DOI: https://doi.org/10.54393/pjhs.v7i4.3763

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 7, Issue 04 (April 2026)

Original Article

OPEN ACCESS

Incidental Renal Artery Stenosis amongst a Cohort of Hypertensive Patients Undergoing Coronary Angiography: An Analytical Cross-Sectional Study

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ARTICLE INFO

Keywords:
Renal Artery Obstruction, Hypertension, Coronary Angiography, Incidental Renal Artery Stenosis

How to Cite:
Din, Z. U., Ishaq, S., Ibrahim, J., Khan, S. D., Gul, H., Noor, S., & Khan, W. H. (2026). Incidental Renal Artery Stenosis amongst a Cohort of Hypertensive Patients Undergoing Coronary Angiography: An Analytical Cross-Sectional Study : Incidental Renal Artery Stenosis: Hypertensive Patients Undergoing Coronary Angiography. Pakistan Journal of Health Sciences, 7(4), 27-32. https://doi.org/10.54393/pjhs.v7i4.3763

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Received Date: 29th December, 2025
Revised Date: 26th January, 2026
Acceptance Date: 13th February, 2026
Published Date: 30th April, 2026

ABSTRACT

There has been less research on accidental RAS in patients with hypertension who have received coronary angiography. **Objectives:** To determine the prevalence rate of incidental renal artery stenosis (IRAS) in patients having coronary angiography. **Methods:** This analytical cross-sectional study was conducted at Khyber Teaching Hospital for six months between 1st April 2025 and 30th September 2025. Consecutive sampling was used to enroll 139 hypertensive patients under diagnostic coronary angiography as participants. Findings of coronary angiography and incidental evaluation of the renal artery were recorded, with stenosis of ≥50% seen as IRAS. The analysis of data was done with SPSS version 25.0. Odds ratios were estimated at 95% confidence intervals using univariate analysis. **Results:** Incidental renal artery stenosis was observed in 18.0% of patients, and in 13.7% and 4.3%, respectively, bilateral and unilateral renal artery stenosis. IRAS was significantly correlated with longer hypertension period and high serum creatinine ($p<0.05$). **Conclusions:** Nearly one-fifth of hypertension patients who had coronary angiography had incidental renal artery stenosis, most of which were unilateral. Chronic hypertension and high creatinine were identified as some of the most important associated factors, and it is important to evaluate renal arteries when the coronary arteries should be evaluated to be able to assess the cardiovascular and renal risks.

INTRODUCTION

Hypertension is an important factor in cardiovascular morbidity and mortality, therefore being one of the largest global public health issues [1, 2]. Pharmacological treatment for hypertension has improved, yet a sizable portion of patients still have resistant or uncontrolled hypertension, suggesting other underlying etiological causes. Among these is renal artery stenosis (RAS), a clinically relevant disease that is frequently misdiagnosed [3, 4]. It is primarily induced by atherosclerotic disease, and it is closely linked to systemic vascular pathology and coronary artery disease (CAD) [5, 6]. The association of RAS with CAD demonstrates diffuse atherosclerosis, and many patients who underwent a coronary angiography might have an asymptomatic or incidental involvement of the renal artery [7]. The occurrence of renal artery stenosis is reported to be widely variable based on the population of patients and the detection method, with 5%-40% prevalence being reported in cases where patients are undergoing coronary angiography or peripheral vascular assessment [7]. Additionally, compared to the general population, hypertensive patients with widespread atherosclerosis are far more likely to develop renal artery

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stenosis [8]. Incidental RAS identified on coronary angiography has been of growing interest due to the possible effects it could have on blood pressure management, worsening of renal function, cardiovascular events, and therapeutic decision-making [9]. Early detection is especially important in hypertensive patients with resistant hypertension, unexplained renal dysfunction, or diffuse vascular disease, in which the preventive intervention at the initial stage can have an impact on the treatment plan and the outcome [10]. Although clinically important, incidental renal artery stenosis can be easily missed during standard cardiovascular assessment, particularly in the resource-constrained environment where renal artery imaging may not be conducted everywhere during coronary angiography [11].

Also, there is limited regional data regarding the burden of incidental RAS on hypertensive cohorts who have undergone coronary angiography. The production of local evidence is necessary to emphasize its magnitude, inform screening decisions, and facilitate risk-stratified assessment of hypertensive patients at risk. This research is thus conceptualized to close this knowledge deficit by measuring the incidence of incidental renal artery stenosis in hypertensive patients during coronary angiography and thus add essential information to the continuum of systemic involvement of atherosclerosis among the hypertensive patients. This study aims to determine the frequency of incidental renal artery stenosis (IRAS) in hypertensive patients undergoing coronary angiography.

METHODS

The design of this study was analytical, cross-sectional, and carried out over the course of six months, from April 1, 2025, to September 30, 2025, at the Department of Radiology of the Khyber Teaching Hospital in Peshawar. The Institutional Research and Ethical Review Board (IREB) of Khyber Medical College in Peshawar granted ethical permission with approval number 280/DME/KMC. To calculate the sample size, the WHO sample size calculator was used using the formula $n = Z^2 \times p \times (1-p) / d^2$ [12], where n was the required sample size, Z was the standard normal variate at 95% (1.96), p was the anticipated prevalence of incidental renal artery stenosis (10%) [13], and d = margin of error (5%). The total calculated sample size was 139. A non-probability Consecutive sampling was used to recruit participants. The inclusion criteria involved patients aged 18-80 Years, both male and female, and hypertensive patients undergoing coronary angiography, as per operational definitions. Individuals who had previously been diagnosed with renal artery stenosis, had undergone renal interventions such as renal stenting or angioplasty, or had non-atherosclerotic causes of renal artery stenosis such as fibromuscular dysplasia, were not allowed to participate in the study. Data collection was done after the IREB of KMC provided the ethical approval. The hypertensive patients undergoing diagnostic coronary angiography over the study period participated in the data collection. All patients who were admitted to the cardiac catheterization laboratory were screened consecutively, and those who met the inclusion criteria were enrolled with informed consent. Individuals having a history of hypertension, antihypertensive drug use, or a diagnosis of hypertension were all included. Individuals with a history of renal artery stenosis, renal artery revascularization surgeries, kidney transplants, or incomplete renal artery visibility were not included. To ensure confidentiality and eliminate duplication, each enrolled participant was given a unique study identification code. Baseline demographic and clinical parameters were gathered using a systematic review of medical records and structured interviews before the procedure of coronary angiography was performed. These parameters included age, sex, and years of hypertension, status of smoking, diabetes mellitus, dyslipidemia, serum creatinine level, and previous ischemic heart disease. All data were recorded using a standardized pro forma created for this investigation. Experienced interventional cardiologists utilized either radial or femoral arteries via aseptic coronary angiography using the Philips Allura Xper FD10 angiography system (Philips Healthcare, Netherlands) with Judkins 6F/7F catheters (Cordis Corporation, USA). An iodinated contrast agent, Iopamidol 370 mg/mL (Bayer Healthcare, Germany has been used, and a standard coronary projection has been obtained following the institutional protocol. At the same time, the renal artery delineation, where feasible, was performed using the abdominal aortography or the spillover of contrast during the angiographic run, hence removing the unnecessary exposure to contrast. The angiographic images were checked in real-time and on the digital archive. Renal artery stenosis was determined by visual estimation of luminal constrictions. Renal artery stenosis of at least 50% in either or both of the renal arteries was referred to as incidental renal artery stenosis (IRAS) [14]. Angiographic evaluation was also done by two senior cardiologists, who independently assessed it in order to reduce bias in observers, and disagreements were solved using consensus. Additional angiography factors were also recorded, such as the number of coronary artery diseases and the existence of multivessel coronary artery disease. The second investigator made sure that every form was filled out completely and consistently. Angiography logs or patient records were used to double-check any missing or ambiguous entries.

The data were entered and analyzed using the Statistical Package of Social Sciences (SPSS) software, version 25.0.

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The Shapiro-Wilk test was used to assess the normality of two continuous variables: age and the length of hypertension. Regularly distributed data were shown using the mean and standard deviation (SD), while non-normally distributed variables were shown using the median and interquartile range (IQR). Frequencies and percentages were used to describe the categorical variables, including gender, diabetes mellitus, smoking status, dyslipidemia, coronary artery disease pattern, and incidental renal artery stenosis (IRAS). The prevalence of IRAS in hypertensive individuals undergoing coronary angiography served as the primary outcome measure. The percentage of study subjects with ≥50% luminal constriction in one or both renal arteries during angiographic evaluation was used to calculate the prevalence. The purpose of the stratified analysis was to look at the differences in IRAS between the predefined subgroups, such as age groups, sex, duration of hypertension, diabetes, smoking, and severity of coronary artery disease. To ascertain the relationship between IRAS and categorical characteristics, the chi-square test was utilized. The Independent Samples t-test for normally distributed data and the Mann-Whitney U test for non-parametric data were used to compare continuous variables between patients with and without IRAS. The factors associated with IRAS were identified by univariate analysis, and the results were presented as crude odds ratios (OR) with 95% confidence intervals (CI). Statistical significance was defined as a p-value of ≤0.05.

RESULTS

The study included 139 male and 33.8 female hypertensive patients. The prevalence of diabetes mellitus was 45.3% and, dyslipidemia was 56.8, and current smokers were 34.5%. The participants had a history of ischemic heart disease in 41.7% and a median of 8 (5–12) years of hypertension. The majority of the patients had normal renal functions, with a median serum creatinine reading of 1.0mg/dL (0.9-1.3)(Table 1).

Table 1: Baseline Demographic and Clinical Characteristics (n=139)

Variables	Mean ± SD / n (%)	Median (IQR)
Age in Years	58.6 ± 9.8	–
Male	92 (66.2%)	–
Female	47 (33.8%)	–
Duration of Hypertension (years)	–	8 (5–12)
Diabetes Mellitus	63 (45.3%)	–
Dyslipidemia	79 (56.8%)	–
Current Smoker	48 (34.5%)	–
Creatinine in Serum (mg/dL)	–	1.0 (0.9–1.3)
History of Ischemic Heart Disease	58 (41.7%)	–

Coronary angiography showed that 29.5% of the patients had single-vessel coronary artery disease (CAD), 33.1% had double-vessel disease, and 37.4% had triple-vessel disease. A total of 70.5% of the cohort possessed multivessel CAD (Table 2).

Table 2: Coronary Angiographic Findings (n=139)

Variables	n (%)
Single-vessel CAD	41 (29.5%)
Double-vessel CAD	46 (33.1%)
Triple-vessel CAD	52 (37.4%)
Multivessel CAD (≥2 vessels)	98 (70.5%)

Incidental renal artery stenosis (IRAS) was present in 18.0% of the patients and was unilateral in 13.7% and bilateral in 4.3% of the patients. Most of the participants (82.0%) did not show any sign of renal artery stenosis by angiography. (Table 3).

Table 3: Frequency and Pattern of Incidental Renal Artery Stenosis (IRAS)

Outcomes	n (%)
Incidental RAS (≥50% stenosis)	25 (18.0%)
Unilateral IRAS	19 (13.7%)
Bilateral IRAS	6 (4.3%)
No renal artery stenosis	114 (82.0%)

Stratified analysis revealed that the prevalence of IRAS was higher among patients aged ≥60 years (23.4%) than in patients aged <60 years. The IRAS was more prevalent in patients with diabetes (23.8%) than in non-diabetic patients (13.2%) (p=0.11). There were 22.9% of smokers with IRAS compared to 15.4% non-smokers (p=0.29). IRAS was more common in patients with multivessel CAD (20.4%) than in single vessel disease (12.2%), though this was not statistically significant (p=0.28). In the univariate analysis, the presence of IRAS was significantly correlated with a longer history of hypertension (≥10 years) and high serum creatinine (≥1.2mg/dl). Participants aged ≥60 years, those with diabetes, smokers, males, and those who had multivessel CAD had greater odds of IRAS; none of the relationships were found statistically significant (Table 4).

Table 4: Association of Clinical and Demographic Factors with Incidental Renal Artery Stenosis (IRAS)

Variables	IRAS		OR (95% CI)	p-value
	Present, n (%)	Absent, n (%)		
Age				
≥60 Years	15 (23.4%)	49 (76.6%)	1.99 (0.84–4.68)	0.12
<60 Years	10 (13.2%)	65 (86.8%)	Reference	
Gender				
Male	17 (18.5%)	75 (81.5%)	1.11 (0.44–2.80)	0.84
Female	8 (17.0%)	39 (83.0%)	Reference	
Diabetes Mellitus				
Present	15 (23.8%)	48 (76.2%)	2.06 (0.89–4.78)	0.09
Absent	10 (13.2%)	66 (86.8%)	Reference	

DOI: https://doi.org/10.54393/pjhs.v7i4.3763

Smoking Status				
Current Smoker	11 (22.9%)	37 (77.1%)	1.64 (0.71–3.79)	0.24
Non-smoker	14 (15.4%)	77 (84.6%)	Reference	
Coronary Artery Disease				
Multivessel CAD	20 (20.4%)	78 (79.6%)	1.83 (0.73–4.55)	0.19
Single-vessel CAD	5 (12.2%)	36 (87.8%)	Reference	
Duration of Hypertension				
≥10 Years	–	–	2.57 (1.09–6.07)	0.03*
<10 Years	–	–	Reference	
Serum Creatinine				
≥1.2 mg/dL	–	–	2.71 (1.18–6.21)	0.02*
<1.2 mg/dL	–	–	Reference	

*Statistical significance at p≤0.05

The mean age of patients with IRAS was somewhat greater than that of patients without IRAS, although this difference was not statistically significant (p=0.28). People with IRAS had a longer median history of hypertension than people without, which was statistically significant (p=0.04). Similarly, the serum levels of creatinine in the IRAS and non-IRAS groups differed statistically significantly (p=0.02)(Table 5).

Table 5: Comparison of Continuous Variables between Patients with and without IRAS

Variables	IRAS		p-value
	Present (n=25)	Absent (n=114)	
Age (Years), Mean ± SD	60.4 ± 9.2	58.2 ± 10.0	0.28[1]
Duration of Hypertension (Years), Median (IQR)	10 (6–14)	8 (5–11)	0.04[2*]
Serum Creatinine (mg/dL), Median (IQR)	1.2 (1.0–1.5)	1.0 (0.9–1.2)	0.02[2*]

[1]p-value calculated using the Independent Samples t-test. [2]p-value calculated using the Mann–Whitney U test. *Statistical significance at p≤0.05

DISCUSSION

The current study found that among hypertension patients having coronary artery angiography, the incidence of accidental renal artery stenosis (IRAS) was 18.0%. This incidence is consistent with previous findings showing high levels of RAS are not a rare occurrence in high-risk cardiovascular populations. In individuals undergoing coronary angiography, a meta-analysis of 31 studies involving over 31,000 patients revealed a total RAS frequency of roughly 13.4%. The ratio of severe to bilateral disease is comparable to our result of bilateral disease with primarily unilateral involvement [7]. The current study's prevalence rate is comparable to that of a multi-center study conducted in Iraq, which found that 15% of hypertensive individuals who had elective coronary angiography had RAS. RAS is strongly associated with abnormal coronary outcomes and inadequate blood pressure control [14]. These results support the idea that systemic atherosclerosis often affects both the coronary and renal arterial beds, especially in patients who have chronic hypertension. A recent observational study in Indian patients receiving primary percutaneous coronary intervention has also shown RAS in 16% of patients, and older age and hypertension have a significant association with the prevalence of stenosis, which is consistent with our significant associations between duration of hypertension and increased creatinine levels [11]. Although previous studies have reported lower prevalence rates, ranging between 12-15% among the coronary artery disease patients, the estimates are generally in line with ours when they look at the variation in the population risk profiles, screening methods, and threshold of significant stenosis. According to a study on the prevalence of renal artery stenosis in CAD patients, the frequency was 12.9%, and one of the prognostic factors was female gender [15]. Similar to the patterns seen in our investigation, a different worldwide cohort also found that 11.9% of hypertensive patients with CAD had substantial RAS [16]. A systematic review revealed that the prevalence rates of RAS in hypertensive patients undergoing coronary angiography in the past were within the range of about 10-30%, depending on the unique cohorts and imaging modalities [7]. Current results are well within this range, which confirms the consistency of the estimates of RAS prevalence in recent studies. Correspondingly, systematic epidemiologic reviews have indicated that the prevalence of substantial RAS among patients with atherosclerotic vascular disease, including combined hypertension and CAD, is not uniformly distributed, something that further indicates the importance of context-specific screening approaches [17]. The incidence of RAS among relevant patient categories in South Asia is not well documented locally, although this usually indicates a significant burden. In hypertensive populations, a cross-sectional study conducted in Pakistan showed a strong correlation between RAS and coronary artery disease (CAD), supporting the notion that renovascular pathology frequently leads to systemic atherosclerosis in this group. However, the investigation's main findings did not include precise prevalence data [18]. The most recent study about RAS prevalence was published in a hospital-based cohort in Visakhapatnam, India, where it is reported that 19% where unilateral involvement, was 14%, and 5% had bilateral involvement [19]. These two studies indicate that RAS is a significant comorbidity among patients with hypertensive CAD in South Asia. These results are similar to those reported internationally, including a cohort study using multi-centers across South Asia in which extensive RAS prevalence near 24% was highly related to age, disease duration, and burden of comorbidity, confirming that metabolic and vascular risk factors increase the predisposition of developing renovascular affection [20].

There are various limitations to this research. First, because it is a cross-sectional, single-center study, the findings

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cannot be extrapolated to other regions or the whole population of hypertension patients. Second, the sample size, though sufficient to estimate prevalence, might not have been powerful to determine statistically significant relationships with some risk factors, such as diabetes, smoking, and multivessel coronary artery disease. Third, analysis of the renal artery was conducted incidentally with coronary angiography and not with specific renal imaging, which might not have well reflected the actual prevalence of stenosis. Lastly, univariate analysis was applied only, and there was no control of potential confounding factors; therefore, one should interpret the observed associations with caution.

CONCLUSIONS

Incidental renal artery stenosis was found in almost a quarter of hypertensive patients undergoing coronary angiography, and it was predominantly unilateral. Hypertension and serum creatinine were important predictors, with a longer period of hypertension and high levels of serum creatinine. These results underline the need to observe IRAS among high-risk hypertensive patients since early identification can be used to shape specific management plans and avoid the development of renal and cardiovascular issues. Routine monitoring of the renal arteries during coronary angiography may thus present a viable opportunity for early diagnosis and thorough risk classification, which falls between cardiac and renal care.

Authors' Contribution

Conceptualization: ZUD
Methodology: ZUD, SI, JI, SDK
Formal analysis: ZUD, SN
Writing and Drafting: ZUD, SI, JI, SDK, HG
Review and Editing: ZUD, SI, JI, SDK, HG, SN, WHK

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

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