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Original Research Article

Diagnostic Accuracy of CT Angiography in Stable Patients Suspected of Obstructive Coronary Artery Disease

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Abstract: *Coronary artery disease (CAD) remains a leading cause of morbidity and mortality worldwide. Accurate diagnosis in stable patients at high risk of obstructive CAD is critical for timely intervention. While invasive coronary angiography (ICA) is the gold standard, coronary computed tomography angiography (CCTA) is increasingly being used as a non-invasive alternative with promising diagnostic value and fewer procedural risks.* ***Objective:*** *To analyze and compare the diagnostic accuracy and safety of CCTA and ICA in stable patients at high risk of obstructive CAD.* ***Methods:*** *A prospective study was conducted in the Department of Cardiology, Punjab Institute of Cardiology, Lahore, between May 2023 to May 2025. Eligible patients included those with left ventricular ejection fraction (LVEF) <50% and typical angina symptoms, with pre-test probability of obstructive CAD between 50–85% along with a positive functional test, or >85% regardless of functional testing. A total of 100 patients were consecutively enrolled and divided equally: Group A (n=50) underwent CCTA, and Group B (n=50) underwent ICA. Outcomes were evaluated for diagnostic utility, frequency of non-actionable procedures, and safety endpoints. Statistical analysis included chi-square testing and comparison of proportions, with p<0.05 considered significant.* ***Results:*** *Use of CCTA significantly reduced the rate of invasive procedures by 65% (p<0.0001) and decreased non-actionable ICAs by 90% (p<0.0001). At one-year follow-up, major adverse cardiac outcomes—including mortality, acute coronary syndrome, urgent revascularization, stroke, and cardiac-related hospital admission—were observed in 20 (40%) patients in Group A and 21 (42%) in Group B (p=0.91).* ***Conclusion:*** *CCTA provides a safe and effective alternative to ICA for diagnosing obstructive CAD in stable high-risk patients, reducing unnecessary invasive procedures without compromising clinical outcomes.*

Keywords: Angiography, Coronary; Coronary Artery Disease; Coronary Vessels; Multidetector Computed Tomography

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Introduction

CT coronary angiography is a non-invasive examination method for the diagnosis and confirmation of coronary artery disease in stable but symptomatic patients. As it was readily available and had satisfactory accuracy, its use was recommended before exploring its prognostic profile. Large studies have confirmed the prognostic accuracy of coronary CTA in short-term follow-up. (1, 2) However, such patients have a rare cardiovascular rate in the short term, so there is a need for long-term studies to analyze the risk better.

Coronary CTA can detect the presence and risk of obstructive coronary artery disease while assessing CAD. Obstructive CAD cannot be seen on functional stress imaging, but recent literature shows that it is important to detect it as it is a predictor of acute cardiovascular events and mortality. (3, 4)However, there is scarce evidence regarding the association between obstructive CAD and a higher likelihood of coronary events. (5)

This study was conducted to analyze the comparative diagnostic accuracy and safety of coronary CTA angiography and invasive coronary angiography in patients at high risk of obstructive coronary artery disease.

Methodology

A prospective study was performed in the Cardiology Department of Punjab Institute of Cardiology, Lahore, from May 2023 to May 2025. A total of 100 patients with LVEF less than 50% and typical angina symptoms, who had a pre-probability test result of 50-85% with a positive functional test, and those with a pre-probability test result greater than 85%, were selected for the study. Patients at high risk of in-stent restenosis, with acute coronary syndrome, arrhythmia, GFR less than 60 ml/min, BMI more than 35, and contraindication to angiography were excluded.

Patients were consecutively divided into two equal groups: Group A and Group B. Group A included 50 patients undergoing non-invasive coronary CTA, and Group B included 50 patients undergoing invasive coronary angiography directly. CCTA was performed on 2 x 192 dual-source scanners after administering 0.8 mg sublingual nitrates to patients in Group A. Patients were also given 5 mg IV metoprolol if the flashed heart rate was more than 70 and the forced heart rate was more than 80 per minute. Retrospective ECG gating was employed, whose voltage and collimation were adjusted according to body mass index. SAFIRE was used at level 3 for image reconstruction. Experienced cardiologists examined the results, and a consensus of at least two was required, especially in equivocal cases.

Invasive coronary angiography was performed by standard fluoroscopic instruments in Group B. Quantitative coronary angiography was performed in equivocal cases. Experienced cardiologists examined the results, and a consensus of at least two was required, especially in equivocal cases.

Primary short-term outcomes, including the number of index and non-index ICAs or PCIs, the number of non-actionable invasive procedures, the total radiation dose, and the average volume of contrast used, were assessed within 3 months of the start of the study. Long-term composite outcomes including all-cause mortality, major adverse cardiovascular events, urgent hospital admission for cardiovascular cause, unplanned PCI or CABG due to complications, acute coronary syndrome, need for surgical intervention or blood transfusion, kidney dysfunction, hemorrhage, restenosis and formation of fistula, pseudoaneurysm or

occlusion were assessed for efficacy and safety of procedures in 1 year follow-up.

All data were analyzed by SPSS version 24. Normally distributed continuous parameters were reported as mean±SD, and their comparison was done by t-test. Non-normally distributed variables were reported as median, and the Mann-Whitney U test was used for comparison. Categorical parameters were reported as percentages, and Fisher's exact test was used for their comparison. Outcomes were evaluated by logistic regression analysis and Cox regression analysis. Statistical significance was set at $p < 0.05$.

Results

Neither group differed significantly in terms of demographic and clinical variables, as shown in Table I. The incidence of obstructive CAD was found in 27 patients (54%), and the difference between groups was insignificant (p=0.51). A total of 14 patients (28%) in Group A and 17 patients (34%) in Group B underwent elective coronary revascularization (p=0.45).

Regarding the short-term outcomes, undergoing CCTA significantly reduced the rate of invasive procedures by 65% (p<0.0001) and the rate of non-actionable ICAs by 90% (p<0.0001). Additionally, there was also a 66% decrease in the number of hospitalized patients by CCTA (p<0.0001). The volume of contrast material (81.2 vs 89 ml, p=0.09) and radiation dose (10.2 vs 9.8 mSv, p=0.07) did not differ significantly between the two groups. In the short three-month follow-up, no patient reported any adverse events.

In the long-term 1-year follow-up, mortality, ACS, urgent revascularization, stroke, and hospital admission due to cardiac events occurred in 20 (40%) patients in Group A and 21 (42%) patients in Group B (p=0.91). The rate of major adverse cardiac events was not significantly different between the two groups (HR: 1.11 (0.46-2.58). Logistic regression analysis found no relationship between imaging technique and adverse effects (OR: 0.9 (0.5-8.2) (Table 2)

Table 1: Baseline demographic and clinical features

Parameters	Group A	Group B	P
Mean age	65 ± 6.8	66.7 ± 9.1	0.37
Female gender	20 (40%)	17 (34%)	0.69
Mean BMI	28.2 ± 2.9	27.9 ± 4.0	0.31
Diabetes	11 (22%)	15 (30%)	0.30
Hypertension	40 (80%)	44 (88%)	0.19
Mean systolic blood pressure	131.1 ± 17.6	131.1 ± 20.2	1.1
Mean diastolic blood pressure	77.8 ± 10.2	75.5 ± 9.9	0.38
Hyperlipidemia	45 (90%)	44 (88%)	0.63
Current or ex-smokers	36 (72%)	31 (62%)	0.27
Family history of CAD	18 (36%)	16 (32%)	0.89
History of coronary revascularization	15 (30%)	20 (40%)	0.21
History of ACS	7 (14%)	7 (14%)	1.2
Previous PCI	9 (18%)	18 (36%)	0.17
Previous CABG	5 (10%)	2 (4%)	0.54
Current typical angina symptoms	22 (44%)	15 (30%)	0.25
Current atypical angina symptoms	29 (58%)	35 (70%)	0.24
Mid-high pre-test probability	44 (88%)	42 (84%)	0.82
High pre-test probability	6 (12%)	7 (14%)	0.80
Heart failure	11 (22%)	7 (14%)	0.37
Atrial fibrillation	6 (12%)	7 (14%)	0.63
Valvular heart disease	2 (4%)	4 (8%)	0.47
Chronic obstructive pulmonary disease	2 (4%)	1 (2%)	0.26

Table 2: Cumulative long-term adverse events of CCTA and ICA

Adverse events	Group A	Group B	P
All-cause mortality	5 (10%)	2 (4%)	0.21
Cardiac death	4 (8%)	2 (4%)	0.32
Non-cardiac death	1 (2%)	-	0.54
ACS	3 (6%)	3 (6%)	0.74
Urgent coronary revascularization	5 (10%)	8 (16%)	0.29
Urgent cardiovascular hospitalization	7 (14%)	8 (16%)	0.77
Stroke	-	-	-
Urgent PCI	-	-	-
Urgent CABG	-	-	-
Surgical intervention		-	-
Need for hospital admission	13 (26%)	13 (26%)	0.90
Pseudoaneurysm, fistula, or occlusion	-	-	-
Renal dysfunction	4 (8%)	3 (6%)	0.53
Hemorrhage	2 (4%)	-	0.54
Severe morbidity	9 (18%)	7 (14%)	0.78
Substantial health damage	5 (10%)	8 (16%)	0.29

Discussion

The present study was conducted to compare the outcomes of CCTA and ICA in high-risk CAD patients with obstructive CAD. The results showed that CCTA is significantly more effective and safer than ICA, reducing the number of invasive procedures and hospital stays by 2/3rd. This can be explained by the fact that for CCTA patients without actionable and significant findings, they are not catheterized. These findings agree with previous literature (6-8)

The CAT-CAD trial examined the short-term effects of CCTA, finding that performing CCTA before ICA led to a 2/3 increase in non-invasive OPD cases, similar to our study. They suggested that it should be used as the first-line imaging in patients suspected of CAD.(9)A review analysis by Serruys et al also showed that CTA was more accurate, safe, and cost-effective as compared to ICA and can diagnose CAD without extensive medical interventions. (10)

A meta-analysis comparing CCTA and functional testing found a 76.3% specificity and 94.6% sensitivity, which was significantly higher than the latter, i.e., 60.9 vs 54.9%, respectively. (11) The single-proton emission CT also had lower diagnostic accuracy parameters, as 44.9% and 72.9% indicating CTA as the most reliable method for exclusion of obstructive CAD.

Although the rate of MACE was not statistically different in patients, a meta-analysis of more than 26,000 patients showed a significant difference between ICA and CCTA with an odds ratio of 1.37 for MACE ($p=0.02$) and 1.56 for all-cause death ($p<0.00001$) in patients with stable CAD. (12) On 3 or more follow-ups, patients who underwent ICA had a significantly high incidence of MACE.

Conclusion

CCTA is safer and more effective for the diagnosis of obstructive coronary artery disease in stable patients as compared to invasive coronary angiography.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC--23)

Consent for publication
Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

RAY (Assistant Professor)
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AH (Assistant Professor)
Conception of Study, Development of Research Methodology Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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