

Echocardiographic Evaluation of Left Ventricular Function in Patients With Chronic Kidney Disease

P Kavitha ¹, Dr Sasikumar A ², K.Kishore Kanna ³, N. Sowmiya ⁴

¹ Assistant Professor, Vels School of Allied Health Sciences, Vels Institute of Science Technology and Advanced Studies (VISTAS), Chennai-600117, Tamil Nadu, India.

² Principal, Vels School of Allied Health Sciences, Vels Institute of Science Technology and Advanced Studies (VISTAS), Chennai 600117, Tamil Nadu, India.

³ Vice Principal, Vels School of Allied Health Sciences, Vels Institute of Science Technology and Advanced Studies (VISTAS), Chennai 600117, Tamil Nadu, India.

⁴ Postgraduate Student, Vels School of Allied Health Sciences, Vels Institute of Science Technology and Advanced Studies (VISTAS), Chennai 600117, Tamil Nadu, India. Email- sowmiyamiya02@gmail.com

Corresponding author P Kavitha

ABSTRACT

Cardiovascular Morbidity and Mortality are closely linked to chronic kidney disease (CKD). Even in the early stages of chronic kidney disease, cardiac structural and functional abnormalities are very common, especially involving the left ventricle. Patients with chronic kidney disease frequently exhibit left ventricular hypertrophy, systolic and diastolic dysfunction, and altered LV geometry. These anomalies may be subclinical at first, but can gradually worsen global cardiac function, making it harder for the heart to sustain sufficient circulation. Heart failure is common in Chronic kidney disease patients and is closely related to abnormalities in left ventricular function. Impaired left ventricular systolic or diastolic function can reduce cardiac output while increasing ventricular filling pressures, eventually leading to Heart failure. Echocardiography is a widely accessible, non-invasive imaging technique that enables evaluation of systolic and diastolic function of the left ventricle. Observational-cross sectional study was conducted on 82 patients with Chronic kidney disease. Renal function was assessed using urea, serum creatinine and estimated glomerular filtration rate (eGFR). Echocardiography was performed to evaluate left ventricular systolic and diastolic function. LV systolic function was assessed using left ventricular ejection fraction. LV diastolic function was assessed using mitral E velocity, A velocity, E/A ratio, deceleration time and E/e' ratio. The relationship between renal function and echocardiographic findings was analysed using appropriate statistical tests.

82 patients were included in this study. 75.6% of the patients had stage 5 chronic kidney disease. 54.46 ± 11.83 was the mean age. Assessment of LV systolic function showed that age was significantly associated with LV systolic dysfunction ($p < 0.001$). A significant association was also observed between duration of CKD and LV systolic dysfunction ($p = 0.04$). However, gender, BMI, serum creatinine, eGFR, and CKD stage were not significantly associated with LV systolic dysfunction. For diastolic function, the mean E velocity was 0.68 ± 0.21 m/s, E/A ratio 0.97 ± 0.51 , deceleration time 182.61 ± 30.13 ms, and E/e' ratio 9.09 ± 2.96 . No significant association was observed between the studied demographic or renal parameters and LV diastolic dysfunction. Correlation analysis showed weak and statistically non-significant relationships between renal function parameters and echocardiographic indices due to the small sample size and the predominance of stage 5 CKD in the study population. Systolic and diastolic abnormalities were seen in patients with chronic kidney disease (CKD). Older age and longer duration of CKD were significantly associated with LV systolic dysfunction. The echocardiographic indices of left ventricular function, however, did not significantly correlate with renal function parameters. These results highlight the importance of echocardiographic evaluation for early detection of cardiac dysfunction in patients with chronic kidney disease, particularly in those who are older or have had kidney disease for longer period of time.

KEYWORDS: Chronic kidney disease; Left ventricular systolic function; Left ventricular diastolic function; Echocardiography; Estimated Glomerular filtration rate; serum creatinine.

INTRODUCTION:

Chronic kidney disease (CKD) is a progressive disorder characterized by persistent impairment of kidney structure or function. Progressive deterioration of renal function is accompanied by several systemic changes that can adversely affect the cardiovascular system. Cardiovascular abnormalities in CKD may involve both the structure and function of the left ventricle. With increasing severity of renal impairment, chronic volume and pressure overload can result in changes in left ventricular dimensions and myocardial structure. The assessment of left ventricular systolic function is an important component of echocardiographic evaluation in CKD. Renal function assessment is the essential part of the assessment for staging the chronic kidney disease. Serum creatinine is a commonly used biochemical marker of renal filtration, while estimated glomerular filtration rate (eGFR) provides an estimate of overall kidney filtration capacity and is used to assess the severity of renal impairment. Echocardiography is a non-invasive imaging technique used to assess cardiac structure

and function. It provides important information about left ventricular dimensions, wall thickness, and left ventricular systolic function. Left ventricular ejection fraction (LVEF) is commonly used to assess systolic function. Doppler echocardiography helps evaluate LV diastolic filling. Therefore, it is a useful tool for evaluating cardiovascular involvement in patients with CKD. M-mode echocardiography provides high temporal resolution for assessing left ventricular (LV) dimensions and wall thickness. Mitral inflow doppler provides information about LV filling during diastole. The early diastolic E wave velocity and the late diastolic A wave velocity are transmitral flow velocities. LV diastolic function is evaluated by mitral inflow velocities such as E/A ratio, deceleration time, and tissue doppler imaging. A reduced E/A ratio and changes in DT may indicate impaired LV relaxation, while an increased E/e' ratio generally suggests elevated LV filling pressure. LV systolic function is commonly assessed using left ventricular ejection fraction (LVEF), calculated from LV end-diastolic and end-systolic volumes. The Modified Biplane Simpson's method calculates LVEF by tracing the LV endocardial border in apical four- and two-chamber views. Improved image quality and proper endocardial border tracing helps to get accurate measurements.

Objectives:

1. To evaluate left ventricular systolic and diastolic function using echocardiography in patients with chronic kidney disease.
2. To assess the relationship between echocardiographic parameters and renal function parameters such as serum urea, serum creatinine, and eGFR.
3. To evaluate the association between CKD severity and left ventricular function.
4. To assess the association of age and other clinical factors with LV functional abnormalities in CKD patients.

Methods

Design and setting

Observational cross sectional study design was conducted. This study was conducted in VELS college and hospital in Manjankaranai, Periyapalayam, Thiruvallur.

Participants and sampling

A total of 82 participants with chronic kidney disease. The purpose of the study was to evaluate the left ventricular systolic and diastolic function of these patients through transthoracic echocardiography. Inclusion and exclusion criteria were strictly followed. Detailed patient histories were collected, including information on cardiovascular risk factors, such as hypertension, and a history of myocardial infarction or any cardiac surgeries. Chronic kidney disease patients attending the hospital or admitted to the hospital during the study period were included.

Patients above 18 years were included. All stages of chronic kidney disease patients were included. Both female and male patients were included. Patients with valvular heart disease, congenital heart disease, acute kidney injury, previous cardiac surgery, poor echocardiographic window were excluded. The thesis reports a sample-size calculation of 82 participants using a 95% confidence level, an assumed proportion of 0.90, and a 6.49% margin of error.

Measures:

- LEFT VENTRICULAR DIMENSIONS: It can be assessed by using TEICHOLZ METHOD at the level of mitral valve tip in PLAX view.
- END DIASTOLIC AND END SYSTOLIC VOLUME: It can be calculated by using both TEICHOLZ and SIMPSON'S method.
- INTERVENTRICULAR SEPTAL THICKNESS AND POSTERIOR WALL THICKNESS: It can be measured by TEICHOLZ METHOD at the level of mitral valve tip in PLAX view.
- EJECTION FRACTION: Can be calculated during BIPLANE SIMPSON METHOD.
- E/A RATIO: Obtained by using pulse wave Doppler at the tip of the mitral valve.
- E/e': Obtained by using tissue doppler and pulse wave doppler at the mitral annulus.

Data collection and ethics

Institutional ethics approval were obtained according to the study. Written informed consent was obtained from all participants, following ethical standards. Participation was voluntary, and the

patients were informed about the purpose of the study. confidentiality and privacy of the patients were maintained throughout the study. Echocardiography was performed using a non-invasive and radiation free technique.

STATISTICAL ANALYSIS:

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS). Categorical data were presented as frequencies and percentages, whereas continuous variables were summarized as mean $\pm$ standard deviation (SD). Depending on the distribution of the data, the median and interquartile range were also used where appropriate. Changes in echocardiographic parameters of left ventricular function were assessed using a paired t-test. A p-value <0.05 was considered statistically significant.

Results

Table 1. Demographic Characteristics of the Study Population

Variable		Mean $\pm$ SD / n (%)
Age (years)		54.46 $\pm$ 11.83
Age classification	25-35 years	5(6.1%)
	36-45 years	16(19.5%)
	46-55 years	26(31.7%)
	56-65 years	19(23.2%)
	>66 years	16(19.5%)
Gender	Male	53(64.6%)
	Female	29(35.4%)
Height (cm)		152.85 $\pm$ 15.46
Weight (kg)		66.61 $\pm$ 11.3
BMI (kg/m ²)		28.98 $\pm$ 5.93

This study comprised 82 participants with chronic kidney disease. Baseline parameters were represented in table 1, including 53 males (64.6%) and 29 females (35.4%). The study population's mean age was 54.46 $\pm$ 11.83 years. The age distribution revealed that the majority of patients belonged to the 46-55 years group, 26 (31.7%), followed by the 56-65 age group, 19 (23.2%), the 36-45 age group, 16 (19.5%), and the 23-35 age group, 5 (6.1%).

The mean height in centimeters was 152.85 $\pm$ 15.46.

66.61 $\pm$ 11.3 kg was the mean weight. The study's mean BMI was 29.93 $\pm$ 5.93. This implied that a large number of patients were overweight

TABLE 2: Clinical Characteristics of the Study Population

Variable	Mean $\pm$ SD
Heart Rate (beats/min)	81.8 $\pm$ 10.58
Systolic Blood Pressure (mmHg)	139.15 $\pm$ 22.83
Diastolic Blood Pressure (mmHg)	84.15 $\pm$ 9.23
Duration of CKD (years/months)	3.34 $\pm$ 1.3

The study population's mean heart rate was 81.8 $\pm$ 10.58 beats per minute.

139.15 $\pm$ 22.83 mm Hg was the mean systolic blood pressure.

The mean diastolic blood pressure was 84.15±9.23 mm Hg. The mean duration of CKD was 3.34±1.3 years.

TABLE 3: Renal Function Parameters

Variable		Mean ± SD
Blood Urea (mg/dL)		89.26±32.8
Serum Creatinine (mg/dL)		7.8±4.05
eGFR (mL/min/1.73 m ²)		11.15±9.9
CKD STAGES	Stage 1	0
	Stage 2	0
	Stage 3	6(7.3%)
	Stage 4	14(17.1%)
	Stage 5	62(75.6%)

The mean blood urea level was 89.26 ± 32.8 mg/dl. The mean serum creatinine level was 7.8 ± 4.05 mg/dl. 11.15±9.9 ml/min/1.73 m² was the mean glomerular filtration rate (eGFR). This illustrates the research population's severe kidney abnormalities.

Based on CKD stages, the majority of patients (75.6%) were in stage 5 of CKD. Stage 4 CKD was present in 14 patients (17.1%). 6 patients (7.3%) had stage 3 chronic kidney disease. None of the patients had CKD in stages 1 and 2.

Table 4. Echocardiography Parameters

Variable		Mean ±SD
Left Ventricular Dimensions	IVSd (cm)	1.22±0.18
	PWTd (cm)	1.18±0.18
	LVIDd (cm)	4.79±0.48
	IVSs (cm)	1.49±0.22
	PWTs (cm)	1.38±0.21
	LVIDs (cm)	3.32±0.51
Left Ventricular Systolic Function	End-Diastolic Volume (EDV, ml)	108.82±25.39
	End-Systolic Volume (ESV, ml)	46.91±18.76
	Ejection Fraction (EF, %)	57.17±8.14
Left Ventricular Diastolic Function	Mitral E Velocity (cm/s)	0.68±0.21
	Mitral A Velocity (cm/s)	0.75±0.15
	E/A Ratio	0.97±0.51
	Deceleration Time (ms)	182.61±30.13
	E/E' Ratio	9.99±2.96

On echocardiographic parameters, the mean interventricular septal thickness in diastole (IVSd) was 1.22±0.18 cm, while the mean posterior wall thickness in diastole (PWTd) was 1.18±0.18 cm. The mean left ventricular internal diameter in diastole (LVIDd) was 4.79±0.48 cm.

During systole, the mean interventricular septal thickness in systole (IVSs) was 1.49±0.22 cm.

The mean posterior wall thickness in systole (PWTs) was 1.38±0.21 cm. Left ventricular internal diameter in systole (LVIDs) was 3.32±0.51 cm. This implied that many patients had left ventricular hypertrophy. An evaluation of the systolic function of the left ventricle revealed a mean end diastolic volume (EDV) of 108.82±25.39 ml and a mean end systolic volume (ESV) of 46.91±18.79 ml.

The mean ejection fraction was 57.17±8.14%. As a result, while individual patients' ejection fraction varied, the study population's average ejection fraction was maintained at a relatively preserved level.

The diastolic function parameters were assessed. The mean mitral E velocity was 0.68±0.21 cm/s. The mean mitral A velocity was 0.75±0.15 cm/s. The mean E/A ratio was 0.97±0.51. The mean deceleration time was 182.61±30.13 ms, while the mean E/E' ratio was 9.99±2.96.

Table 5. Comparison of Demographic and Clinical Variables by Left Ventricular Systolic Dysfunction

Variable		LV systolic dysfunction		P value
		Present	Absent	
Age		65.19±11.11	51.86±10.53	<0.001
Gender	Male	12(75%)	41(62.1%)	0.33
	Female	4(25%)	25(37.9%)	
Serum creatinine		8.86±3.64	8.86±7.55	0.24
eGFR		8.11±8.15	11.89±10.2	0.17
CKD Stage	Stage 3	1(6.3%)	5(7.6%)	0.1
	Stage 4	0(0%)	14(21.2%)	
	Stage 5	15(93.8%)	47(71.2%)	
Duration of CKD	< 3 years	5(31.3%)	39(59.1%)	0.04
	> 3years	11(68.8%)	27(40.9%)	
BMI		28.05±5.65	29.20±6.01	0.49

Patients with and without left ventricular systolic dysfunction were compared. The mean age was higher among patients with systolic dysfunction (65.19±11.11 years). compared with the patients without systolic dysfunction (51.86±10.53 years). This difference was statistically significant ($p<0.001$). This suggests that older age was significantly related to the presence of LV systolic dysfunction. Patients with systolic dysfunction 4 (25%) were female, and 12 (75%) were male. Patients without systolic dysfunction 25 (37.9%) were female and 41 (62.1%) were male. However, the difference ($p=0.33$) was not statistically significant.

The mean serum creatinine was 8.86±3.64 mg/dl in patients with systolic dysfunction and 8.86±7.55 mg/dl in those without systolic dysfunction. The difference was not statistically significant ($p=0.24$).

The mean eGFR was 8.11±8.15 ml/min/1.73 m² in patients with systolic dysfunction. The mean eGFR was 11.89±10.2 ml/min/1.73 m² in patients without systolic dysfunction. The difference was not statistically significant ($p=0.17$).

Based on CKD stage, most patients with systolic dysfunction were in stage 5 CKD (15 (93.8%)), while 1 patient (6.3%) was in stage 3. None of the patients with systolic dysfunction were in stage 4.

Patients without systolic dysfunction, 47 (71.2%), were in stage 5 CKD; 14 (21.2%) were in stage 4 CKD, and 5 (7.6%) were in stage 3 CKD. The association between CKD stage and LV systolic dysfunction was not statistically significant ($p=0.1$).

Based on the duration of the CKD,

Patients with systolic dysfunction, 11 (68.8%), had CKD for more than 3 years. 5 (31.3%) had CKD for less than 3 years. Of the patients without systolic dysfunction, 27 (40.9%) had CKD for more than 3 years and 39 (59.1%) had CKD for less than 3 years. This difference was statistically significant ($p=0.04$). This suggests that a longer duration of CKD was related to LV systolic dysfunction.

The mean BMI was 20.05±5.65 kg/m² in patients with systolic dysfunction. The mean BMI was 29.20±6.01 kg/m² in patients without systolic dysfunction. This difference was not statistically significant ($p=0.49$).

Table 6. Comparison of Demographic and Clinical Variables by Left Ventricular Diastolic Dysfunction

Variable		LV diastolic dysfunction		P value
		Present	Absent	
Age		56.7±14.95	54.15±11.43	0.52
Gender	Male	8(80%)	45(62.5%)	0.27
	Female	2(20%)	27(37.5%)	
Serum creatinine		7.99±5.10	7.78±3.93	0.88
eGFR		11.43±9.82	11.11±9.98	0.92
CKD Stage	Stage 3	1(10%)	5(6.9%)	0.89
	Stage 4	2(20%)	12(16.7%)	
	Stage 5	7(70%)	55(76.4%)	
Duration of CKD	< 3 years	5(50%)	39(54.2%)	0.80
	> 3years	5(50%)	33(45.8%)	

BMI	26.40±4.48	29.34±6.04	0.14
-----	------------	------------	------

Patients with and without diastolic dysfunction were compared. The mean age of the patients with diastolic dysfunction was 56.7±14.95 years. The mean age of patients without diastolic dysfunction was 54.15±11.43 years. The difference in age between the two groups was not statistically significant (P=0.52).

In patients with diastolic dysfunction, 8 (80%) were males and 2 (20%) were females. In patients without diastolic dysfunction, 45 (62.5%) were males and 27 (37.5%) were females. This finding implied that males were more frequently represented in the diastolic dysfunction group. The difference was not statistically significant (p=0.27).

The mean serum creatinine was 7.99±5.10 mg/dl in patients with diastolic dysfunction and 7.78±3.93 mg/dl in those without diastolic dysfunction. There was no statistical significance (p=0.88).

The mean eGFR was 11.43±9.82 ml/min/1.73 m² among patients with diastolic dysfunction and 11.11±9.98 ml/min/1.73 m² in those without diastolic dysfunction. This difference was not statistically significant (p=0.92).

With regard to CKD stage, patients with diastolic dysfunction, 1 (10%), were in stage 3 CKD, 2 (20%) were in stage 4 CKD, and 7 (70%) were in stage 5 CKD. Those without diastolic dysfunction, 5 (6.9%), were in stage 3 CKD; 12 (16.7%) were in stage 4; and 55 (76.4%) were in stage 5. The distribution of CKD stages between the two groups was not statistically significant (p=0.89).

Based on the duration of CKD, 5 patients with diastolic dysfunction had CKD for less than 3 years, and 5 (50%) had CKD for more than 3 years.

Patients without diastolic dysfunction, 39 (54.2%), had CKD for less than 3 years; 33 (45.8%) had CKD for more than 3 years. This difference was not statistically significant (p=0.80).

The mean BMI was 26.40 ± 4.48 kg/m² in patients with diastolic dysfunction and 29.34 ± 6.04 kg/m² in patients without diastolic dysfunction. This difference was not statistically significant (p=0.14).

Table 7. Correlation Between Renal Function Parameters and Echocardiographic Parameters of Left Ventricular Function

Variables		Correlation Coefficient (r)	P-value
Renal Function Parameter	Echocardiographic Parameter		
eGFR	EF	0.052	0.64
eGFR	E/A Ratio	0.09	0.39
eGFR	E/E'	0.12	0.25
Serum Creatinine	EF	-0.05	0.61
Serum Creatinine	E/A Ratio	-0.04	0.71
Serum Creatinine	E/E'	-0.14	0.18
Blood Urea	EF	-0.06	0.59
Blood Urea	E/A Ratio	-0.07	0.52
Blood Urea	E/E'	-0.10	0.38

Table 7 represents the correlation between renal function parameters (eGFR, serum creatinine, and blood urea) and echocardiographic parameters (EF, E/A RATIO, and E/E' RATIO). There was a very weak positive correlation between eGFR and EF with a correlation coefficient of r=0.005. Similarly, eGFR showed a weak positive correlation with the E/A ratio (r=0.09, p=0.39) and E/E' ratio (r=0.12, p=0.25). None of these were statistically significant.

Serum creatinine showed a weak negative correlation with EF (r=-0.05, p=0.61). Similarly, serum creatinine showed a weak negative correlation with the E/A ratio (r=-0.04, p=0.71) and with the E/E' ratio (r=-0.14, p=0.18). However, none of these correlations were statistically significant.

Blood urea showed a weak negative correlation with EF (r=-0.06, p=0.59). Similarly, blood urea showed a weak negative correlation with the E/A ratio (r=-0.07, p=0.52) and with the E/E' ratio (r=-0.10, p=0.38). However, none of these correlations were statistically significant.

Discussion

The present study included 82 patients with CKD to assess the relationship between renal function and LV function. 54.46 ± 11.83 years was the mean age with male predominance (64.6%). Many patients had stage 5 CKD (75.6%) and a mean eGFR of 11.15 ± 9.9 mL/min/1.73 m². The severe renal impairment observed in our study is clinically important because CKD is associated with structural and functional cardiac abnormalities. Previous studies have also reported a close relationship between CKD and cardiovascular dysfunction.

Our study showed that the mean age of the participants was 54.46 ± 11.83 years, with the largest proportion belonging to the 46-55 years age group (31.7%). This predominance of middle-aged and older individuals is clinically relevant because increasing age is associated with myocardial fibrosis, increased arterial stiffness, and impaired ventricular relaxation. The study also demonstrated a male predominance, with 53 males (64.6%) and 29 females (35.4%). The mean BMI was 28.98 ± 5.93 kg/m², indicating that overweight and increased body mass were common among the study participants. The renal parameters in the present study demonstrated a severe degree of renal impairment. The mean blood urea was 89.26 ± 32.8 mg/dl, serum creatinine was 7.8 ± 4.05 mg/dl, and the mean eGFR was 11.15 ± 9.9 mL/min/1.73 m². Among the 82 patients, 6 (7.3%) were in CKD stage 3, 14 (17.1%) were in stage 4, and 62 (75.6%) were in stage 5. No patients belonged to stages 1 or 2. The predominance of advanced CKD in our study is important because severe renal dysfunction is associated with chronic volume overload, hypertension, anemia, uremic toxin accumulation, vascular calcification, and disturbances in mineral metabolism, all of which can adversely affect myocardial structure and function. Previous echocardiographic studies have similarly demonstrated significant cardiac abnormalities among patients with advanced CKD.

We also assessed conventional echocardiographic parameters of left ventricular mean and diastolic function in our study. The mean LV end-diastolic volume was 108.82 ± 25.69 ml, and the mean LV end-systolic volume was 46.91 ± 18.76 ml. The mean left ventricular ejection fraction (LVEF) was $57.17 \pm 8.14\%$. No patient had severe LV systolic dysfunction, but the mean LVEF was in the preserved range, with 16 (19.5%) cases of LV systolic dysfunction.

In the present study, assessment of LV diastolic function showed a mean mitral E velocity of 0.68 ± 0.21 m/s, E/A ratio of 0.97 ± 0.51 , deceleration time of 182.61 ± 30.13 ms, and E/E' ratio of 9.09 ± 2.96 . These findings suggest the presence of altered ventricular relaxation in a proportion of patients with advanced CKD. Diastolic dysfunction in CKD may result from chronic pressure and volume overload, LV hypertrophy, myocardial fibrosis, and abnormalities in mineral metabolism. Previous studies have also reported a high prevalence of LV diastolic abnormalities among patients with CKD.

In the present study, age was significantly associated with LV systolic dysfunction (LVSD), with patients having LVSD being older than those without LVSD ($P < 0.001$). This may be related to the cumulative effects of hypertension, vascular stiffness, myocardial fibrosis, and prolonged cardiovascular stress associated with CKD. Aging may therefore contribute to increased cardiovascular vulnerability in patients with advanced CKD. However, there was no significance found between LVSD and gender or BMI.

The Duration of CKD and LVSD were found to be significantly correlated ($P=0.04$). Longer exposure to volume and pressure overload, anemia, uremia, inflammation, and vascular calcification may promote LV remodeling and myocardial dysfunction over time. However, serum creatinine, eGFR, and CKD stage were not significantly associated with LVSD. This may partly be explained by the predominance of advanced renal disease in the study population, with 75.6% of patients belonging to CKD stage 5, resulting in limited variation in renal function.

Regarding LV diastolic dysfunction (LVDD), no statistically significant association was observed with age, gender, BMI, serum creatinine, eGFR, CKD stage, or duration of CKD. Although previous studies have demonstrated associations between CKD-related metabolic abnormalities and diastolic dysfunction, the absence of significance in the present study may be related to the relatively small number of patients with LVDD. The analysis's statistical power may have been diminished because only 10 patients were identified as having LVDD.

Correlation analysis also showed weak and statistically non-significant correlations between renal function parameters and conventional echocardiographic indices of LV systolic and diastolic function. This suggests that cardiac dysfunction in CKD may not be determined by renal biochemical parameters alone. CKD-related cardiovascular changes are multifactorial and may involve hemodynamic, metabolic, and structural myocardial abnormalities.

Overall, the present study indicates that age and longer duration of CKD were significantly associated with LV systolic dysfunction, whereas renal biochemical parameters and CKD stage did not show significant associations with LV systolic or diastolic dysfunction. Comprehensive cardiovascular assessment may therefore be important in patients with advanced CKD.

Strengths

- The study evaluated both systolic and diastolic function of the left ventricle.
- Both structural and functional cardiac parameters such as LVID, IVSd, PWT, EDV, ESV and EF were assessed.
- Doppler echocardiographic parameters including E wave, E/a ratio, deceleration time and E/e' were included to assess diastolic function.
- Renal function was evaluated using serum urea, serum creatinine and eGFR allowing comparison between cardiac and renal parameters.
- The study included patients with different stages of CKD which allowed for better assessment of cardiac changes across various levels of CKD severity.
- Echocardiography is a non-invasive method that is widely available and clinically useful for evaluating cardiac function.

Limitations

- The small sample size may have limited the statistical significance between echocardiographic parameters and renal parameters.
- Patients from the earlier stages of CKD were underrepresented since a significant portion of the participants had CKD stage 5.
- The results may not be as applicable to different populations because the study was carried out in a single center environment.

Implications for practice

The results of the study demonstrate the potential value of echocardiography in the evaluation of patients' hearts who have chronic kidney disease. Early detection of cardiac problems may be aided by assessment of both left ventricular systolic and diastolic function. When evaluating and monitoring patients with chronic kidney disease, echocardiographic results might be taken into account in addition to renal function measurements. Patients with chronic kidney disease may be more susceptible to left ventricular dysfunction, hence routine cardiovascular monitoring may be especially important for them.

CONCLUSION

Systolic and diastolic abnormalities were seen in patients with chronic kidney disease (CKD). Older age and longer duration of CKD were significantly associated with LV systolic dysfunction. The echocardiographic indices of left ventricular function, however, did not significantly correlate with renal function parameters. The small sample size may have contributed to lack of significant associations with echocardiographic and renal parameters. These results highlight the importance of echocardiographic evaluation for early detection of cardiac dysfunction in patients with chronic kidney disease, particularly in those who are older or have had kidney disease for longer period of time.

Acknowledgment: The authors sincerely thank all the participants and hospital authorities for their valuable cooperation and support throughout the study.

Conflict of interest: The authors declare that there is no conflict of interest.

Reference:

1. Chen SC, Su HM, Hung CC, et al. Echocardiographic parameters are independently associated with rate of renal function decline and progression to dialysis in patients with chronic kidney disease. *Clinical Journal of the American Society of Nephrology*. 2011.
2. Franczyk-Skóra B, Gluba A, Olszewski R, Banach M, Rysz J. Heart function disturbances in chronic kidney disease – echocardiographic indices. *Archives of Medical Science*. 2015;11(6):1109–1116.
3. Mavrakanas TA, Khatkhat A, Singh K, et al. Echocardiographic parameters and renal outcomes in patients with preserved renal function, and mild-moderate CKD. *BMC Nephrology*. 2018;19:176

4. Patterns of left ventricular hypertrophy in chronic kidney disease: an echocardiographic evaluation Ravinder S Sambhi et al. Indian Heart J. 2011 May-Jun.
5. G ao X, et al. Assessment of Left Ventricular Functional Impairment in Patients With Chronic Kidney Disease Using Three-Dimensional Speckle Tracking Imaging. Echocardiography. 2024.
6. Echocardiography to predict adverse cardiac and vascular events in patients with severe chronic kidney disease (stage 4): a prospective study. François Lesaffre et al. Arch Cardiovasc Dis. 2013 Apr.