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The Prevalence of Left Ventricular Dysfunction in Chronic Kidney Disease Patients Stage II to V by Using 2D Echocardiography

Dr. Charles Bansal[1], Dr. Gurinder Mohan[2*]

[1]3rd Year Medicine Resident, SGRD Institute of Medical Sciences and Health Research, Amritsar, Punjab, India.
[2*]Professor and Head, Department of Medicine, SGRD Institute of Medical Sciences and Health Research, Amritsar, Punjab, India.

*Correspondence Author:
Dr. Gurinder Mohan
Professor and Head, Department of Medicine, SGRD Institute of Medical Sciences and Health Research, Amritsar, Punjab, India.
Correspondence
Email: drgurinder1968@gmail.com

Abstract

Aim: The aim of the present study was to assess the prevalence of left ventricular dysfunction in Chronic Kidney Disease patients stage II to V by using 2D Echocardiography.

Methods: In this study, patients of CKD stage II to V visiting the OPD and/or admitted as in patient at SGRDIMSR, Vallah, Amritsar from 01st Jan, 2023 to 31st March 2024 and fulfilling the inclusion criteria were enrolled after taking informed consent for the same and were assessed for cardiovascular manifestations especially LV dysfunction and were compared and tabulated for various stages of CKD enrolled.

Results: Mean age of the patients was 58.71±13.76 years. 30.2% patients belonged to 60-69 years old followed by 50-59 years (25.5%), >69 years (22.6%). Mostly, that is 66% belonged to Kidney failure stage-5 followed by Severely decreased GFR stage-4 (18.9%), Moderately to severely decreased GFR-stage 3B (11.3%), and mildly to moderately decreased GFR-stage 3A (3.8%). On ECG, in 52.8% patient's sinus tachycardia was present, 49.1% patients had LVH, Q Waves and ST-T Changes were seen in 17.9% patients. 2D Echocardiography showed 90.6% patients having LVDD; in 57.5% patients LVH was present, LVSD was present in 17.9% patients; RWMA in 17.9% patients and pericardial effusion in 11.3% patients. 53.8% patients had cholesterol <200 mg/dl and 46.7% had >200 mg/dl.

Conclusion: In conclusion, left ventricular dysfunctions especially LV systolic and diastolic dysfunction are significantly prevalent among CKD patients and these dysfunctions increase with increasing severity of CKD. Hence, it is important to routinely screen these patients for LV dysfunction. There are various modalities to determine LV dysfunction and echocardiography is one such important non-invasive method.

Keywords: prevalence, Left ventricular dysfunction, Chronic Kidney Disease patients, 2D Echocardiography

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1. INTRODUCTION

Chronic kidney disease (CKD), the prevalence of which is still growing worldwide, confers a higher risk of coronary artery disease (CAD), congestive heart failure (CHF) and/or death independently of conventional cardiovascular risk factors.[1-4] In CKD patients left ventricular (LV) diastolic dysfunction occurs frequently and is associated with heart failure (HF) and higher mortality.[5] Other studies demonstrated that CKD severity was the most independent predictor of elevated LV filling pressure and could be responsible for impaired systolic and diastolic functions in predialysis CKD.[6] Left ventricular diastolic dysfunction is observed even in patients with early stages of chronic kidney dysfunction.[7] It was estimated that 15% of patients starting dialysis therapy have systolic dysfunction of the left ventricle while the prevalence of diastolic dysfunction at dialysis inception is much higher. Either systolic or diastolic dysfunction can lead to clinically evident congestive heart failure.[8] Left ventricular systolic dysfunction is often associated with severe CAD and it is a major determinant of prognosis.[9] Left ventricular diastolic dysfunction in CKD patients is of complex nature. According to studies, it may be influenced by the increase in LV preload due to progression of CKD stage.[10] Also LV hypertrophy, CAD, microvascular abnormalities, interstitial fibrosis, altered fluid and electrolyte metabolism and neurohumoral alterations might contribute to the development of LV diastolic dysfunction in patients with CKD.[11] Over-activation of the renin–angiotensin–aldosterone system (RAAS) might play an important role in the pathomechanism since even a mild CKD results in early cardiac fibrosis with mild LV diastolic impairment and preserved systolic function.[12]

Patients with CKD and congestive heart failure have worse survival when compared to patients with CKD but without congestive heart failure, irrespective of other clinical parameters. Patients with CKD and congestive heart failure have a mean survival of only 36 months compared with 62-month survival of patients with CKD without heart failure.[13] Furthermore, the risk of mortality is increased by 50% after about 3-month who have congestive heart failure when starting dialysis as compared to CKD patients without congestive heart failure.[14] It is estimated that 15% of patients starting dialysis therapy have systolic dysfunction of the left ventricle while the prevalence of diastolic dysfunction at dialysis inception is much higher. Either systolic or diastolic dysfunction can lead to clinically evident congestive heart failure.[15] Left ventricular systolic dysfunction is often associated with severe CAD and it is a major determinant of prognosis.[16] Left ventricular diastolic dysfunction in CKD patients is of complex nature.

According to studies, it may be influenced by the increase in LV preload due to progression of CKD stage.[17]The aim of the present study was to assess the prevalence of left ventricular dysfunction in Chronic Kidney Disease patients stage II to V by using 2D Echocardiography.

2. MATERIALS AND METHODS

In this study, patients of CKD stage II to V visiting the OPD and/or admitted as in patient at SGRDIMSR, Vallah, Amritsar from 1stJan2023 to 31stMarch 2024 and fulfilling the inclusion criteria were enrolled after taking informed consent for the same and were assessed for cardiovascular manifestations especially LV dysfunction and were compared and tabulated for various stages of CKD enrolled.

INCLUSION CRITERIA

1) Age >18 years

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2) CKD stage II –V

EXCLUSION CRITERIA

1) Patients with pre-existing cardiac diseases (Rheumatic Heart Disease, Congenital Heart Disease, Myocarditis).
2) Patients on erythropoietin therapy

All these patients were subjected to a proper history, physical and systemic examination. Baseline investigations like ECG, CBC, RFT LFT, NA, K, PO4, Calcium, BNP (wherever indicated), Chest X-ray, USG W/A and 2D Echocardiography were done and the data was collected and tabulated for statistical analysis.

CKD staging: Chronic kidney disease stages were classified based on KDIGO classification of CKD and the GFR calculated by Cockcroft-Gault formula.

KIDNEY DISEASE IMPROVING GLOBAL OUTCOME (KDIGO) CLASSIFICATION OF CHRONIC KIDNEY DISEASE (CKD).

KDIGO 2012: Prognosis of CKD by GFR and albuminuria categories				Persistent albuminuria categories Description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g	30-300 mg/g	>300 mg/g
GFR categories (ml/min/1.73m²) Description and range	G1	Normal or high	≥ 90			
	G2	Mildly decreased	60-89			
	G3a	Mildly to moderately decreased	45-59	α		
	G3b	Moderately to severely decrease	30-44	ω		
	G4	Severely decreased	15-29			
	G5	Kidney failure	<15			

Statistical Analysis:

The recorded data was compiled and entered in a spreadsheet computer program (MicrosoftExcel 2010) and then exported to data editor page of SPSS version 22 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics including computation of percentages, means and standard deviations were calculated. Statistical test applied for the analysis was Chi-square test/Fisher's exact test/ One-way ANOVA. The level of confidence interval and p-value were set at 95% and 5%.

3. RESULTS

Table1: Baseline characteristics

Age(InYears)	Frequency	Percent
20-29	4	3.8
30-39	2	1.9
40-49	17	16.0
50-59	27	25.5
60-69	32	30.2
>69	24	22.6
Mean±SD	58.71±13.76	

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Gender		
Female	30	28.3
Male	76	71.7
CKDstages		
Mildly to moderately decreased(3A)	4	3.8
Moderately to severely decreased(3B)	12	11.3
Severely decreased(4)	20	18.9
Kidney failure(5)	70	66.0
LVH		
Absent	45	42.5
Present	61	57.5
LVDD		
Absent	10	9.4
Present	96	90.6
Cholesterol		
<200	57	53.8
>200	49	46.2

Mean age of the patients was 58.71±13.76 years. 30.2% patients belonged to 60-69 years old followed by 50-59 years (25.5%), >69 years (22.6%), 40-49 years (16%), 20-29 years (3.8%), and 30-39 years (1.9%). 71.7% were males and 28.3% were females. Mostly, that is 66% belonged to Kidney failure stage-5 followed by Severely decreased GFR stage-4 (18.9%), Moderately to severely decreased GFR-stage 3B (11.3%), and mildly to moderately decreased GFR-stage 3A (3.8%). In 57.5% patients, LVH was present. In 90.6% patients, LVDD was present. 53.8% patients had cholesterol levels of <200 mg/dl and 46.7% had >200 mg/dl.

Table2: distribution of ECG findings

ECGfindings	Frequency	Percent
SinusTachycardia		
Absent	50	47.2
Present	56	52.8
LVH		
Absent	54	50.9
Present	52	49.1
QWaves,ST-TChanges		
Absent	87	82.1
Present	19	17.9
TallTWaves		
Absent	90	84.9
Present	16	15.1
QTProlongation		
Absent	92	86.8
Present	14	13.2

In 52.8% patients, sinus tachycardia was present. In 49.1% patients, LVH was present. Q Waves, ST-T Changes were seen in 17.9% patients. Tall T waves were seen in 15.1% patients. QT prolongation was seen in 13.2% patients. Low voltage ECG was seen in 18.9% patients.

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Table3: distribution of LVDD and LVH according to CKD stages

CKDstages	LVDD		Total	p-value
	ABSENT	PRESENT		
Kidneyfailure(5)	8	62	70	0.0238
	11.4%	88.6%	100.0%	
Severelydecreased (4)	2	18	20	0.0923
	10.0%	90.0%	100.0%	
Moderately to severely decreased(3B)	0	12	12	0.369
	0.0%	100.0%	100.0%	
Mildly to moderately decreased(3A)	0	4	4	0.512
	0.0%	100.0%	100.0%	
Total	10	96	106	
	9.4%	90.6%	100.0%	
CKDstages	LVH			
Kidneyfailure (5)	30	40	70	0.0213
	42.9%	57.1%	100.0%	
Severely decreased(4)	8	12	20	0.0805
	40.0%	60.0%	100.0%	
Moderately to severely decreased(3B)	6	6	12	0.758
	50.0%	50.0%	100.0%	
Mildly to moderately decreased(3A)	1	3	4	0.635
	25.0%	75.0%	100.0%	
Total	45	61	106	
	42.5%	57.5%	100.0%	

LVDD was present in 88.6% stage 5 patients,90% of stage 4 patients and 100% of stage3A and 3B patients each. Association of LVDD with stage 5 patients was found statistically significant but was non-significant with respect to stage 3A,3B and 4 patients.LVH was present in 57.1% stage 5 patients, 60% of stage 4 patients, 50% of stage 3B, and 75% of stage 3A patients. Association of LVH with stage 5 patients was found statistically significant but was non-significant with respect to stage 3A, 3B and 4 patients.

In patients with cholesterol <200 mg/dl , LVDD was present in 93% patients and in patients with cholesterol >200 mg/dl , LVDD was present in 87.8% patients. The relation was found non- significant. In patients with cholesterol <200, LVH was present in 56.1% patients and in patients with cholesterol >200, LVH was present in 59.2% patients. The relation was found non-significant.

4. DISCUSSION

Chronic kidney disease (CKD) is defined as the presence of kidney damage or an estimated glomerular filtration rate (eGFR) less than 60 ml/min/1.73 mt^2 of glomerular surface area and persisting for 3 months or more, irrespective of the cause.[18] It is a state of progressive loss of kidney function, ultimately resulting in the need for renal replacement therapy (dialysis or transplantation). Kidney damage refers to pathologic abnormalities either suggested by imaging studies or renal biopsy, abnormalities in urinary sediment, or increased urinary albumin excretion rates.

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In the present study, mean age of the patients was 58.71±13.76 years. In study conducted by Chillo P and Mujuni E[19] the mean age of the total study population was 48+13 years. In this study, we divided all patients into six groups. 30.2% patients belonged to 60-69 years old followed by 50-59 years (25.5%), >69 years (22.6%), 40-49 years (16%), 20-29 years (3.8%), and 30-39 years (1.9%). In present study, 71.7% were males and 28.3% were females. This is in accordance to the SEEK study[20] where males showed a higher preponderance over females. The Indian CKD registry[21] showed that the CKD male: female ratio was 70: 30. The age and gender distribution of the population in both the study groups were almost equal and were comparable.

In present study, 66% belonged to Kidney failure (stage 5) followed by Severely decreased GFR stage (Stage 4) (18.9%), Moderately to Severely decreased GFR (Stage 3B) (11.3%), and Mildly to Moderately decreased GFR (Stage 3A) (3.8%). In study conducted by Chillo P and Mujuni E[19] the proportions of patients with CKD stages 3, 4, and 5 were 0%, 2.1%, and 97.9%, respectively, in the total population. In current study, on ECG sinus tachycardia was present in 52.8% patients and LVH was present in 49.1% patients, Q Waves, ST-T Changes were seen in 17.9% patients, tall T waves were seen in 15.1% patients, QT prolongation was seen in 13.2% patients, low voltage ECG was seen in 18.9% patients. In similar study conducted by Shafi S et al[22], Bignotto LH et al[23] at least one ECG abnormality was noticed in 78.4% of all CKD patients. 17.6% patients had sinus tachycardia, 19.2% had prolonged QRS duration, 8% had prolonged QTc interval. In 40.8% patients, LVH was present and 13.6% patients had RVH. ST segment depression or elevation was seen in 23.4% patients.

In present study, on 2D echocardiography LVH was present in 57.5% patients. This is in accordance with the study done by Levin et al which showed that 70% of ESRD patients had LVH[24] and by Paoletti et al[25] in which 74% had LVH. After age, left ventricular hypertrophy (LVH) is considered to be the strongest independent predictor of cardiovascular disease and events, cardiovascular death and total mortality. LVDD was present in 90.6% patients in current study. In study conducted by Chillo P and Mujuni E19 68.6% patients had different degrees of LV diastolic dysfunction. LVDD was present in 88.6% stage 5 patients, 90% of stage 4 patients, and 100% of stage 3A and 3B patients in current study. Association of LVDD with stage 5 patients was found statistically significant (p value-0.0238) but was non-significant with respect to stage 3A, 3B and 4 patients (p value->0.05). A similar study conducted by Nitin et al[26] had found that 51.85% of patients with mild/moderate CKD had diastolic dysfunction, whereas 82.6% of patients with severe CKD had diastolic dysfunction.

5. CONCLUSION

In conclusion, left ventricular dysfunctions especially LV systolic and diastolic dysfunction are significantly prevalent among CKD patients and these dysfunctions increase with increasing severity of CKD. Hence, it is important to routinely screen these patients for LV dysfunction. There are various modalities to determine LV dysfunction and echocardiography is one such important non-invasive method. Thus, the use of echocardiography can detect LV dysfunction at an early stage among the high-risk population of CKD to help plan appropriate strategies to slow the progression of cardiac dysfunction and improve prognosis.

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