

## ORIGINAL PAPER

# Clinical study of cardiovascular complications in chronic kidney disease patients with special reference to echocardiography

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Received on January 12, 2016; editorial approval (revised) on October 15, 2016

## ABSTRACT

**Background:** Cardiovascular abnormalities are commonly encountered in patients with chronic kidney disease (CKD) or end stage renal disease (ESRD) and these include left ventricular hypertrophy (LVH), left ventricular dilatation, and left ventricular systolic and diastolic dysfunction. Uremic cardiomyopathy is thought to be the pathological cardiac hypertrophy, indicating the influence of impaired renal function on the myocardium. Cardiovascular complications lead in all causes of mortality among patients with CKD, accounting for approximately 50% of deaths. **Method:** It was a hospital based study conducted from March 2014 to March 2015 in Guwahati Medical College where CKD patients were evaluated for presence of any cardiovascular morbidity. **Results:** Cardiomegaly on chest x-ray was present in 64% of the patients. Electrocardiography and 2D echocardiography of patients revealed LVH in 76% and 84% of patients. Left ventricular systolic dysfunction (LVSD) was found in 52 % of patient of which 34 % had mild dysfunction (LVEF= 45% -54%) and 18 % had moderate dysfunction (LVEF= 35% -44%). Diastolic dysfunction was found in 54 % of patient. **Conclusion:** Cardiovascular complications are common in patients with chronic kidney disease, which is an important cause of morbidity and mortality in these patients and the most common morbidity found in this study was left ventricular hypertrophy.

**Keywords:** Chronic kidney disease, cardiovascular complications, echocardiography

## INTRODUCTION

Chronic kidney disease (CKD) encompasses a spectrum of different pathophysiologic processes associated with abnormal kidney function and a progressive decline in glomerular filtration rate (GFR). Cardiovascular abnormalities commonly encountered in patients with CKD or ESRD include left ventricular

hypertrophy (LVH), left ventricular dilatation, and left ventricular systolic and diastolic dysfunction.<sup>1</sup> Uremic Cardiomyopathy is thought to be the pathological cardiac hypertrophy, indicating the influence of impaired renal function on the myocardium. It is the result of pressure overload, volume overload, and the uremic state itself. LV pressure overload occurs frequently from hypertension and arteriosclerosis, and occasionally from aortic stenosis; LV volume overload occurs as a result of the presence of an arteriovenous fistula, anemia, and hypervolemia. Cardiovascular complications are a major cause of morbidity and mortality in CKD patients, accounting for approximately 50% of deaths.<sup>2</sup>

**Aims:** (i) To study the clinical presentation with special reference to cardiovascular system in patients with chronic kidney disease and (ii) To study the prevalence of various cardiovascular abnormalities in chronic kidney disease patients using echocardiography.

## MATERIALS AND METHODS

The study was conducted in patients with chronic kidney disease admitted in Department of Nephrology and Medicine, Gauhati Medical College Hospital, Guwahati during the period March 2014 to March 2015. CKD patients are divided into 5 stages according to GFR as shown in **Table 1**. CKD stage 3 to stage 5 were included in the study

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**Table 1** Stages of Chronic kidney disease

Stages	GFR (ml/min)
1	≥ 90
2	60- 89
3	30- 59
4	15- 29
5	< 15

**Exclusion criteria:**

- 1) Patients who were known valvular heart disease, coronary heart disease, diabetes mellitus, hyper/hypothyroidism.
- 2) Patients who were known hypertensive for years before the onset of CKD.
- 3) Patients who underwent dialysis after admission.
- 4) Patients above 50 years of age.
- 5) Patients who were alcoholics.

After admission, each patient was subjected to a thorough history and clinical examination with special interest to the cardiovascular system, necessary blood investigations, chest X ray, electrocardiography (ECG) and 2D Echocardiography.

**RESULTS**

The study included a total of 50 CKD patients of which 5 (10%) belonged to stage 3 CKD, 29 (58%) belonged to stage 4 and 16 (32%) belonged to stage 5 CKD. Chronic glomerulonephritis (52%) was the most common cause of CKD in the present study, followed by chronic interstitial nephritis (16%), obstructive uropathy (10%), systemic lupus erythmatosus (6%) and etiology was unknown in 8 (16%) patients. Of these 50 patients, 40(80%) were males and 10 (20%) were females. The age and sex distribution of the patients are shown in **Table 2**.

**Table 2** Age-sex distribution of patients

Age group (years)	Male	Female
< 20	5	2
21- 30	13	3
31- 40	16	5
41- 50	6	0
Total	40	10

Regarding the symptoms, easy fatigability was found in 100% of patients, followed by dyspnea in 68 %, chest pain in 18 %, palpitation in 14 % and syncope in 8 % of patients. The symptoms of the patients are shown in **Table 3**.

**Table 3** Showing the symptoms

Symptoms	Present	
	Numbers	Percentage (%)
Easy fatigability	50	100
Dyspnea	34	68
Chest pain	9	18
Palpitations	7	14
Syncope	4	8

The various examination findings in the patients including the signs in general physical examination, signs in clinical examination and auscultatory findings are shown in **Table 4**, **Table 5** and **Table 6** respectively.

**Table 4** Showing the signs on clinical examination (General physical examination)

Symptoms	Present	
	Numbers	Percentage (%)
Pallor	50	100
Pedal edema	26	52
Elevated JVP	17	34
Hypertension	40	80
Tachycardia	8	16
Irregular pulse	7	14

**Table 5** Signs on clinical examination (Systemic examination)

Symptoms	Present	
	Numbers	Percentage (%)
Apex shifted	5	10
Muffled heart sounds	8	16
Murmurs	12	24
Pericardial rub	1	2
Tender hepatomegaly	1	2
Anasarca (ascites± pleural effusion± pedal edema)	7	14
Pulmonary edema	18	36

**Table 6** Auscultatory findings in CKD patients

Auscultatory findings	Numbers	Percentage (%)
Muffled heart sounds	8	16
Haemic murmur	5	10
ESM-AA	4	8
PSM-MA	3	6
Pericardial rub	1	2

Chest X ray and ECG were done in all the patients. In chest x ray (PA view), 64% of patients had cardiomegaly (cardiothoracic index >0.5). Pulmonary edema and pleural effusion was present in 8 % and 12 % of patients respectively. The various electrocardiographic (ECG) findings of the patients are shown in **Table 7**

**Table 7** Electrocardiography (ECG) changes in CKD patients

Findings		No of patients (n=50)	Percentage (%)
Rhythm	Sinus	45	90
	Non sinus	5	10
Rate	Tachycardia	8	16
	Bradycardia	0	0

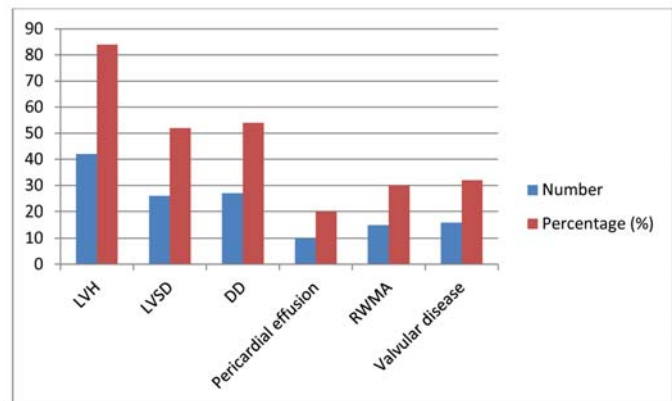
QRS axis	Left	10	20
	Right	0	0
Atrial enlargement	Left	10	20
	Right	0	0
	Both	0	0
Ventricular hypertrophy	Left	38	76
	Right	0	0
	Both	0	0
Conduction defect	1p AV block	2	4
	2p AV block	1	2
	LBBB	0	0
	RBBB	18	36
	CHB	10	20
	IVCD	0	0
Arrhythmia	AF	2	4
	APC	8	16
	VPC	18	36
	Sinus		
	tachycardia	8	16
	Others	0	0
Poor R wave progression		9	18
Non specific ST-T changes		17	34

IVCD (intraventricular conduction defect), AF (atrial fibrillation), APC (atrial premature contraction), VPC (ventricular premature contraction)]

On 2D echocardiography, LVH was found in 84 % of the patients. Left ventricular systolic dysfunction (LVSD) was found in 52 % of patient of which 34 % had mild dysfunction (LVEF= 45% - 54%) and 18 % had moderate dysfunction (LVEF= 35% - 44%). Diastolic dysfunction (DD) was found in 54 % of patient of which 36 % had grade 1 dysfunction and 18 % had grade 2 dysfunction. Pericardial effusion was found in 20 % and regional wall motion abnormalities (RWMA) in 30 % of patients. Valvular heart disease was detected in 32 % of patients of which mitral regurgitation was found in 22% of patients and aortic stenosis in 10 % of patients. The echocardiographic findings of the patients are shown in **Table 8** and **Figure 1**.

**Table 8** Echocardiographic findings of the patients

Echocardiographic Findings	Number	Percentage (%)
LVH	42	84
LVSD	26	52
DD	27	54
Pericardial effusion	10	20
RWMA	15	30
Valvular heart disease	16	32



**Figure 1** Showing echocardiographic findings of the patients

The Clinico–ECG–Echocardiographic correlation regarding LVH is shown in **Table 9**.

**Table 9** Showing Clinico–ECG–Echocardiographic correlation regarding LVH

	No	Percentage (%)
Apex shifted	5	10
Cardiomegaly in CXR	32	64
LVH in ECG	38	76
LVH in 2D ECHO	84	84

## DISCUSSION

All adult patients who fulfilled the inclusion and exclusion criteria were included in the study. A total of 50 cases were taken of which 40 (80%) were males and 10 (20%) were females.

Easy fatigability was the most common symptom which was present in all the patients. Chest pain was found in 9 patients (18%). Foley RN et al<sup>3</sup> in their study found angina pectoris in 19% of the CKD patients they studied which is comparable to our study (19% vs. 18%). History of palpitations was obtained from 7 (14%) patients. Foley RN et al<sup>3</sup> in their study found palpitations (dysrhythmias) in 7% of the CKD patients they studied (7% vs. 14%).

Hypertension was present in 80% of patients. Ulasi LL et al<sup>4</sup> in their cross sectional study (involving CKD patients) found hypertension in 85.3% of the patients which is comparable to the present study which found hypertension in 80% of the patients (85.3% vs. 80%). Levin Adeera<sup>5</sup> in their study also found prevalence of hypertension and LVH in 87-90% of the patients.

Left ventricular hypertrophy (LVH) by electrocardiography (ECG) was detected in 38 out of 50 patients (76%). Stewart GA et al<sup>6</sup> in their study found LVH in more than 80% of the study group concentric type being dominant. Costa Fde A et al in their study also found LVH in 83% of CKD patients.<sup>7</sup>

Other electrocardiographic abnormalities also detected in the study were left axis deviation (20%), left atrial enlargement (20%), 1p degree AV block (4%), 2p degree AV block (2%), LBBB (36%), RBBB (20%), VPCs (36%), poor R wave progression (18%). The ECG 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 QTc 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 ventricular as studied by Shapira OM et al.<sup>8</sup> Non specific (ischemic like) ST-T changes were seen in 34%. Shapira OM et al<sup>8</sup> in their study also found non specific ST-T changes in 22 to 39 % of the patients.

Findings of present study and Stewart GA et al is comparable.<sup>6</sup> Difference between our study and Costa Fde A et al,<sup>7</sup> Shapira OM et al could be because of the difference in sample size.<sup>8</sup>

On 2D echocardiography, LVH was found in 84% of the patients. Ulasi LL et al in their cross sectional study (involving CKD patients) found LVH in 95.5% of the cases and 6.7% of controls (95.5% vs. 84%).<sup>4</sup> Levin Adeera<sup>5</sup> in their study found LVH to be present in 75% of the patients prior to hemodialysis (75% vs. 84%). The variation could be due to difference in the sample size and its composition, selection criteria.

Pericardial effusion was present in 20% of patients in the present study which is comparable to Chinwuba Ijoma et al who found it to be in 15.9%.<sup>9</sup>

Regional wall motion abnormalities suggestive of coronary artery disease (CAD) were found to be in 15 patients (30%) by 2D echo. Kamalesh B et al.<sup>10</sup> in their study found the prevalence of CAD (wall motion abnormalities) in 38% of CKD patients (almost double of that present in non CKD patients). Levin Adeera<sup>5</sup> in his study found IHD/angina to be present in 35% of CKD patients.<sup>108</sup> In, NEOERICA study,<sup>11</sup> the prevalence of ischaemic heart disease (IHD) in stage 3 to stage 5 was found to be 25%. The difference in prevalence of angina/IHD/CAD could be explained by the different sample size, duration of study and criteria used to select the patients, presence of other comorbidities.

In our study, diastolic dysfunction (DD) was seen in 54% of patients whereas left ventricular systolic dysfunction (LVSD) was seen in 52% of patients. LV diastolic dysfunction was more common in all stages of CKD.<sup>12</sup> In the study conducted on ESRD patients by Parfrey PS et al had systolic dysfunction was found in 16% of patients.<sup>13</sup> This difference with the present study could be because of varying sample size and baseline characteristics.

## CONCLUSION

Cardiovascular complications are common in patients with chronic kidney disease, which is an important cause of morbidity and mortality in these patients. The most common morbidity found in this study was left ventricular hypertrophy. Proper cardiac evaluation should be done in all CKD patients so that early intervention can be initiated to decrease the incidence of complications.

**Conflict of interest:** None declared.

**Ethical clearance:** Taken.

**Source of funding:** None declared.

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