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ASSOCIATION BETWEEN ESTIMATED GLOMERULAR FILTRATION RATE AND CAROTID FEMORAL PULSE WAVE VELOCITY IN CHRONIC KIDNEY DISEASE PATIENTS IN WESTERN RAJASTHAN, INDIA

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ABSTRACT **Background :** The recent years have witnessed a surge in the incidence of chronic kidney disease cases worldwide. Increased pulse wave velocity is associated with renal microvascular damage in chronic kidney disease (CKD) patients. Many clinical & Epidemiological investigations suggested that damage to big conduit arteries is the primary cause of morbidity and death in individuals with Chronic Kidney Disease. Atherosclerosis is the frequent common underlying cause of these issues. **Aim:** We evaluated the association between renal function determined by estimated glomerular filtration rate (eGFR) and Carotid femoral PWV in Predialysis CKD patients. **Method:** This cross-sectional study included 100 patients of both genders, aged 20–60 yrs, who attended OPD in the Nephrology department at Mathura Das Mathur Hospital, Dr. Sampurnanand Medical College, Jodhpur. eGFR Measurement using the Cockcroft gault equation & arterial stiffness (PWV) was performed using a periscope instrument and the data were collected that is analyzed by using relevant statistical tests. **Result-** Subjects were divided by tertiles of eGFR level. cf-PWV increased as the eGFR value decreased. Pearson correlations analyses showed that the cf-PWV negatively correlated with the estimated glomerular filtration rate (eGFR), we found a strong association between eGFR and CF-PWV(r=-.466, p=0.000) **Conclusion-** These outcomes suggest that the increase in peripheral arterial stiffness was closely associated with declining renal function in western Rajasthan.

KEYWORDS : eGFR(estimated Glomerular filtration rate), cf-PWV, CKD, arterial stiffness

INTRODUCTION

The recent years have witnessed a surge in the incidence of chronic kidney disease cases worldwide. Increased pulse wave velocity is associated with renal microvascular damage in chronic kidney disease (CKD) patients.

Many clinical & Epidemiological investigations suggested that damage to big conduit arteries is the primary cause of morbidity and death in individuals with chronic kidney disease.[1] Atherosclerosis is the frequent underlying cause of these issues.[2]

Arterial stiffness is typically assessed through non-invasive measurements, with **pulse wave velocity (PWV)** being the most widely used parameter. PWV assesses the speed at which the pressure wave generated by the heartbeat travels through the arteries, with higher values indicating the stiffness of arteries[3]

The aim of this study is to evaluate the correlation of arterial stiffness parameters (PWV) with eGFR in CKD patients attending a tertiary care center of Western Rajasthan.

MATERIAL & METHOD

The cross-sectional observational study was done at the Department of Physiology & Nephrology, Mathura Das Mathur Hospital, Dr. S. N. Medical College, Jodhpur, Rajasthan, India. Sample size- 100 Predialysis CKD patients

Inclusion Criteria:

1) Diagnosed CKD patients of both genders (male/female) attending OPD or admitted to the nephrology ward, aged 18 to 60 years.
2) For the study, who is willing to give written consent.

Exclusion Criteria:

1. Patients with a renal transplant,
2. Patients with systemic vasculitis or connective tissue disease,
3. Peripheral artery disease.
4. Unstable Patients (hypotensive, respiratory distress, encephalopathy) and not able to perform the tests.

Measurement of eGFR using Cockcroft Gault equation[4]

$$\text{GFR (ml/min)} = \frac{(140 - \text{age in years}) \times \text{body weight in kg}}{\text{Plasma Creatinine (mg/dl)} \times 72} \times 0.85 \text{ (if female)}$$

STAGE	GFR CATEGORIES DESCRIPTION	GFR VALUE(ML/MIN./1.73M^2)
G1	Kidney damage with normal GFR or raised GFR	More than 90
G2	Kidney damage with mild or decreased GFR	60-89
G3a	Mild to moderately decreased GFR	45-59
G3b	Moderate to Severely decreased GFR	30-44
G4	Severely decreased GFR	15-29
G5	Established Kidney failure	Less than 15

- The arterial stiffness indices were evaluated by device PERISCOPE (RMS India). This device is computer-based and shows pulse waveform analysis with the help of four limb pressure waveforms, simultaneous non-invasive blood pressure readings, and Electrocardiogram (ECG) waveforms. It calculates - PWV

RESULT

One Way ANOVA was conducted to compare the C-F PWV (Independent Variable) in Mild, Moderate, and Severe, Chronic Kidney Disease groups. (Dependent Variable).

The mean value of C-F PWV in the Mild CKD group was (M=849.378, SD=151.5049), in the Moderate CKD group was (M=1128.721, SD=174.3069), in the Severe CKD group was (M=1244.377, SD=399.9368).

There was a statistically significant variation in the mean C-F PWV in Mild, Moderate, and Severe Chronic Kidney Disease Groups. { F(2,97)= 13.277,P=.000}

Equal variance was not assumed since the Levene statistic is significant. Gomes Howell was selected to examine the post hoc comparison of the group's individual differences. Post hoc Gomes

Howell test revealed that C-F PWV differed significantly between the Mild, moderate, and Severe CKD groups. (P=.000)

As the chronic kidney disease progresses rise in mean C-F PWV was observed {F(2,97)=13.277, P=.000}. The mean C-F PWV was significantly raised between the Mild CKD group, moderate CKD group, and the Severe CKD group comparison. (P=.000)

A negative correlation between eGFR and cf PWV was observed. A statically highly significant relation was observed for C-F PWV (cm/sec) (r-value -.466, p-value 0.000)

Table 1 Shows Anova Test

	Mean Square	F	Sig.
Between Groups	1214589.981	13.277	0.000
Within Groups	91477.603		
Total			

Table 2 Shows Test Of Homogeneity Of Variances

		Levene Statistic	df1	df2	Sig.
C-F PWV	Based on Mean	4.494	2	97	0.014
	Based on Median	3.397	2	97	0.037
	Based on Median and with adjusted df	3.397	2	57.818	0.040
	Based on trimmed mean	3.711	2	97	0.028

Table 3 Shows Multiple Comparisons Between Mild, Moderate, And Severe Ckd Groups Using The Games-howell Test

(I) Renal Staging		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Mild CKD	Moderate CKD	-279.3424*	45.2291	0.000	-388.621	-170.064
	Severe CKD	-394.9988*	65.8048	0.000	-552.746	-237.251
Moderate CKD	Mild CKD	279.3424*	45.2291	0.000	170.064	388.621
	Severe CKD	-115.6564	66.1813	0.195	-274.149	42.836
Severe CKD	Mild CKD	394.9988*	65.8048	0.000	237.251	552.746
	Moderate CKD	115.6564	66.1813	0.195	-42.836	274.149

DISCUSSION

Renal failure, cardiovascular mortality, all-cause death, and kidney damage are all independently predicted by glomerular filtration rate (GFR). Given the strong connection between cardiovascular diseases (CVD) and chronic kidney disease (CKD), improving the risk stratification of atherosclerotic disease requires early renal dysfunction identification.

Carotid-femoral PWV (CF-PWV) is considered the gold standard for measuring central arterial stiffness, and our study found a robust inverse correlation between CF PWV and eGFR. Similar to the findings of Safar et al., (2002), who demonstrated that CF PWV is highly predictive of cardiovascular events in CKD patients, particularly in those with advanced renal failure[5]. As eGFR decreased, CF PWV increased significantly, reflecting heightened central arterial stiffness in patients with declining kidney function. Compared to the study by Agharazii et al. (2012), which highlighted CF PWV as a key marker for arterial calcification in ESRD, our findings showed a similar trend, especially in the later stages of CKD[6]

Our study revealed a significant inverse correlation between PWV and eGFR, with arterial stiffness increasing as renal function deteriorated. This is consistent with findings from London et al. (2003), which demonstrated that arterial stiffness, measured through PWV, increases significantly with declining kidney function due to factors like uremic toxicity, oxidative stress, and vascular calcification.[7]

In West Rajasthan, studies have indicated a significant association between decreased eGFR and increased cfPWV, aligning with findings from studies in other geographic regions. For instance, a study by Naranjo et al. (2019) in a South American cohort said that individuals with eGFR <60 mL/min/1.73 m² had a markedly higher cfPWV compared to those with normal renal function[8]. Similarly, data from India's urban settings indicate that as eGFR declines, there is a consistent increase in arterial stiffness (Gupta et al., 2017). These findings support the notion that deteriorating renal function is closely linked to cardiovascular risk across diverse populations.[9]

Similar to our study, many studies have highlighted the impact of hypertension and diabetes on cfPWV in CKD patients. A study by Wang et al. (2020) demonstrated that hypertensive CKD patients had significantly higher cfPWV compared to normotensive counterparts, reinforcing the notion that hypertension exacerbates arterial stiffness [10]. In West Rajasthan, a significant proportion of CKD patients also suffer from hypertension and diabetes (Khan et al., 2019), leading to an amplified chance of cardiovascular events. The congruence to these findings across different populations underscores the critical importance of managing comorbid conditions in CKD patients.[11]

CONCLUSION

A negative Pearson correlation between eGFR and arterial stiffness indices was observed which means a decrease in eGFR value leads to an increase in arterial stiffness. A statistically highly significant relation was observed for cfPWV. The arterial stiffness parameters accurately indicate atherosclerotic vascular damage, including an inflammatory stage. Additionally, in clinical practice, non-invasive techniques to measure cfPWV will also be useful in the preclinical assessment of atherosclerosis.

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