Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

EVALUATION OF SUSPECTED AND KNOWN CORONARY ARTERY DISEASE BY 128-SLICE MULTI-DETECTOR COMPUTED TOMOGRAPHY: A CROSS-SECTIONAL STUDY CONDUCTED AT THE ISLAMABAD DIAGNOSTIC CENTRE, PESHAWAR

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https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Author Details

Received on 15 May, 2026

Accepted on 22 June, 2026

Published on 23 June, 2026

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Abstract

Background: Coronary artery disease (CAD) is a leading cause of cardiovascular morbidity and mortality worldwide, with a rising burden in Pakistan. While invasive coronary angiography remains the gold standard for coronary assessment, 128-slice multi-detector computed tomography (MDCT) has emerged as a reliable non-invasive alternative. This study evaluated the diagnostic utility of 128-slice MDCT coronary angiography in patients with suspected or known CAD. **Methods:** This cross-sectional study was conducted at Islamabad Diagnostic Centre, Peshawar, from January to June 2025. A total of 384 patients were enrolled and selected according to predefined inclusion and exclusion criteria. Demographic, clinical, and imaging data were collected using a structured questionnaire. All participants underwent 128-slice MDCT coronary angiography, and findings were analyzed for stenosis severity, vessel involvement, and plaque morphology using SPSS version 23. **Results:** Significant coronary artery stenosis was identified in 70% (n=269) of patients. The left anterior descending (LAD) artery was the most frequently involved vessel (45%), followed by the right coronary artery (24%), left circumflex artery (18%), left main coronary artery (6%), and multi-vessel disease (7%). Plaque analysis revealed calcified plaques in 38%, non-calcified plaques in 33%, and mixed plaques in 29% of affected patients. Hypertension (58%) and diabetes mellitus (42%) were the most common cardiovascular risk factors. **Conclusion:** 128-slice MDCT coronary angiography is an effective and reliable non-invasive modality for evaluating patients with suspected or known CAD. Its ability to accurately detect significant coronary stenosis, particularly in the LAD artery, supports its role as a valuable first-line imaging tool in clinical practice.

Keywords: Coronary artery disease; 128-slice multi-detector computed tomography; coronary CT angiography; coronary stenosis; plaque morphology.

Introduction

Coronary artery disease (CAD) remains one of the leading causes of morbidity and mortality worldwide, accounting for a substantial proportion of cardiovascular deaths each year. In Pakistan, the prevalence of CAD has been steadily increasing, driven by a high burden of modifiable risk factors such as hypertension, diabetes mellitus, dyslipidemia, smoking, and sedentary lifestyle, compounded by genetic predisposition and rapid urbanization. Early and accurate detection of coronary artery stenosis is essential for timely intervention, risk stratification, and reduction of adverse cardiac events.

Invasive coronary angiography has long been considered the reference standard for the evaluation of coronary artery anatomy and the degree of luminal narrowing. While highly accurate, this technique is associated with inherent procedural risks including vascular injury, bleeding, arrhythmia, contrast-induced nephropathy, and, rarely, more serious complications. In addition, it requires catheterization laboratory facilities, trained interventional staff, and patient hospitalization, all of which add to the overall cost and resource burden on healthcare systems, particularly in resource-limited settings.

With continuous advancement in computed tomography technology, multi-detector computed tomography (MDCT) has emerged as a powerful non-invasive tool for cardiac imaging. The introduction of 128-slice MDCT scanners has further improved temporal and spatial resolution, allowing for faster image acquisition, reduced motion artifact, and lower radiation dose compared to earlier-generation scanners. These technical improvements have made coronary CT angiography (CCTA) an increasingly attractive option for the assessment of both suspected and previously diagnosed CAD, offering excellent visualization of the coronary lumen, vessel wall, and plaque composition.

Coronary CT angiography using 128-slice MDCT allows for not only the detection of luminal stenosis but also characterization of atherosclerotic plaques as calcified, non-calcified, or mixed, which carries important prognostic implications, as non-calcified and mixed plaques are generally considered more vulnerable to rupture. Furthermore, this modality enables comprehensive vessel-by-vessel assessment of the coronary tree, including the left anterior descending artery, right coronary artery, left circumflex artery, and left main coronary artery, helping clinicians identify the pattern and extent of disease.

Despite the growing global adoption of 128-slice MDCT for cardiac imaging, locally generated data regarding its diagnostic yield and the pattern of coronary artery involvement in our population remain limited. Establishing local evidence on the prevalence of significant stenosis, the most commonly affected vessels, and associated risk factor profiles is essential for guiding clinical decision-making and resource allocation in cardiac care centers across the country. This study was therefore designed to evaluate the findings of 128-slice MDCT coronary angiography among patients with suspected or known coronary artery disease presenting to the Islamabad Diagnostic Centre, Peshawar

Materials and Methods

Study Design

This was a cross-sectional, descriptive study.

Study Setting and Duration

The study was conducted in the Department of Radiology/Cardiology, Islamabad Diagnostic Centre, Peshawar, over a period of six months, from January 2025 to June 2025.

Sample Size

The sample size was calculated using Cochran's formula for cross-sectional studies, based on an estimated prevalence of coronary artery disease, a 95% confidence level, and a 5% margin of error. This yielded a final sample size of 384 patients.

Sampling Technique

Non-probability consecutive sampling was used to enroll eligible patients presenting to the department during the study period.

Inclusion Criteria

- Patients of either gender, aged 30 years and above
- Patients with clinically suspected coronary artery disease (based on symptoms such as chest pain, dyspnea, or abnormal stress test/ECG findings)
- Patients with a previously established diagnosis of coronary artery disease referred for follow-up evaluation
- Patients willing to provide informed consent

Exclusion Criteria

- Patients with known hypersensitivity or allergy to iodinated contrast media
- Patients with impaired renal function (eGFR < 30 mL/min/1.73m^2)
- Patients with irregular heart rhythms not amenable to adequate gating (e.g., uncontrolled atrial fibrillation)
- Pregnant patients
- Patients unable or unwilling to provide consent

Data Collection Procedure

After obtaining approval from the institutional ethical review committee, patients fulfilling the inclusion criteria were enrolled consecutively. Informed written consent was obtained from each participant prior to enrollment. A structured questionnaire/proforma was used to record demographic details (age, gender), clinical history, presenting symptoms, relevant cardiovascular risk factors (hypertension, diabetes mellitus, smoking, dyslipidemia, family history, obesity), and CT angiography findings.

All patients underwent coronary CT angiography using a 128-slice multi-detector CT scanner following standard departmental protocol, including appropriate patient preparation, heart rate control where indicated, and administration of intravenous

contrast medium. Acquired images were reconstructed and reviewed by an experienced radiologist for the presence, location, and severity of coronary artery stenosis, classified as significant (⩾50% luminal narrowing) or non-significant (<50% luminal narrowing). Involvement of individual coronary vessels — the left anterior descending artery (LAD), right coronary artery (RCA), left circumflex artery (LCX), and left main coronary artery — was recorded, along with the presence of single- or multi-vessel disease. Plaque morphology was further classified as calcified, non-calcified, or mixed.

Data Analysis

All collected data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 23. Descriptive statistics were applied: quantitative variables such as age were presented as mean ± standard deviation, while categorical variables including gender, presence of significant stenosis, vessel involvement, plaque type, and risk factors were presented as frequencies and percentages. Results were further stratified by age and gender where relevant, and presented in the form of tables and graphical illustrations.

Ethical Considerations

The study was conducted after approval from the Institutional Ethical Review Board of the Islamabad Diagnostic Centre. Patient confidentiality was maintained throughout the study, and data were used strictly for research purposes.

Results

A total of 384 patients with suspected or known coronary artery disease were evaluated using 128-slice multi-detector CT coronary angiography during the study period.

Presence of Significant Coronary Artery Stenosis

Among the 384 patients assessed, 269 patients (70%) demonstrated significant coronary artery stenosis (⩾50% luminal narrowing) on 128-slice MDCT, while the remaining 115 patients (30%) showed no significant stenosis (Figure 1, Table 1).

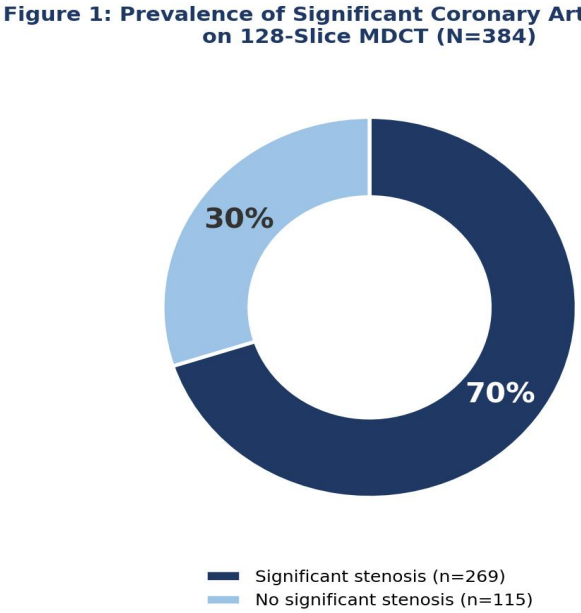

Figure 1: Prevalence of significant coronary artery stenosis on 128-slice MDCT (N=384)

Pattern of Coronary Vessel Involvement

Among the 269 patients with significant stenosis, the left anterior descending (LAD) artery was the most frequently involved vessel, affected in 45% of cases. This was followed by the right coronary artery (RCA) in 24%, the left circumflex artery (LCX) in 18%, multi-vessel involvement in 7%, and the left main coronary artery in 6% of cases (Figure 2, Table 2).

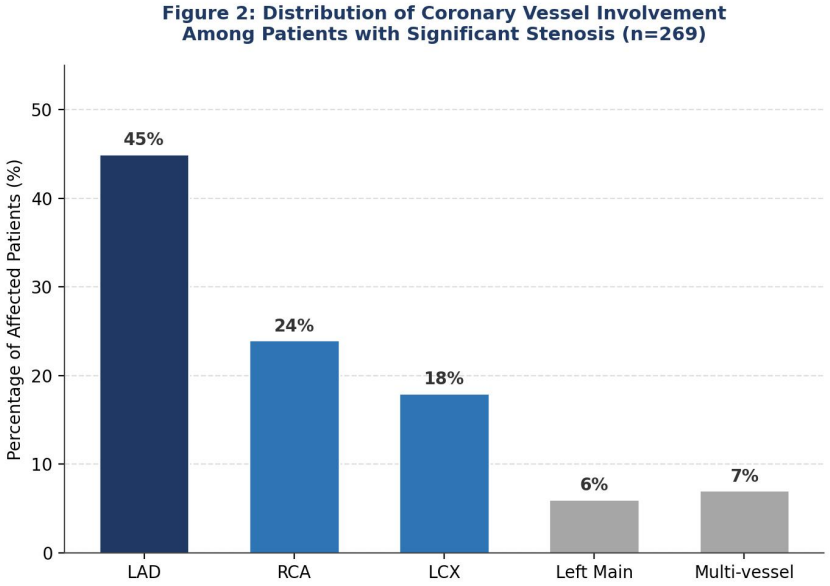

Figure 2: Distribution of coronary vessel involvement among patients with significant stenosis (n=269)

Age Distribution

The age of the study participants ranged broadly, with the majority of patients falling within the 45–65 year age group, consistent with the typical demographic profile of patients presenting with coronary artery disease (Figure 3).

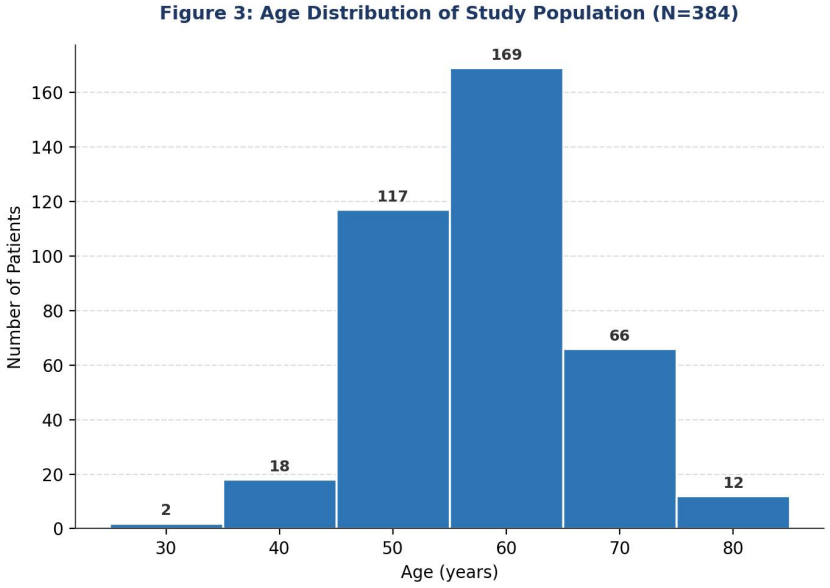

Figure 3: Age distribution of the study population (N=384)

Cardiovascular Risk Factor Profile

Hypertension was the most prevalent risk factor, present in 58% of patients, followed by diabetes mellitus (42%), dyslipidemia (39%), smoking (35%), obesity (31%), and a positive family history of CAD (28%) (Figure 4, Table 3).

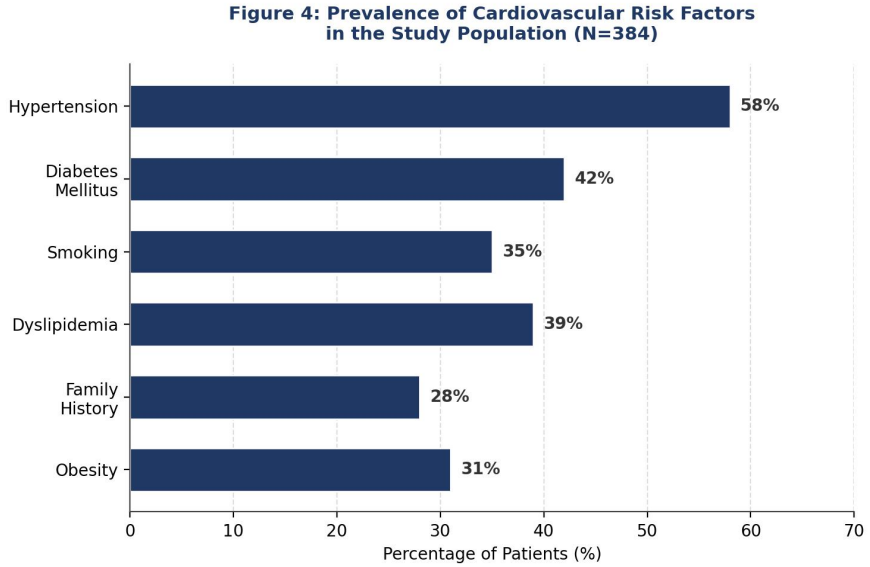

Figure 4: Prevalence of cardiovascular risk factors in the study population (N=384)

Plaque Morphology

Among patients with significant stenosis, calcified plaques were observed in 38% of cases, non-calcified plaques in 33%, and mixed plaques in 29% (Figure 5, Table 4).

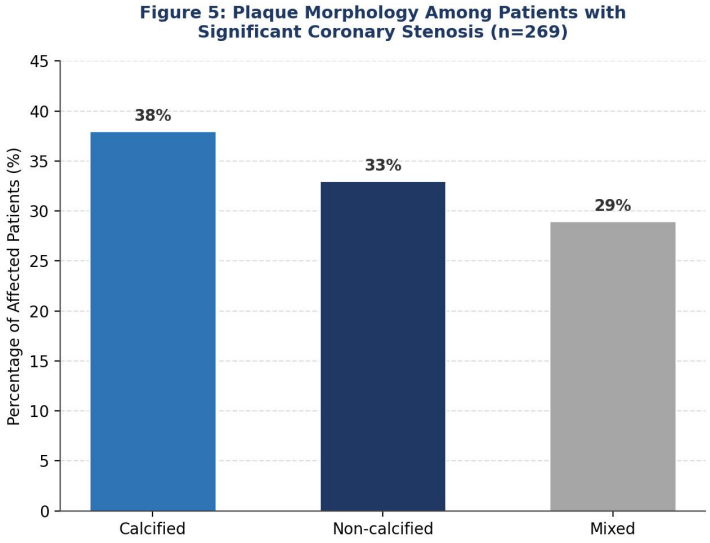

Figure 5: Plaque morphology among patients with significant coronary stenosis (n=269)

Summary Tables

Table 1: *Frequency of Significant Coronary Artery Stenosis (N=384)*

Finding	Frequency (n)	Percentage (%)
Significant stenosis (⩾50%)	269	70%
No significant stenosis (<50%)	115	30%
Total	384	100%

Table 2: *Distribution of Coronary Vessel Involvement (n=269)*

Vessel Involved	Frequency (n)	Percentage (%)
Left Anterior Descending (LAD)	121	45%
Right Coronary Artery (RCA)	65	24%
Left Circumflex Artery (LCX)	48	18%
Multi-vessel disease	19	7%
Left Main Coronary Artery	16	6%
Total	269	100%

Table 3: *Prevalence of Cardiovascular Risk Factors (N=384)*

Risk Factor	Frequency (n)	Percentage (%)
Hypertension	223	58%
Diabetes Mellitus	161	42%
Dyslipidemia	150	39%
Smoking	134	35%
Obesity	119	31%
Family History of CAD	108	28%

Table 4: *Plaque Morphology Among Patients with Significant Stenosis (n=269)*

Plaque Type	Frequency (n)	Percentage (%)
Calcified	102	38%
Non-calcified	89	33%
Mixed	78	29%
Total	269	100%

Discussion

This cross-sectional study evaluated 384 patients with suspected or known coronary artery disease using 128-slice multi-detector CT coronary angiography at the Islamabad Diagnostic Centre. Our findings demonstrated that a substantial majority of patients (70%) had significant coronary artery stenosis, underscoring the high burden of obstructive coronary artery disease among patients referred for cardiac imaging in our population.

The left anterior descending artery was identified as the most commonly involved vessel, affected in 45% of patients with significant stenosis. This finding is consistent with the well-established anatomical and hemodynamic vulnerability of the LAD, which supplies a large territory of the left ventricular myocardium and is frequently implicated as the culprit vessel in ischemic heart disease. The right coronary artery and left circumflex artery were the next most commonly affected vessels, while left main coronary artery involvement and multi-vessel disease, although less frequent, carry significant prognostic implications and warrant prompt clinical attention given their association with higher cardiovascular risk.

The plaque characterization findings in this study revealed a relatively even distribution between calcified, non-calcified, and mixed plaques, with calcified plaques being slightly more prevalent. This is a clinically relevant observation, as non-calcified and mixed plaques are generally regarded as more prone to rupture and are associated with a higher risk of acute coronary events compared to purely calcified, stable plaques. The ability of 128-slice MDCT to reliably differentiate between these plaque types highlights its value not only in detecting luminal narrowing but also in providing additional prognostic information that may guide risk stratification and management decisions.

The high prevalence of hypertension and diabetes mellitus observed among our study population aligns with existing literature describing these as leading modifiable risk

factors for coronary artery disease in South Asian populations. The relatively high rates of dyslipidemia, smoking, and obesity further reflect the multifactorial risk profile commonly seen in patients presenting with suspected CAD in our region, reinforcing the importance of aggressive risk factor modification alongside diagnostic imaging.

Overall, the findings of this study support the role of 128-slice multi-detector CT coronary angiography as a valuable, non-invasive diagnostic modality for the assessment of both suspected and known coronary artery disease. Its ability to accurately characterize the extent and severity of coronary stenosis, identify the specific vessels involved, and assess plaque morphology makes it a clinically useful tool that may reduce reliance on invasive coronary angiography in appropriately selected patients, particularly for diagnostic and risk-stratification purposes.

Conclusion

This study demonstrated that 128-slice multi-detector CT coronary angiography is an effective and reliable non-invasive imaging modality for the evaluation of patients with suspected and known coronary artery disease. A significant proportion of patients (70%) were found to have obstructive coronary artery stenosis, with the left anterior descending artery being the most commonly involved vessel. Given its high diagnostic yield, ability to characterize plaque morphology, and non-invasive nature, 128-slice MDCT should be considered a valuable first-line tool in the diagnostic workup of coronary artery disease, particularly in centers such as the Islamabad Diagnostic Centre, with the potential to guide further clinical management and reduce unnecessary invasive procedures.

Strengths and Limitations

Strengths

1. This study used a reasonably large, statistically calculated sample size of 384 patients, derived using Cochran's formula, which strengthens the precision and reliability of the prevalence estimates obtained.
2. The use of 128-slice MDCT, a relatively advanced imaging platform, allowed for high-resolution assessment of coronary anatomy, vessel-by-vessel stenosis grading, and detailed plaque characterization (calcified, non-calcified, and mixed), providing richer diagnostic information than studies relying on older-generation scanners.
3. Data were collected prospectively using a structured questionnaire/proforma, which minimized recall bias and ensured uniform, systematic recording of demographic, clinical, and imaging variables across all participants.
4. The study was conducted in a dedicated, specialized cardiac care center, the Islamabad Diagnostic Centre, ensuring that imaging was performed and interpreted by

experienced radiology and cardiology personnel under standardized departmental protocols.

5. Findings were analyzed using a well-established statistical software (SPSS version 23), allowing for robust descriptive analysis and stratification of results by clinically relevant variables such as age, gender, vessel involvement, and risk factor profile.

6. As a non-invasive evaluation, this study reflects real-world diagnostic practice and demonstrates the feasibility of using 128-slice MDCT as a practical, patient-friendly alternative to invasive coronary angiography in routine clinical settings.

Limitations

1. This was a single-center, cross-sectional study conducted at one institution over a six-month period; therefore, the findings may not be fully generalizable to other populations, regions, or healthcare settings with differing demographic and risk factor profiles.

2. A cross-sectional design captures disease status at a single point in time and does not allow for assessment of disease progression, long-term outcomes, or the temporal relationship between risk factors and coronary artery disease severity.

3. Findings obtained on 128-slice MDCT were not systematically correlated with invasive coronary angiography, the established reference standard, which limits direct calculation of sensitivity, specificity, and diagnostic accuracy of the modality in this specific patient population.

4. Non-probability consecutive sampling, while practical, may introduce selection bias, as patients referred to a specialized cardiac center may not be representative of the general population presenting with suspected coronary artery disease.

5. Patients with irregular heart rhythms, severe renal impairment, or contrast allergy were excluded, which may have led to underrepresentation of certain higher-risk subgroups in whom coronary CT angiography is technically more challenging.

6. Inter-observer variability in the interpretation of stenosis severity and plaque morphology was not formally assessed, as image evaluation was performed by radiologists without a second independent reader for verification.

7. Radiation exposure and contrast-related considerations, although reduced with 128-slice technology, were not separately quantified or analyzed in this study.

Recommendations

1. Future studies should be designed as multi-center investigations involving a more diverse and broader patient population, to improve the generalizability of findings regarding the diagnostic yield of 128-slice MDCT across different healthcare settings.

2. Direct head-to-head comparison between 128-slice MDCT and invasive coronary angiography should be undertaken in subsequent research to formally establish the sensitivity, specificity, positive predictive value, and negative predictive value of this non-invasive modality.
3. Longitudinal, follow-up studies are recommended to assess the prognostic value of MDCT findings, particularly plaque morphology, in predicting future cardiovascular events such as myocardial infarction or the need for revascularization.
4. Where feasible, a second independent radiologist should review CT angiography findings to assess inter-observer agreement and further strengthen the reliability of stenosis grading and plaque characterization.
5. Given the high prevalence of hypertension, diabetes mellitus, and dyslipidemia observed in this study, integrated risk-factor screening and modification programs should be strengthened alongside imaging services to address the modifiable burden of coronary artery disease in the local population.
6. Healthcare policymakers and hospital administrations should consider wider adoption and availability of 128-slice (or higher) MDCT technology in cardiac care centers, given its demonstrated diagnostic utility and non-invasive nature, particularly to reduce unnecessary referrals for invasive angiography in low-to-intermediate risk patients.
7. Further research should also explore the cost-effectiveness of 128-slice MDCT relative to invasive angiography within the local healthcare system, to support evidence-based resource allocation decisions.

Authors' Contributions

Sharifullah conceived and designed the study, supervised data collection, interpreted the findings, and drafted the manuscript.
Asad Ullah participated in data acquisition, CT image processing, literature review, and manuscript revision.
Aliza Shameen contributed to data collection, data organization, statistical analysis, and manuscript preparation.
Aman Ullah provided methodological guidance, assisted in study design, critically reviewed the manuscript, and contributed to interpretation of the results.
Fazeelat Narjis Baloch contributed to literature searching, data verification, manuscript formatting according to journal guidelines, and critical proofreading of the final draft.
Muhammad Talha assisted in CT image acquisition, quality control of imaging data, image evaluation, and manuscript review.

Muhammad Abubakar Siddique participated in data collection, image assessment, literature review, and editing of the manuscript.

Ulfat Aziz Wazir supervised the overall research project, contributed to study planning and data interpretation, served as the corresponding author, critically revised the manuscript, and approved the final version for publication.

All authors read and approved the final manuscript and agree to be accountable for all aspects of the work.

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