

## ORIGINAL ARTICLE

# ECG for Detection of Left Ventricular Hypertrophy in patients with Chronic Kidney Disease

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## ABSTRACT

**Background:** Left ventricular hypertrophy is the most common cardiac event associated with chronic kidney disease.**Aim:** To detect LVH by electrocardiography in patients with CKD.**Study design:** Observational study.**Methodology:** It was an observational study with total of 62 CKD patients enrolled through convenience sampling. Their blood 3ml was drawn aseptically for estimation of serum creatinine. All enrolled subjects underwent electrocardiographic examination. Patients with low GFR (<60ml/min/1.73m<sup>2</sup>) and high serum creatinine concentration (>1.5mg/dl) were included. Data was evaluated by using SPSS v24. The results were presented as counts, means and standard deviation as appropriate.**Results:** Left ventricular hypertrophy was present in 50% of enrolled patients as depicted by ECG recording. The calculated sensitivity and specificity of ECG for LVH were 75% and 100% respectively. Almost 38.7% patients were 56-65 years of age. There were 33.9% patients in the age of 35-45 years and 27.4% was in the age of 46-55 years. The median (IQR) age was 54.50 (41.75-60) years. In our study population, median (IQR) of height was 152cm (150-156). The mean weight was 65.85 kg with standard deviation of 8.42 kg i.e., 65.85 ±8.42kg. Mean body mass index was 27.85. **Practical Implication:** Current project helped health providers to diagnose cardiac event at an early stage among patients of kidney failure on ECG findings thus the adverse outcomes could be prevented or delayed.**Conclusion:** ECG abnormalities are common in hospitalized CKD patients in local population. All hospitalized CKD patients should undergo ECG to screen for cardiovascular disease. It was thus concluded that ECG can be used as a sensitive diagnostic tool in combination with different ECG indices to detect LVH.**Key words:** Electrocardiography, Chronic Kidney Disease, Left Ventricular Hypertrophy and Sokolow-Lyon Voltage Index.

## INTRODUCTION

Literature review revealed that when abnormality of kidney structure and function (GFR<60ml/min/1.73m<sup>2</sup>) is present for more than 3 months than Chronic kidney disease (CKD) is labeled.<sup>1</sup> Classically, albuminuria precedes deterioration in renal functional as shown by decrease in GFR.<sup>2</sup> Chronic kidney disease (CKD) is a common health issue in developing countries according to many epidemiological surveys. Unfortunately, according to one estimate, stage 3 and 4 CKD has incidence of almost 14% in Pakistan, being highest in Punjab province.<sup>3</sup> This disease usually affect middle and older age groups people as reported by previous study<sup>4</sup>.

There are many risk factors that are associated with this disease but diabetes and hypertension are the silent killers of humans. They both affect kidneys and result in CKD later in life.<sup>5</sup> Other risk factors for CKD include metabolic syndrome, low levels of High Density Lipoprotein (HDL) and abdominal obesity.<sup>6</sup> (Chen et al., 2004). Obesity is a mother cause of many diseases like diabetes and hypertension thus increases CKD chances among patients and ultimately cause glomerulosclerosis.<sup>7</sup>

Left ventricular hypertrophy is the most common cardiac event associated with chronic kidney disease. As CKD advances from early stage to ESRD than LVH prevalence increases from 25% to 70% as reported by one study.<sup>8,9</sup> Pathologically, constantly increased workload on the heart causes an increase in left ventricular mass. Pattern of hypertrophy depends on inciting mechanism for hypertrophy. There is an association between cardiac and kidney functions. Dysfunction in any of these organs puts stress on other resulting in cardio-renal Syndrome (CRS)<sup>10</sup>.

One previous literature review revealed that overall 78.4% of all CKD patients have one or more ECG abnormality. Left ventricular hypertrophy (40%), Q waves (27.2%), ST segment elevation or depression (23.4%), prolonged QRS duration (19.2%), tachycardia (17.6%) and left and right atrial enlargement (17.6%) were the most common abnormalities<sup>11</sup>.

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According to literature review it was revealed that Left ventricular hypertrophy was the commonest morphological abnormality observed among CKD patients. Myocardial ischemia, conduction disturbance were better made out electrocardiographically. Echocardiography was a more sensitive diagnostic procedure to detect left ventricular dysfunction<sup>12</sup>.

Electrocardiography is a simple tool for recording electrical activity of heart<sup>13</sup>. It can indicate depolarization anomalies associated with LVH among patients with chronic heart disease<sup>14</sup>. Literature review reported that Sokolow Lyon index (SLI) has 90% specificity with 40% sensitivity for LVH detection. When there is R wave in V5 or V6 and S wave in V1 chest leads and their sum becomes greater than 35mm than LVH is diagnosed.<sup>15</sup> There is high incidence of CKD and risk of LVH development in our society thus early diagnosis of cardiovascular event is required. ECG abnormalities occur commonly among CKD hospitalized patients. In order to prevent and treat cardiac event at an early stage being a developing country, need of hour is to have cheap diagnostic tool hence use of ECG for every patient can be helpful. Due to lack of local data on the significance of ECG as diagnostic tool for LVH, we planned current study. Thus this project helped health providers to diagnose cardiac event at an early stage among patients of kidney failure on ECG findings thus the adverse outcomes could be prevented or delayed.

The objective of the study was to detect left ventricular hypertrophy by ECG in patients with chronic kidney disease.

## METHODOLOGY

It was an observational study with total of 62 CKD patients enrolled through convenience sampling. Their blood 3ml was drawn aseptically for estimation of serum creatinine. All enrolled subjects underwent electrocardiographic examination. Patients with low GFR (<60ml/min/1.73m<sup>2</sup>) and high serum creatinine concentration (>1.5mg/dl) were included. Patients with ECG abnormalities while taking drugs which can alter ECG like digitalis therapy were ruled

out from study. Written informed consent with demographic data was taken.

**Statistical analysis:** Data was evaluated by using SPSS version 24. Gender presented as frequencies and percentages. Median and interquartile range (IQR) given for non-normally distributed variables (age). Normal distribution of the data was checked by using test of normality (Kolmogorov-Smirnov test). Mean±standard deviation given for normally distributed quantitative variables & median and interquartile range (IQR) given for non-normally distributed variables. Independent sample “t-test” and Mann-Whitney U test were applied to compare normally and non-normally distributed variables respectively. Spearman correlation was applied to check the correlation of variables. P value of < 0.05 was considered significant.

**RESULTS**

Age ranged from 35 to 65 years. Other parameters like gender, BMI and CTSI were shown as frequency and percentage in table-1. Almost 38.7% patients were 56-65 years of age. Almost 33.9% patients were in the age of 35-45 years and 27.4% was in the age of 46-55 years. The median (IQR) age was 54.50 (41.75-60) years. (Table-1) In our study population, median (IQR) of height was 152cm (150-156). The mean weight was 65.85 kg with standard deviation of 8.42 kg i.e., 65.85 ±8.42kg. The percentage of obese (>28kg/m<sup>2</sup>) in the study population was 46.8% while 41.9% of the study population was overweight (23.00-27.99)kg/m<sup>2</sup> and 11.3% had normal weight (17.50-22.99) kg/m<sup>2</sup>. No one was underweight i.e <17.50kg/m<sup>2</sup>. Mean body mass index was 27.85 (table-1).

Table-1: Demographic Data (n=62)

Parameters	Groups	Frequency(%)
Age (years)	35-45	21(33.9%)
	46-55	17(27.4%)
	56-65	24(38.7%)
	Median IQR for Age	54.50 (41.75-60)
Gender	Male	36(58.1%)
	Female	26(41.9%)
BMI (kg/m <sup>2</sup> )	Normal Weight	7(11.3%)
	Over Weight	26(41.9%)
	Obese	29(46.8%)
	Mean ± SD	27.85±3.88

Electrocardiography findings among patients with chronic kidney disease on the basis of different cardiac indices were demonstrated in table-2. Present study results showed that 28(45.2%) had LVH and 34(54.8%) had no LVH according to Sokolow Lyon amplitude criteria.

Table-2: LVH Among CKD patients as per ECG Indices

ECG Indices	LVH(+)	LVH(-)	Median IQR
SLA	28(45.2%)	34(54.8%)	29.5
CA	04(6.5%)	58(93.5%)	13.50
SLP	01(1.6%)	61(98.4%)	1420
CP	0(0%)	62(100%)	560
ECG	31(50%)	31(50%)	

Diagnostic accuracy of ECG for LVH in terms of sensitivity and specificity shown in table-3.

Table-3: Sensitivity and Specificity of ECG for LVH in CKD Patients

Parameters	Sensitivity	Specificity	PPV	NPV
ECG	75%	100%	100%	67%
SLA	68%	100%	100%	61.76%
CA	9.7%	100%	100%	36.20%
SLP	2.5%	100%	100%	2.5%
CP	0%	0%	0%	0%

**DISCUSSION**

Left ventricular hypertrophy was present in 50% of enrolled patients as depicted by ECG recording. Among the ECG indices used, SLI showed 68% sensitivity in detecting LVH. Our results

were in line with many studies that reported its sensitivity from 61 to 68%<sup>16-18</sup>. Paradoxically, few studies reported poor sensitivity of SLI ranging from 7 to 21%<sup>19,20</sup>.

Indices like Sokolow Lyon product (SLP) and Cornell product (CP) showed low sensitivity of 9.7% and 2.5% respectively according to our results. One study reported high sensitivity (15% and 33% respectively) for above mentioned indices thus different to our findings.<sup>21</sup> According to our results specificity of SLI and CI was 100% which was in line with many previous studies that reported that high specificity (85-100%) for all the ECG indices.<sup>22,23</sup>

There are many parameters that affect the sensitivity of ECG indices for LVH detection. Obesity lowers the sensitivity of SLI. One previous literature review revealed that overall 78.4% of all CKD patients have one or more ECG abnormality. Left ventricular hypertrophy (40%), Q waves (27.2%), ST segment elevation or depression (23.4%), prolonged QRS duration (19.2%), tachycardia (17.6%) and left and right atrial enlargement (17.6%) were the most common abnormalities<sup>11</sup>. Our results showed that LVH was a common cardiac issue and is well diagnosed by ECG. In our study majority of patients were obese (46.8%) and overweight (41.9%) thus decreased sensitivity of ECG indices.

Similarly on study showed that electrocardiographically determined cardiovascular abnormalities were observed in 72% of patients. LVH in 30% patients, Ischemia is observed in 16% patients. Intraventricular conduction disturbance in found in 8 patients (16%). P mitrale in noticed in 10 patients (10%). Arrhythmia found in 6 patients (6%). Echocardiographic abnormalities were observed in 68 patients (68%). Left ventricular hypertrophy was seen in 46 patients (46%). LA+LV dilatation was seen in 8 patients (8%). Regional wall motion abnormalities were seen in 12 patients (12%).<sup>12</sup> Pericardial effusion was seen in 6 patients (6%). Their results were similar to our findings.

**CONCLUSION**

ECG abnormalities are common in hospitalized CKD patients in local population. All hospitalized CKD patients should undergo ECG to screen for cardiovascular disease. It was thus concluded that ECG can be used as a sensitive diagnostic tool in combination with different ECG indices to detect LVH.

**Author’s contribution: HH&MS:** Overall supervision, write up and literature review, **HNL&SK:** Statistics application, analysis literature review, helped in write up, **AZ & NMR:** Literature review help in write-up.

**Limitations:** Single centre study with financial constrains and limited resources.

**Conflict of interest:** None

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