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Original Research Paper

Nephrology

NEPHRON TO CARDIOMYOCYTE : DIASTOLIC DYSFUNCTION IN CKD

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ABSTRACT

Background: CKD is a progressive condition associated with significant cardiovascular morbidity and mortality too. Left ventricular diastolic dysfunction is increasingly recognized as an early and prevalent cardiac abnormality in CKD patients, contributing substantially to heart failure and mortality. Its relationship with CKD stage progression and biochemical markers such as calcium, phosphorus, and intact parathyroid hormone remains a subject of clinical interest. To evaluate the prevalence and severity of diastolic dysfunction across various stages of CKD. **Methods:** This prospective observational study was conducted on 150 adult patients with CKD not on dialysis. All patients underwent detailed clinical evaluation, laboratory investigations, and echocardiographic assessment to determine the grade of diastolic dysfunction. Patients were classified according to KDIGO CKD staging. Statistical analysis was performed to assess associations between CKD stages, grades of LVDD, and biochemical parameters. **Results:** Diastolic dysfunction was detected in all participants. Grade I, II, III, and IV LVDD were found in 20.7%, 26%, 32%, and 21.3% of patients, respectively. A statistically significant correlation was observed between worsening diastolic function and advancing CKD stage ($p < 0.001$). Serum creatinine, urea, phosphorus, and iPTH levels increased, while calcium and hemoglobin levels decreased with higher grades of diastolic dysfunction. Ejection fraction declined progressively across grades of LVDD, though remaining in the preserved range. **Conclusion:** As the grades of CKD increases diastolic function declines. So routine echocardiographic screening in CKD patients is mandatory for early detection of LVDD and prompt treatment to improve the quality of life and to prolong the years of survival.

KEYWORDS : Diastolic Dysfunction, Echocardiography, Calcium, Phosphorus, iPTH, cardiovascular risk.

INTRODUCTION

CKD is a progressive condition characterized by the gradual loss of renal function, with significant systemic and cardiovascular consequences. Among these, left ventricular diastolic dysfunction (LVDD) is increasingly recognized as a major contributor to morbidity and mortality. Notably, cardiovascular disease is the leading cause of death among CKD patients, with diastolic dysfunction contributing significantly to this burden even before end-stage renal disease (ESRD) sets in.

Diastolic dysfunction, defined by impaired myocardial relaxation and increased ventricular filling pressures, often precedes systolic dysfunction and heart failure with preserved ejection fraction (HFpEF).

The interrelationship between CKD and diastolic dysfunction stems from overlapping pathophysiological processes-chronic volume overload, hypertension, left ventricular hypertrophy, myocardial fibrosis, and disturbances in mineral metabolism, particularly serum calcium, phosphorus, and (iPTH) parathyroid hormone levels.

This study was conducted to assess the prevalence and severity of diastolic dysfunction in non-dialysis CKD patients and its correlation with disease stage and biochemical abnormalities, aiming for early detection and intervention.

METHODS

This prospective observational case-control study was conducted at the Departments of Medicine and Nephrology, M.L.N. Medical College, Prayagraj, from March 2024 to February 2025.

Inclusion criteria included adults aged ≥18 years with CKD as per KDIGO guidelines, excluding those on dialysis or with overt cardiovascular diseases.

Investigations included CBC, KFT, LFT, serum calcium, phosphorus, iPTH, vitamin D, and echocardiography to evaluate diastolic dysfunction. CKD staging was based on eGFR.

RESULTS

There was a significant difference in the levels of UREA (mg/dl) across the different grades ($p < 0.001$). The mean UREA values were 67.48 ± 24.99 mg/dl in Grade I, 78.10 ± 25.66 mg/dl in Grade II, 85.42 ± 26.97 mg/dl in Grade III, and 104.09 ± 34.26 mg/dl in Grade IV of diastolic dysfunction.

Similarly, creatinine (mg/dl) levels also showed a significant difference across the grades ($p < 0.001$). The mean CREATININE values were 2.55 ± 1.70 mg/dl in Grade I, 2.53 ± 1.16 mg/dl in Grade II, 3.45 ± 1.36 mg/dl in Grade III, and 4.76 ± 1.49 mg/dl in Grade IV.

Below table shows mean comparison of Urea and Creatinine in different grades of diastolic dysfunction of study participants

	Grades of Diastolic dysfunction								p-value
	Grade I		Grade II		Grade III		Grade IV		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
UREA (mg/dl)	67.48	24.99	78.10	25.66	85.42	26.97	104.09	34.26	<0.001
CREATININE(mg/dl)	2.55	1.70	2.53	1.16	3.45	1.36	4.76	1.49	<0.001

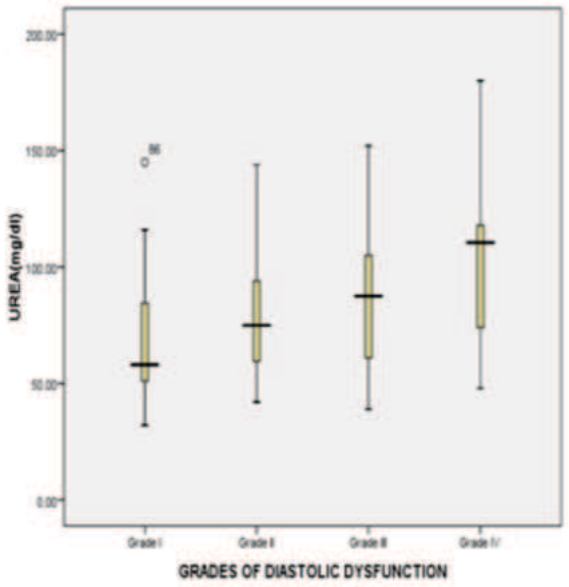

Fig.1

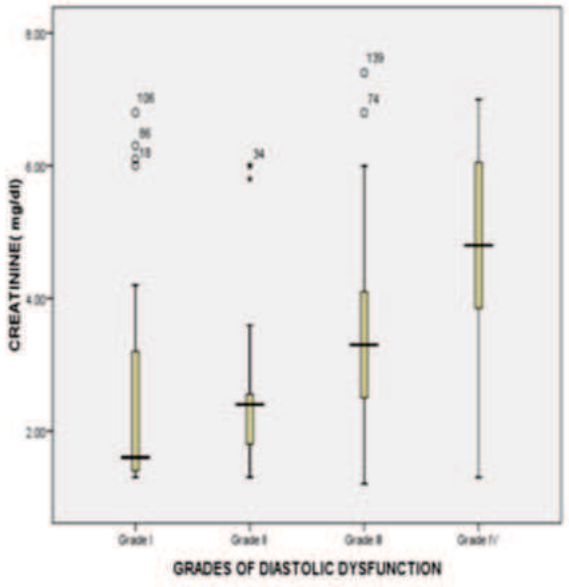

Fig .2

Fig.1 And Fig.2 showing mean comparison of urea and creatinine in different grades of diastolic dysfunction of study participants.

DISCUSSION

CKD is increasingly recognized as a systemic illness with significant cardiovascular implications. Among the most prevalent and prognostically significant cardiac abnormalities in CKD is left ventricular diastolic dysfunction. Our study reveals that diastolic dysfunction is present across all CKD stages and tends to worsen with disease progression. This observation aligns with earlier reports highlighting a rising burden of LVDD even in early CKD, with its severity correlating strongly with declining renal function.

In our study of 150 non-dialysis CKD patients, 100% had some grade of LVDD: 20.7% had Grade I, 26% had Grade II, 32% had Grade III, and 21.3% had Grade IV. The progression in dysfunction paralleled the deterioration of eGFR, indicating that as CKD advances, myocardial relaxation and compliance are progressively impaired. This is likely due to a combination of factors including chronic volume overload, hypertension-induced left ventricular hypertrophy, endothelial dysfunction, and uremiarelated myocardial fibrosis.

We observed a significant decrease in hemoglobin levels with increasing LVDD grade, supporting the role of anemia as a contributor to myocardial hypoxia and impaired cardiac performance. Similarly, serum creatinine and urea levels were positively correlated with higher LVDD grades, reflecting the declining renal clearance capacity and associated metabolic disturbances that stress myocardial function.

The study also highlighted a progressive decline in ejection fraction (EF), albeit within the preserved range, across worsening grades of diastolic dysfunction. This suggests a subclinical compromise of systolic performance in the context of worsening diastolic properties, possibly portending HFpEFa common outcome in CKD.

Crucially, mineral metabolism markers showed significant associations with LVDD severity. Serum calcium levels decreased, while phosphorus and intact parathyroid hormone (iPTH) levels increased with higher LVDD grades. These abnormalities promote vascular calcification, myocardial stiffness, and cardiac remodelingcentral to the pathophysiology of uremic cardiomyopathy. This reinforces the concept that CKD-mineral and bone disorder (CKD-MBD) directly impacts cardiovascular structure and function.

Interestingly, vitamin D levels were also found to differ significantly across dysfunction grades, with higher grades having relatively better levels. This may reflect supplementation or an adaptive increase in late-stage CKD, though its clinical implications in the context of LVDD need further exploration.

Our findings are consistent with prior studies which demonstrate that even early-stage CKD patients may harbor significant subclinical cardiac changes. The progressive nature of LVDD in CKD emphasizes the need for early cardiovascular evaluation using echocardiography and tissue Doppler imaging. Regular monitoring, combined with optimal control of blood pressure, anemia, volume status, and mineral metabolism, may slow the cardiovascular deterioration inherent to CKD progression.

CONCLUSION

Diastolic dysfunction is highly prevalent in CKD and worsens with advancing stages. It is significantly associated with abnormalities in calcium-phosphorus metabolism and iPTH levels. Early diagnosis through echocardiography and correction of biochemical imbalances can mitigate cardiovascular morbidity and mortality in CKD.

This study emphasizes the need for **routine cardiovascular screening in all CKD patients**, even at early stages, with special attention to **mineral metabolism correction**.

REFERENCES

1. 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;3:1-150.
2. Borrelli S, De Nicola L, Stanzione G, Conte G, Minutolo R. The burden of chronic kidney disease and cardiovascular risk: An update from recent epidemiological studies. Nephrol Dial Transplant 2022;37:2295-305.
3. Gao Q, Li J, Meng L, Wang Y, Xu Z. Diastolic dysfunction in chronic kidney disease: Pathophysiology, diagnosis and management. Front Cardiovasc Med 2024;11:1410762.
4. Otsuka T, Suzuki M, Yoshikawa T, Takahashi M, Ishii H, Amano T, et al. Left ventricular diastolic dysfunction in patients with chronic kidney disease. Clin Nephrol 2009;71:334-41.
5. Romejko K, Dzida G, Dziemidok P, Puzanowska B, Wnuk A, Krzesi□ski P, et al. Diastolic dysfunction in patients with chronic kidney disease: Prevalence, clinical correlates and prognostic value. Cardiol J 2022;29:913-21.
6. Kang SH, Park JW, Cho KH, Do JY. Left ventricular diastolic dysfunction and outcomes in chronic kidney disease: A systematic review and meta-analysis. Kidney Res Clin Pract 2022;41:170-84.

7. Han SH, Kim JS, Kang S, Heo NJ, Choi SO, Na KY, et al. Left ventricular diastolic dysfunction predicts cardiovascular outcomes in patients with chronic kidney disease. Am J Nephrol 2015;41:177-85.
8. Gromadzi□ski L, Piotrowski G, Wyrzykowski B, Pudlo R, Banach M. Echocardiographic assessment of left ventricular diastolic function in patients with chronic kidney disease. Cardiol J 2014;21:143-9.
9. Franczyk-Skóra B, Gluba A, Olszewski R, Banach M, Rysz J. Heart function disturbances in chronic kidney disease—Echocardiographic indices. Ren Fail 2014;36:110-6.