



CLINICAL SPECTRUM AND PREDICTORS OF PERIPHERAL ARTERIAL DISEASE AMONG PATIENTS WITH CHRONIC KIDNEY DISEASE IN INDIA

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ABSTRACT :

Aim: To examine the clinical characteristics of peripheral arterial disease (PAD) in individuals with chronic kidney disease (CKD). **Materials and Methods:** A cross-sectional observational study was conducted in the Department of Medicine at Sree Mookambika Institute of Medical Sciences, Kulasekaram, Southern India. The study included fifty patients admitted to the medical wards with a diagnosis of CKD. **Results:** The study identified that older age, prolonged duration of CKD, presence of coronary artery disease, comorbid diabetes mellitus, anemia, elevated parathyroid hormone (PTH) levels, increased high-sensitivity C-reactive protein (hsCRP), reduced estimated glomerular filtration rate (eGFR), elevated total cholesterol, high low-density lipoprotein (LDL) cholesterol levels, and presence of albuminuria were significantly associated with the development of PAD in patients with CKD. **Conclusion:** PAD is highly prevalent among patients with CKD in India. Significant risk factors include older age, diabetes mellitus, coronary artery disease, advanced stages of CKD, albuminuria, and elevated hsCRP levels. Early detection of patients with occult PAD may enhance preventive strategies and therapeutic outcomes. **Keywords:** Chronic kidney disease; Peripheral arterial disease

INTRODUCTION:

Chronic kidney disease (CKD) constitutes a major global public health issue, associated with significant morbidity and mortality. In India, it is estimated that over 100,000 new cases of end-stage renal disease (ESRD) are diagnosed annually, imposing a considerable burden on both patients and the healthcare system.¹ The increasing prevalence of CKD is particularly pronounced in economically disadvantaged countries, primarily due to the rising incidence of diabetes mellitus, hypertension, obesity, and increased life expectancy. Despite this growing burden, accurately estimating the prevalence of CKD and ESRD in India remains challenging due to the lack of a nationwide CKD registry.² Cardiovascular disease (CVD) is the leading cause of death among individuals with CKD. Global survey data indicate that more than half of all deaths in CKD patients are attributable to cardiovascular causes.³ Peripheral arterial disease (PAD), a manifestation of systemic atherosclerosis characterized by the progressive occlusion



of peripheral arteries—most commonly affecting the lower limbs—has emerged as a significant contributor to cardiovascular morbidity. The prevalence of PAD has been increasing globally, with a particularly rapid rise observed in low- and middle-income countries.⁴ Patients with CKD are at a substantially higher risk of developing PAD compared to individuals with normal renal function. The Atherosclerosis Risk in Communities (ARIC) study demonstrated that, after adjusting for age, sex, and race, individuals with CKD had an 82% higher risk of PAD.⁵ Several studies have further shown that PAD is strongly associated with increased cardiovascular events and premature mortality, both in patients with CKD and in the general population.⁶ Consequently, CKD is now recognized as an important independent risk factor for the development of PAD, with reported prevalence rates ranging from 12% to 38% among CKD patients.^{5,6} Although conventional cardiovascular risk factors—such as advanced age, smoking, physical inactivity, hypertension, diabetes mellitus, and dyslipidemia—play a crucial role in the development of PAD in CKD patients, these factors alone do not fully account for the markedly elevated risk observed in this population.⁷ Several CKD-specific mechanisms have been proposed to explain this excess risk, including endothelial dysfunction, persistent inflammation, oxidative stress, albuminuria, accumulation of uremic toxins, prothrombotic and procalcific states, and microvascular dysfunction.⁸ However, data exploring these non-traditional risk factors remain limited. Peripheral arterial disease, particularly in its advanced stages, can result in serious lower-limb complications such as ischemic ulcers, gangrene, and amputations, significantly affecting patient morbidity and survival. PAD is also associated with poorer quality of life and a higher incidence of concomitant cardiovascular disease in patients with CKD.⁹ Moreover, PAD has been linked to inferior graft outcomes and increased mortality among renal transplant recipients.¹⁰

The ankle–brachial index (ABI) is a simple test. It compares blood pressure at the ankle with blood pressure at the arm. This test helps find and check peripheral arterial disease (PAD). It is often used to screen for PAD and see how it progresses.¹¹ Finding PAD early and treating it can help prevent problems in people with chronic kidney disease (CKD).⁸ But there is not much research on PAD in Indian patients with CKD. So, this study looked at how common PAD is, its symptoms, and risk factors in Indian patients with CKD.

AIM AND OBJECTIVES OF THE STUDY:

Aim

To study the clinical profile and associated risk factors of peripheral arterial disease in patients with chronic kidney disease.

Objectives

1. To determine the prevalence of peripheral arterial disease among patients with chronic kidney disease.
2. To assess the clinical and demographic characteristics of CKD patients with peripheral arterial disease.



MATERIALS AND METHODS:

This cross-sectional observational study was conducted in the Department of Medicine at a tertiary care hospital, Sree Mookambika College of Medical Sciences, among 50 patients admitted to the medicine wards with a diagnosis of chronic kidney disease. The aim of the study was to assess the clinical profile of peripheral arterial disease in patients with chronic kidney disease.

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Demographic details were recorded for all participants, including age, sex, height, weight, duration and stage of chronic kidney disease. Body mass index (BMI) was calculated for each patient. Relevant risk factors and comorbid conditions associated with peripheral arterial disease were assessed, including smoking status, hypertension, diabetes mellitus, dyslipidemia, coronary artery disease, cerebrovascular disease, and anemia.

Laboratory investigations were reviewed and documented, including serum creatinine, serum albumin, total cholesterol, low-density lipoprotein (LDL) cholesterol, uric acid, phosphate, parathyroid hormone (PTH), high-sensitivity C-reactive protein (hsCRP), hemoglobin levels, estimated glomerular filtration rate (eGFR), and urine analysis for albumin. Albuminuria was defined as the presence of albumin on spot urine dipstick testing and was further confirmed using the urine albumin-to-creatinine ratio.

All participants underwent a detailed clinical history and physical examination. Symptoms suggestive of peripheral arterial disease, such as intermittent claudication (defined as reproducible pain, cramping, or fatigue in the calf, thigh, or buttock during exertion), coldness of extremities, numbness, and resting pain were documented. Patients were categorized according to the Fontaine classification.¹² The ankle-brachial index (ABI) was measured in all patients using a portable handheld Doppler device. ABI was calculated by dividing the higher of the ankle systolic pressures (dorsalis pedis or posterior tibial artery) by the higher brachial artery systolic pressure measured in either arm.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS). Quantitative variables were expressed as mean \pm standard deviation, while categorical variables were presented as frequencies and percentages. The independent t-test was applied to continuous variables after confirming normal distribution. The Chi-square test was used to assess differences between categorical variables. Logistic regression analysis was performed with adjustment for age to estimate the independent effects of hypertension, ischemic heart disease, and diabetes mellitus. A p-value of less than 0.05 was considered statistically significant.



RESULTS:

Demographic and baseline characteristics of the study population, stratified by PAD status.

Parameter	No PAD	PAD	Total	P Value
	Mean (SD)	Mean (SD)	Mean (SD)	
No. of Patients	35(70%)	15(30%)	50(100%)	
Mean Age (years)	53.71±8.73	60.20±5.16	55.66±8.34	.012
Male Gender (%)	29(82.86%)	13(86.67%)	42(84%)	0.736
BMI	27.49±1.74	27.27±1.87	27.42±1.76	.705
Duration of CKD	6.03±3.54	9.00±2.73	6.92±3.56	.002
Smoking(%)	5(14.29%)	8(61.54%)	13(26%)	0.004
Dyslipidaemia(%)	7(20%)	6(40%)	13(26%)	0.140
Hypertension	29(82.86%)	15(100%)	44(88%)	0.087
CAD	8(22.86%)	11(73.33%)	19(38%)	0.001
DM	6(17.14%)	11(73.33%)	17(34%)	0.001

Table- 2: Biochemical characteristics of the study population, stratified by PAD status.

Parameter	No PAD	PAD	Total	P Value
	Mean (SD)	Mean (SD)	Mean (SD)	
No. of Patients	35(70%)	15(30%)	50(100%)	
HB	10.37±.64	7.79±1.50	9.59±1.53	<.001
PTH	169.83±91.01	256.53±130.70	195.84±110.63	.010
Phosphorus	3.87±.35	3.69±.20	3.82±.32	.207
Uric Acid	6.26±.66	6.29±.88	6.27±.72	.899
Creatinine	3.07±.80	3.68±.49	3.25±.77	.018
Hs CRP	2.64±.44	5.37±1.66	3.46±1.59	<.001
eGFR	35.01±9.95	28.72±7.87	33.12±9.74	.045
Total Cholesterol (mg/dl)	200.07±22.48	237.83±41.28	218.95±38.06	<.001
LDL Cholesterol (mg/dl)	101.23±13.15	120.67±24.48	110.95±21.81	.002
Albuminuria	8(22.86%)	9(60%)	17(34%)	0.011



DISCUSSION:

Peripheral arterial disease (PAD) weaves a shadowy thread through the tapestry of chronic kidney disease (CKD), casting a formidable shadow over cardiovascular health, lower limb vitality, and clinical outcomes.[10,13,14] In this study, PAD emerged as a silent specter in 30% of CKD patients, highlighting the weighty presence of this condition within the CKD realm. The diagnosis of PAD was etched in certainty through an ankle-brachial index (ABI) value dipping below 0.9, supported by clinical whispers of diminished peripheral pulses and telltale symptoms, crafting a robust and objective diagnostic tapestry. The study's revelations painted a vivid picture of PAD's dance with advancing age, the relentless march of CKD, the presence of diabetes mellitus, and the shadow of coronary artery disease (CAD). Moreover, PAD found companionship with non-traditional CKD-related risk factors, such as albuminuria, a dwindling estimated glomerular filtration rate (eGFR), and elevated high-sensitivity C-reactive protein (hsCRP). These findings suggest that both the familiar specters of cardiovascular risk and the unique mechanisms of CKD conspire in the emergence of PAD within this population. The prevalence of PAD observed in this study echoes the findings of previous research. The United States Renal Data System database reported a PAD prevalence of 24.9% among CKD patients.[15] Similarly, Arroyo et al.[16] and Yamasaki et al.[17] unveiled PAD prevalence rates of 28% and 17.2%, respectively, among CKD patients in diverse populations.

The variability in reported prevalence across studies may be attributed to differences in study design, population characteristics, severity of kidney dysfunction, and diagnostic criteria used for PAD assessment. CKD patients find themselves more susceptible to PAD, not only due to the clustering of traditional cardiovascular disease (CVD) risk factors but also because of CKD-specific pathophysiological mechanisms. These include reduced eGFR, albuminuria, chronic inflammation, oxidative stress, endothelial dysfunction, and a prothrombotic state.[10,13,14] Chen et al.[5] demonstrated that PAD in CKD patients was intertwined with both traditional CVD risk factors and several novel risk factors, including hsCRP, white blood cell count, fibrinogen levels, albuminuria, HbA1c, insulin resistance, phosphate levels, alkaline phosphatase, and total parathyroid hormone (PTH). They concluded that inflammation, oxidative stress, and a prothrombotic milieu significantly amplify the risk of PAD in patients with CKD.

Bourrier et al.[10] reported that peripheral artery disease (PAD) is more prevalent among older male patients with diminished renal function and comorbidities such as diabetes and cardiovascular disease, demonstrating strong associations with low estimated glomerular filtration rate (eGFR), elevated glycated hemoglobin (HbA1c), and albuminuria. Matsushita et al.[18] demonstrated that albuminuria and reduced eGFR independently predict the development of PAD more effectively than traditional cardiovascular risk factors. Albuminuria is indicative of endothelial dysfunction and vascular alterations.[19] Chronic kidney disease (CKD) involves persistent inflammation with elevated inflammatory markers, contributing to vascular calcification and endothelial dysfunction.[20,21].

This explains the strong association between elevated high-sensitivity C-reactive protein (hsCRP) levels and PAD observed in this study. Harlacher et al.[22] identified phosphate and uric acid as contributors to cardiovascular disease in CKD through inflammatory mechanisms, noting a higher prevalence of PAD among smokers and patients with dyslipidemia, although these findings were not statistically significant. These discrepancies may be attributed to differences in study characteristics. Atherosclerosis and arterial calcification are central to the progression of PAD in CKD patients.[13] Cohort studies show varying results regarding PAD prevalence and risk factors, likely due to differences in demographics and diagnostic methods.[5,8,23] This study underscores the importance of early identification of PAD in CKD patients, particularly those with advanced age, diabetes, coronary artery



disease (CAD), albuminuria, reduced eGFR, and elevated inflammatory markers. Early detection through ankle-brachial index (ABI) screening may improve outcomes in this population.

CONCLUSION:

Peripheral artery disease was prevalent in patients with CKD in India. Older age, diabetes, coronary artery disease, advanced CKD stage, albuminuria, and elevated hsCRP levels were identified as risk factors. Early detection of patients with occult PAD may enhance efforts toward proper prevention and treatment.

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