3
TOTAL	94	100

TABLE 5: STAGE OF CKD

	FREQUENCY	PERCENT
3	4	4.3
3B	4	4.3
4	27	28.7
5	59	62.8
TOTAL	94	100

TABLE 6: ECG CHANGES IN CKD PATIENTS:

ECG CHANGE	Frequency	Percentage
Broad QRS	4	4.3
Heart rate changes	8	8.5
Inverted T wave	3	3.2
left ventricular hypertrophy	7	7.4
no changes	37	39.4
premature beats	1	1.1
Prolong PR interval	6	6.4
Prolong QT interval	4	4.3
right bundle branch blocked	1	1.1
Short QT interval	1	1.1
ST elevation	1	1.1
ST segment depression	4	4.3
ST segment depression and T wave inversion	1	1.1
Tall T wave	16	17.0
Total	94	100.0

TABLE 7: GFR

GFR	FREQUENCY
<15	62(65.9%)
15_30	26(27.6%)
31_60	6(6.6%)

DISCUSSION:

Chronic kidney disease (CKD) is a gradual loss of kidney function over a period of months or years ¹¹. CKD is defined as "glomerular filtration rate (GFR) of less than 60 mL/min/1.73 m² for at least 3 months. Loss of kidney function and reduction in GFR is an irreversible process ¹². CKD leads to end stage renal failure and cardiovascular complications if not controlled timely .

Various studies at international , national and local level were done to see the ECG changes in chronic kidney disease patients .Our reference study done in department of nephrology Sharif medical and dental college Lahore showed ECG abnormalities are present in 78.4% of patients .Total number of patients included in the study was 124. 106 (84.8%) had hypertension, 84 (70%) had diabetes mellitus, and 35 (29.9%) had known cardiovascular disease. Mean eGFR was 10.6±9.2 ml/min/1.73 m². Left ventricular hypertrophy was the most common ECG abnormality ¹³. While in our study out of 94 cases 49(52.1%) were males and 45 (47.9%) were females,60(63.8%) had hypertension, 31(33%) had Diabetes ,mean age was 48.6 ,37 (39.4%) had no ECG changes ,16 (17%) had Tall T waves ,heart rate changes in 8 (8.5%) ,left ventricular hypertrophy in 7 (7.4 %) ,Prolong PR interval in 6 (6.4%) ,Prolong QT interval 4(4.3%) ,Broad QRS complex in 4 (4.3%) ,ST segment depression in 4 (4.3%) ,inverted T wave in 3 (3.2%) ,ST segment depression and T wave inversion both were in 1 (1.1%) ,Short QT interval ,ST segment elevation ,Right bundle branch block and premature beats in 1 (1.1%) ¹⁴

A study done in Israel Hadassah Medical Center on chronic renal failure patients who were on dialysis it was observed

that all patients exhibited ECG changes, which were most pronounced during the first 2 hours of dialysis. The most frequent of these changes were a decrease in T wave amplitude and increase in T max time (all patients), an increase of QRS amplitude (61% of patients), shortened or prolonged Q Tc interval (61%) and ischemic-like ST-T changes (22% and 39%, respectively). Potentially clinically significant arrhythmias occurred in 12 patients (31%) of which 8 were supraventricular , 3 were combined ventricular and supraventricular, and 1 was pure ventricular¹⁵. The results were consistent with our study that patients with chronic renal failure frequently exhibit ECG changes and a high incidence of ventricular and supraventricular arrhythmias, which may be prognostically significant during and after hemodialysis.

A study done in India on 60 cases of chronic kidney disease in which ECG was normal in 15 cases (25%) ,LVH in 20 (33.33%) left axis deviation in 9 (15%) ,conduction disturbances in 10 (16.67%) ,ischemia in 12 out of 60 (3.33%) ,P _ mitrale in 4 (6.67 %) .The most common ECG abnormality was left ventricular hypertrophy ¹⁷. A six months cross-sectional study carried out at Chittagong Medical College Hospital in Chittagong, Bangladesh. Total 50 patients were selected .Left ventricular hypertrophy was the most common ECG abnormality . Though 28 patients (56%) were hyperkalaemic only 9 patients (38%) of them had tall tented T wave in ECG¹⁸. Another study done in the UNICOM clinic , total One hundred and seventy nine

patients were included in the study. The majority of the patients were males. About 50% of all patients had, at least, one electrical conduction disturb. Almost half of the patients had QTc prolongation and Left Ventricular Hypertrophy¹⁶.

Cardiovascular disease (CVD) is the main cause of death in patients with chronic kidney disease undergoing hemodialysis, and the high mortality rates and progression of CVD in this population are well known.¹⁸. Electrocardiograms are affordable diagnostic tools for renal therapy centers that provide important information regarding cardiac electrical conduction, some of which has prognostic implications in terms of cardiovascular mortality¹⁹.

CONCLUSION

Majority of people with CKD had no ECG changes. The most common ECG abnormality was electrolyte imbalance depicted as Tall T waves then was Heart rate changes and left ventricular hypertrophy.

REFERENCES

- [1]. Kamyar Kalantar Zedah. Chronic Kidney disease staging and progression. Chronic Kidney Disease Clinical Practice Recommendations for Primary Care Physicians and Healthcare Providers, 6th ed : Henry Ford health system; 2011.
- [2]. Levey AS, Coresh J, Balk E, Kausz AT, Levin A, Steffes MW, et al. National Kidney Foundation practice guidelines for chronic kidney disease: evaluation, classification, and stratification. *Ann Intern Med.* 2003 Jul 15. 139(2):137-47.
- [3]. National Kidney Foundation. K/DOQI Clinical Practice Guidelines for Chronic Kidney Disease: Evaluation, Classification and Stratification. *American Journal of Kidney Diseases* 2002; suppl 1 (39): S1-S266.
- [4]. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2012 clinical practice guideline for the

evaluation and management of chronic kidney disease. *Kidney Int Suppl* 2013;3(1):1–150.

- [5]. Xu JQ, Murphy SL, Kochanek KD, Bastian BA. Deaths: Kidney Disease Statistics for the United States. *NIDDK* 2016;
- [6]. Paul W. Eggers, Rose Connerton, Michael McMullan. The Medicare experience with end-stage renal disease: Trends in incidence, prevalence, and survival. *MMRR* 1984; 5(3):
- [7]. Guijarro-Morales A., Gil-Extremera B., Maldonado-Martín A. "ECG diagnostic errors due to improper connection of the right arm and leg cables". *International Journal of Cardiology.* 2016; **30** (2): 233–235
- [8]. Hudaifa Alani, Asad Tamimi, Nihad Tamimi. Cardiovascular co-morbidity in chronic kidney disease: Current knowledge and future research needs. *World J Nephrol.* 2014 Nov 6; 3(4): 156–168.
- [9]. Salman Shafi, Mohammad Saleem. ECG abnormalities in patients with chronic kidney disease. *J Ayub Med Coll Abbottabad* 2017; 29(1): 61_4
- [10]. Mitra PK, Tasker PR, Ell MS; Chronic kidney disease. *BMJ.* 2007 Jun 16;334(7606):1273
- [11]. "What is Chronic Kidney Disease". National Institute of Diabetes and Digestive and Kidney Diseases. June 2017. Retrieved 19 December 2017.
- [12]. Schnaper HW. Remnant nephron physiology and the progression of chronic kidney disease. *Pediatr Nephrol.* 2014 Feb. 29 (2):193-202.
- [13]. Shapira OM, Bar-Khayim Y.. ECG changes and cardiac arrhythmias in chronic renal failure patients on hemodialysis. *J Electrocardiol* 1992; 25(4):
- [14]. Satish Sachdeva, Tarvinderjit Khurana. ECG and ECHO changes in CKD. *Ann. Int. Med. Den* 2017; 3(5):
- [15]. Dutta PK, Das S.. Value of electrocardiogram in predialytic chronic kidney disease patient without known coronary artery disease. *IJMRHS.* 2014; 3(4): 967-974 ; ():
- [16]. Luís Henrique BignottoI; Marina Esteves KallásII; Rafael Jorge Teixeira DjoukiI; Marcela Mayume SasakiIII; Guilherme Ota VossIV; Cristina Lopez SotoII; Fernando FrattiniV; Flávia Silva Reis MedeirosVI. Electrocardiographic findings in chronic hemodialysis patients. *SCIENO* 2012; 34(3): .
- [17]. Tesar V. Cardiovascular complications in patients with chronic renal insufficiency and chronic kidney failure. *Vnitr Lek.* 2003;49(5): 383–387.
- [18]. Nagesh S. Anavekar, Marc A. Pfeffer. Cardiovascular risk in chronic kidney disease. *KI* Nov 2004; 66(1):
- [19]. Di Iorio BR, D'Avanzo E, Piscopo C, Grimaldi P, Cucciniello E, Cillo N, et al. Progression of vascular calcification increases QT interval in haemodialysis patients. *Nephrol Dial Transplant* 2006;21:3609-10.