RESEARCH PAPER

“Role of Computed Tomography in the evaluation of coronary artery disease: A prospective study”

Mr.Tanish Khandelwal[1], Dr.Mahendra Kumar Verma[1], Ms.Roshani Begam[2], Dr.Surendra Kumar Meena[3]

[1]PG Scholar, Department of Allied HealthCare Sciences (Radiology), Vivekananda Global University, Jaipur, Rajasthan.
[1*]Professor,Dr.Mahendra Kumar Verma(Guide) Department of Allied HealthCare Sciences, Faculty of Allied health Care professions Vivekananda Global University, Jaipur, Rajasthan
[2]Asst.Professor, Department of Allied HealthCare Sciences co- Guide (Radiology), Vivekananda Global University, Jaipur, Rajasthan
[3]Dean -Incharge Faculty of Allied Healthcare Professions
Corresponding Author*, Dr. Mahendra Kumar Verma* (mahendra.verma@vgu.ac.in)

Received: 28th April, 2026; Revised: 17th May, 2026; Accepted: 25th May, 2026; Available Online: 30th May, 2026

Abstract

Background of the Study

Coronary artery disease (CAD) is one of the major causes of morbidity and mortality worldwide and poses a significant healthcare burden in developing countries such as India. The increasing prevalence of hypertension, diabetes mellitus, obesity, smoking, dyslipidemia, and sedentary lifestyle has contributed to the rising incidence of CAD (Virani et al., 2020; Gupta et al., 2016). Conventional invasive coronary angiography remains the gold standard for diagnosing coronary artery stenosis; however, it is invasive and associated with procedural risks. Computed Tomography Coronary Angiography (CTCA) has emerged as an effective non-invasive imaging modality for evaluating coronary artery anatomy, plaque characterization, coronary calcium scoring, and luminal stenosis. Recent developments in multidetector computed tomography (MDCT), Coronary Artery Disease Reporting and Data System (CAD-RADS), fractional flow reserve CT (FFRCT), and artificial intelligence-assisted imaging have further enhanced diagnostic accuracy and prognostic assessment in CAD patients (Cury et al., 2016; Dey et al., 2019).

Aim and Objectives

The present study aimed to evaluate the role of Computed Tomography in the diagnosis and assessment of coronary artery disease among patients with suspected CAD.

Objectives

The assess the diagnostic utility of CT coronary angiography in detecting coronary artery stenosis. To evaluate plaque morphology and coronary artery calcium scoring in CAD patients. To classify coronary artery disease using the CAD-RADS reporting system. To determine the relationship between CT findings and severity of coronary artery disease. To assess the effectiveness of CT as a non-invasive imaging modality in CAD evaluation.

Methodology

A prospective observational study was conducted among patients clinically suspected of coronary artery disease and referred for CT coronary angiography in the Department of Radiodiagnosis at a tertiary care hospital. All patients underwent multidetector CT coronary angiography using standardized acquisition protocols after obtaining informed consent. Demographic data, cardiovascular risk factors, coronary artery calcium scores, plaque characteristics, and severity of luminal stenosis were recorded. CAD-RADS classification was used for standardized interpretation and reporting. Statistical analysis was performed to determine the diagnostic performance and clinical significance of CT findings in CAD evaluation.

Results

The study demonstrated that CT coronary angiography effectively identified coronary artery stenosis, calcified and non-calcified plaques, and coronary calcium burden in patients with suspected CAD. Significant associations were observed between cardiovascular risk factors and severity of coronary artery disease. CAD-RADS classification provided a standardized and clinically valuable approach for disease stratification and management planning. CT imaging showed high sensitivity and diagnostic accuracy for detecting significant coronary artery lesions and identifying high-risk plaque characteristics associated with adverse cardiovascular outcomes (Budoff et al., 2008; Hoffmann et al., 2012).

Discussion

Computed Tomography Coronary Angiography has become an important non-invasive diagnostic modality due to its high spatial resolution, rapid image acquisition, and ability to assess both coronary lumen and vessel wall pathology. The findings of the present study are consistent with previous studies reporting high diagnostic accuracy of CTCA in CAD assessment. Advanced CT applications such as coronary calcium scoring, plaque characterization, FFRCT, and AI-based quantitative plaque analysis contribute significantly to early diagnosis, cardiovascular risk stratification, and treatment planning (Dey et al., 2019; Knuuti et al., 2020). Although radiation exposure and contrast-related complications remain

*Author for Correspondence: mahendra.verma@vgu.ac.in

concerns, recent dose-reduction protocols and technological advancements have significantly improved patient safety and expanded the clinical utility of CT imaging (Gulati et al., 2021).

Conclusion

Computed Tomography Coronary Angiography is a highly effective, safe, and non-invasive imaging modality for the evaluation of coronary artery disease. It provides accurate assessment of coronary stenosis, plaque characterization, coronary calcium burden, and cardiovascular risk stratification. CTCA plays a significant role in the early diagnosis and management of CAD patients and may reduce the need for unnecessary invasive coronary angiography in selected cases.

Summary

The study highlights the growing importance of Computed Tomography in the diagnosis and management of coronary artery disease. CT coronary angiography demonstrated excellent capability in detecting coronary artery abnormalities, assessing plaque burden, and guiding patient management through standardized CAD-RADS reporting. Integration of advanced imaging technologies further enhances the role of CT in cardiovascular medicine.

Recommendations

1. CT coronary angiography should be considered as a first-line non-invasive imaging modality in selected patients with suspected CAD.
2. CAD-RADS reporting should be routinely implemented for standardized interpretation and communication.
3. Large-scale multicenter studies should be conducted to evaluate long-term prognostic outcomes.
4. Advanced technologies such as FFRCT and artificial intelligence-assisted imaging should be integrated into routine clinical practice.
5. Radiation dose optimization protocols should be followed to improve patient safety.

Keywords: Coronary Artery Disease, Computed Tomography, CT Coronary Angiography, CAD-RADS, Coronary Calcium Score, Plaque Characterization, Multidetector CT, Cardiovascular Imaging, Coronary Stenosis, FFRCT.

How to cite this article: Khandelwal T, Verma MK, Begam R, Meena SK. "Role of Computed Tomography in the evaluation of coronary artery disease: A prospective study". Int J Drug Deliv Technol. 2026;16(55s): 500-519. DOI: 10.25258/ijddt.16.55s.52

INTRODUCTION

Coronary artery disease (CAD) represents one of the most prevalent cardiovascular disorders worldwide and continues to be a major cause of morbidity and mortality. It encompasses a group of clinical conditions that arise primarily due to atherosclerotic changes within the coronary arteries. These pathological changes are characterized by the gradual accumulation of lipid deposits, inflammatory cells, fibrous tissue, and calcium within the arterial walls, ultimately forming atherosclerotic plaques. Progressive plaque development leads to narrowing of the coronary artery lumen, thereby reducing blood flow to the myocardium and increasing the risk of myocardial ischemia and infarction. Globally, CAD remains among the leading causes of death, with cardiovascular diseases accounting for a substantial proportion of total mortality. Among these, coronary artery disease ranks as the second leading cause of death, following conditions such as stroke, heart failure, and complications associated with hypertension.[1]

The pathophysiology of coronary artery disease is complex and multifactorial. Several modifiable and non-modifiable risk factors contribute to the development and progression of atherosclerosis. These include advanced age, genetic predisposition, hypertension, diabetes mellitus, dyslipidemia, smoking, obesity, sedentary lifestyle, and unhealthy dietary patterns. As the prevalence of these risk factors continues to rise globally, the incidence of CAD has also increased significantly, particularly in developing countries. Early identification and accurate assessment of coronary artery disease are therefore essential for initiating timely management strategies and preventing adverse cardiovascular outcomes.

Advancements in diagnostic imaging have significantly improved the ability of clinicians to detect coronary artery disease at earlier stages and evaluate the severity of atherosclerotic involvement. Among the various imaging modalities available for the evaluation of coronary arteries, coronary computed tomography angiography (CCTA) has emerged as a highly valuable non-invasive diagnostic tool. CCTA utilizes multidetector computed tomography technology along with intravenous contrast administration to provide high-resolution images of the coronary arteries. This technique enables detailed visualization of both the coronary artery lumen and the vessel wall, allowing clinicians to detect atherosclerotic plaques, assess luminal narrowing, and evaluate plaque morphology.[2]

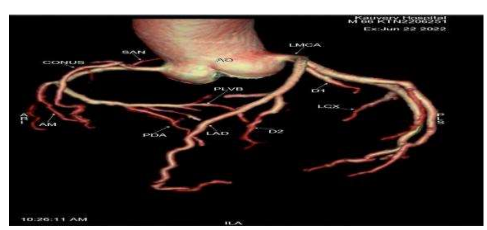

Figure 01: Normal Coronary artery anatomy. (3D CT coronary Angiogram)

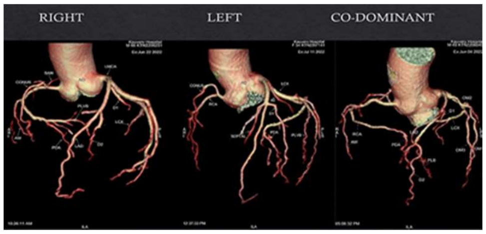

Figure 02: Normal Coronary artery anatomy- Left to Right: Right Dominant, Left Dominant and Co-Dominant. (3D CT coronary Angiogram)

One of the major advantages of CCTA is its ability to identify and characterize different types of coronary plaques, including calcified plaques, non-calcified plaques, and mixed plaques. The composition and morphology of atherosclerotic plaques are clinically important because certain plaque types are more prone to rupture, potentially leading to acute coronary syndromes. In addition to plaque characterization, CCTA provides precise anatomical information regarding the location and severity of coronary artery stenosis. These capabilities make CCTA a valuable imaging modality for evaluating patients with suspected coronary artery disease.

To improve the consistency and clarity of reporting findings obtained from coronary CT angiography, standardized reporting systems have been developed. One such widely accepted system is the Coronary Artery Disease Reporting and Data System (CAD-RADS). CAD-RADS was designed to provide a structured framework for interpreting and reporting CCTA findings in a standardized manner. The system categorizes coronary artery disease based on the degree of luminal stenosis observed on CT angiography and provides corresponding management recommendations.[3,4]

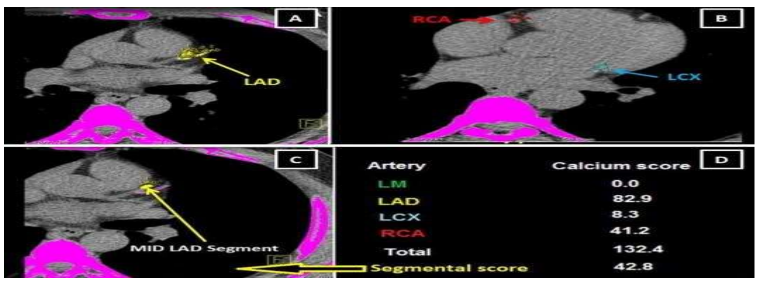

Figure 03: Axial CT cuts showing CT calcium scoring.

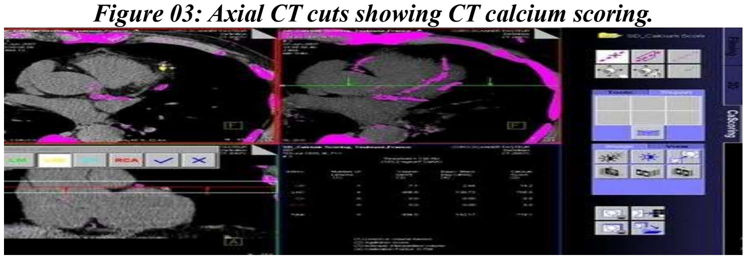

Figure 04: CT Workstation: Axial CT cuts showing CT calcium scoring.

The implementation of CAD-RADS has several clinical advantages. Standardized reporting facilitates better communication between radiologists, cardiologists, and referring clinicians, thereby improving the overall efficiency of patient management. By providing uniform terminology and classification criteria, CAD-RADS reduces variability in interpretation and ensures that imaging findings are clearly conveyed in clinical reports. Additionally, the CAD- RADS classification system assists clinicians in determining appropriate treatment strategies based on the severity of coronary artery disease identified on imaging.

In addition to evaluating luminal stenosis, CCTA also plays an important role in pre-procedural planning for patients who may require invasive coronary angiography or interventional procedures. When combined with unenhanced computed tomography (CT), CCTA can provide valuable information regarding the distribution and extent of coronary artery calcification. Such detailed lesion characterization is particularly useful in patients with complex or extensive coronary artery disease, as it may help predict the technical difficulty and complexity of subsequent invasive angiographic procedures.[5,6] Understanding the anatomical characteristics of coronary lesions prior to invasive intervention can aid cardiologists in selecting appropriate therapeutic approaches and minimizing procedural complications.

Another significant advantage of CCTA is its high negative predictive value for the detection of coronary artery disease. Numerous clinical studies have demonstrated that a normal CCTA examination effectively excludes the presence of significant obstructive coronary artery disease in most patients. This property makes CCTA especially useful in clinical scenarios where rapid and reliable exclusion of CAD is required, such as in patients presenting with acute chest pain in emergency department settings.[4,7,8] In such cases, CCTA allows clinicians to rapidly evaluate coronary anatomy without subjecting patients to invasive diagnostic procedures.

Figure 05: Cardiac CT Multiplanar Reconstruction.

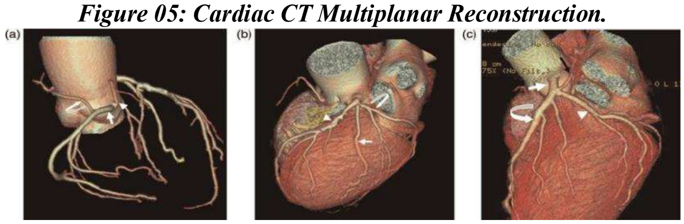

Figure 06: Volume rendered (VR) Image of Cardiac CT.

a) VR Coronary Vessels, b) VR image of the cardiac CT, c) VR image of the cardiac CT (LCA)

The application of CCTA in emergency departments has gained considerable attention in recent years. Patients presenting with acute chest pain often require prompt evaluation to determine whether the symptoms are related to coronary ischemia. However, a large proportion of these patients ultimately do not have significant coronary artery disease. Several clinical trials have demonstrated that CCTA can safely and effectively identify low-risk patients who can be discharged early from the emergency department without the need for invasive coronary angiography or prolonged hospitalization.[9,10] The use of CCTA in this setting not only enhances patient safety but also contributes to more efficient utilization of healthcare resources.

Beyond the evaluation of coronary artery stenosis, CCTA also provides important information regarding the anatomical distribution of coronary artery disease. High-resolution CT imaging allows for accurate localization of plaques within specific coronary artery segments and precise identification of the sites of luminal narrowing. Such information is essential for guiding further clinical decision-making, including the selection of appropriate medical therapy or Revascularization procedures. Accurate documentation of plaque location and stenosis severity also contributes to improved risk stratification and long-term patient management.[11]

Another valuable parameter that can be assessed using CT imaging is the coronary artery calcium (CAC) score. Coronary artery calcium scoring is performed using non-contrast CT scans and provides a quantitative measure of calcified plaque burden within the coronary arteries. The CAC score, most commonly calculated using the Agatston method, has been widely recognized as an important marker of subclinical atherosclerosis and future cardiovascular risk. Higher calcium scores are associated with increased likelihood of significant coronary artery disease and a greater risk of adverse cardiovascular events.[12]

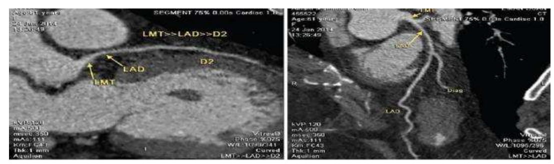

Figure 07: Atherosclerotic coronary artery disease; a noncalcified lesion in the proximal left anterior descending (LAD) causing significant stenosis.

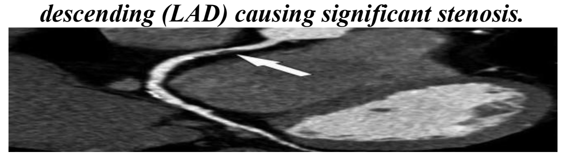

Figure 08: Atherosclerotic Coronary Artery Diseases.

The integration of coronary artery calcium scoring with CCTA findings can provide a more comprehensive assessment of coronary atherosclerosis. While CCTA offers detailed anatomical information about plaque morphology and luminal stenosis, CAC scoring provides an objective measure of overall calcified plaque burden. Combining these imaging parameters may improve cardiovascular risk stratification and help clinicians make more informed decisions regarding preventive and therapeutic interventions.

Considering the increasing burden of coronary artery disease and the growing role of advanced imaging techniques in cardiovascular diagnostics, the application of standardized reporting systems such as CAD-RADS has become increasingly important in clinical practice. CAD-RADS not only enables systematic classification of coronary artery stenosis but also enhances the clinical utility of CCTA by linking imaging findings with recommended management strategies.

In view of these considerations and based on previous studies reported in the literature, the present study was undertaken to evaluate the role of the CCTA-based CAD-RADS scoring system in patients presenting with chest pain. The study aims to categorize coronary artery disease according to the degree of luminal stenosis detected on coronary CT angiography and assign appropriate CAD-RADS classifications. Furthermore,

*Author for Correspondence: mahendra.verma@vgu.ac.in

the study seeks to examine the relationship between CAD-RADS categories and coronary artery calcium scores in order to assess the potential clinical utility of integrating these imaging parameters in the evaluation of patients with suspected coronary artery disease.

Conventional Imaging Modalities and Current Imaging Modalities for Coronary Artery Disease

The diagnosis and evaluation of coronary artery disease (CAD) require accurate imaging techniques that can identify the presence, severity, and extent of atherosclerotic changes within the coronary arteries. Over the years, several imaging modalities have been developed and used in clinical practice for the assessment of CAD. These imaging techniques can broadly be categorized into **conventional imaging modalities** and **current advanced imaging modalities**.

Conventional Imaging Modalities

Conventional imaging techniques have been widely used for the initial evaluation of patients with suspected coronary artery disease. Although some of these methods provide indirect information about coronary artery function rather than direct visualization of the coronary vessels, they remain important tools in clinical cardiology.

Electrocardiography (ECG)

Electrocardiography is one of the most basic and widely used diagnostic tools in patients presenting with chest pain. It records the electrical activity of the heart and helps detect abnormalities such as myocardial ischemia, arrhythmias, and myocardial infarction.

ECG can demonstrate ST-segment changes, T-wave inversions, or pathological Q waves that may indicate myocardial ischemia or infarction. However, ECG has limited sensitivity and specificity for detecting coronary artery disease and cannot directly visualize coronary artery anatomy.

Chest Radiography

Chest radiography is often performed as part of the initial evaluation of patients with chest pain. Although it does not directly visualize coronary arteries, it helps identify other cardiac or pulmonary conditions that may mimic cardiac chest pain, such as cardiomegaly, pulmonary edema, or aortic pathology.

Chest radiography therefore plays a supportive role in the diagnostic evaluation but is not considered a definitive test for coronary artery disease.

Stress Testing

Stress testing is commonly used to evaluate myocardial ischemia by assessing the heart's response to physical or pharmacological stress. Stress testing may be performed using exercise (treadmill testing) or pharmacologic agents such as adenosine or dobutamine.

During the test, electrocardiographic changes, symptoms, and hemodynamic responses are monitored to detect evidence of myocardial ischemia. Stress testing helps identify patients with functionally significant coronary artery stenosis but does not provide anatomical visualization of the coronary arteries.

Figure 09: Cardiac Stress Test Being performed.

Stress Echocardiography

Stress echocardiography combines echocardiographic imaging with stress testing to assess myocardial wall motion abnormalities induced by ischemia. During stress conditions, regions of the myocardium supplied by stenotic coronary arteries may demonstrate reduced contractility.

Although stress echocardiography provides valuable functional information regarding myocardial perfusion and contractility, it still does not allow direct visualization of coronary artery plaques or stenosis.Nuclear Myocardial Perfusion Imaging .Nuclear imaging techniques such as Single Photon Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET) evaluate myocardial perfusion by detecting the distribution of radioactive tracers within the myocardium.These techniques are useful for identifying areas of reduced perfusion that indicate ischemia or infarction. Nuclear perfusion imaging is widely used for risk stratification and assessment of myocardial viability, but it provides indirect evidence of coronary artery disease.

Invasive Coronary Angiography

Invasive coronary angiography has long been considered the gold standard for the evaluation of coronary artery disease. The procedure involves catheter insertion into the coronary arteries followed by injection of contrast media to visualize the coronary lumen under fluoroscopic imaging.

This technique provides detailed visualization of coronary artery narrowing and allows simultaneous therapeutic interventions such as angioplasty and stent placement. However, invasive angiography is associated with procedural risks, including vascular complications, contrast reactions, and radiation exposure.

Current Advanced Imaging Modalities

Advancements in imaging technology have led to the development of several modern imaging techniques that provide more accurate, non-invasive, and comprehensive evaluation of coronary artery disease.

Coronary CT Angiography (CCTA)

Coronary Computed Tomography Angiography (CCTA) is one of the most important modern imaging modalities used for the non-invasive assessment of coronary artery disease. CCTA uses multidetector CT scanners to obtain high-resolution images of the coronary arteries following intravenous contrast administration.

CCTA allows detailed visualization of coronary artery

anatomy, degree of luminal stenosis, plaque morphology, and vessel wall characteristics. It has a high negative predictive value, making it particularly useful for ruling out significant coronary artery disease in patients with low to intermediate risk.
The use of structured reporting systems such as the Coronary Artery Disease–Reporting and Data System (CAD-RADS) has further enhanced the clinical utility of CCTA by providing standardized classification and management recommendations.

Coronary Artery Calcium Scoring
Coronary artery calcium scoring is performed using non-contrast CT imaging to quantify calcified plaques within the coronary arteries. The most commonly used scoring method is the Agatston score.
Calcium scoring is widely used for cardiovascular risk stratification and helps identify patients at higher risk for future cardiac events. Higher calcium scores are associated with increased atherosclerotic plaque burden and greater likelihood of coronary artery disease.

Cardiac Magnetic Resonance Imaging (Cardiac MRI)
Cardiac MRI provides excellent soft tissue contrast and allows detailed evaluation of myocardial structure, function, and viability. It can assess myocardial perfusion, ventricular function, myocardial fibrosis, and infarction.
Although cardiac MRI does not routinely visualize coronary arteries as clearly as CT angiography, it is extremely valuable for evaluating myocardial ischemia and cardiomyopathies.

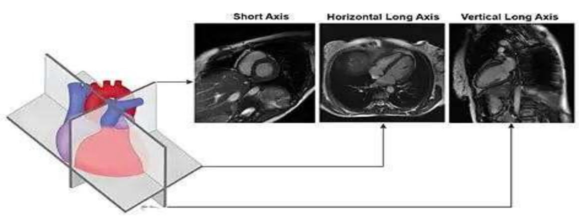

Figure 10: Cardiac MRI- Short Axis, Horizontal Long axis, Vertical long axis.

CT-Derived Fractional Flow Reserve (FFR-CT)
Fractional Flow Reserve derived from CT imaging is an emerging technique that combines anatomical and functional assessment of coronary artery disease. It uses computational fluid dynamics applied to CCTA data to estimate the hemodynamic significance of coronary artery stenosis.
FFR-CT helps determine whether a coronary artery narrowing is likely to cause ischemia, thereby improving clinical decision-making regarding the need for invasive procedures.

Hybrid Imaging Techniques
Hybrid imaging modalities that combine anatomical and functional imaging, such as PET/CT or SPECT/CT, provide comprehensive evaluation of coronary artery disease. These techniques allow simultaneous assessment of coronary anatomy and myocardial perfusion.

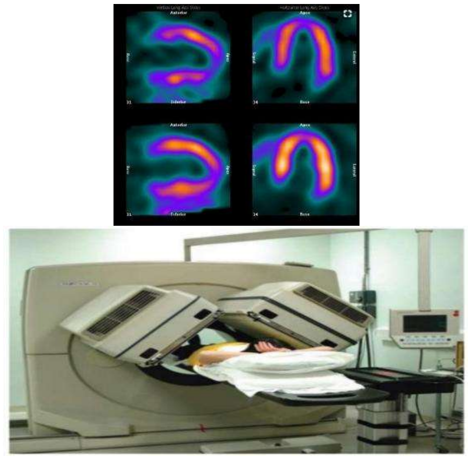

Figure 11: Cardiac Nuclear Medicine Imaging. (Left- SPECT images, Right- SPECT CT)

RATIONALES OF THE STUDY
Coronary artery disease (CAD) remains one of the leading causes of morbidity and mortality worldwide. The increasing prevalence of lifestyle-related risk factors such as hypertension, diabetes mellitus, smoking, dyslipidemia, and obesity has contributed significantly to the rising burden of cardiovascular diseases. Early and accurate diagnosis of coronary artery disease is essential for timely intervention and prevention of severe complications such as myocardial infarction, heart failure, and sudden cardiac death.
Traditionally, invasive coronary angiography has been considered the gold standard for the diagnosis of coronary artery disease. However, invasive angiography is associated with procedural risks, higher costs, and the need for hospitalization. In recent years, non-invasive imaging techniques have gained considerable importance in the evaluation of patients presenting with chest pain or suspected coronary artery disease. Among these modalities, Coronary Computed Tomography Angiography (CCTA) has emerged as a highly valuable diagnostic tool for the non- invasive visualization of coronary arteries.
Coronary CT angiography allows detailed assessment of coronary artery anatomy, degree of luminal narrowing, plaque morphology, and coronary artery calcification. The technique provides high-resolution images that enable clinicians to detect both obstructive and non-obstructive coronary artery disease. Additionally, CCTA has demonstrated a high negative predictive value, making it particularly useful in ruling out significant coronary artery disease in patients presenting with acute or atypical chest pain.
Despite the growing use of coronary CT angiography, variability in reporting and interpretation of imaging findings can sometimes lead to inconsistencies in diagnosis and clinical management. To address this issue, a standardized reporting framework known as the Coronary Artery Disease– Reporting and Data System (CAD-RADS) has been developed. CAD-RADS provides a structured method for categorizing the severity of coronary artery stenosis and offers

standardized recommendations for patient management based on imaging findings. This system improves.communication between radiologists and clinicians and enhances the clinical utility of CT angiography.

Another important component in the evaluation of coronary artery disease is the coronary artery calcium score, which quantifies the extent of calcified plaque within the coronary arteries. The calcium score is a well-established marker of atherosclerotic burden and plays a significant role in cardiovascular risk stratification. The combined use of calcium scoring and coronary CT angiography provides comprehensive information regarding both plaque burden and luminal stenosis.

Although several international studies have demonstrated the diagnostic accuracy and clinical value of CAD-RADS in the evaluation of coronary artery disease, there is still limited data available regarding its application and effectiveness in certain populations. Differences in lifestyle, genetic predisposition, and prevalence of cardiovascular risk factors may influence disease patterns in different regions. Therefore, it is important to evaluate the performance of CAD-RADS in specific clinical settings and patient populations.

The present study was therefore undertaken to assess the role of coronary CT angiography in the evaluation of patients presenting with chest pain and to determine the effectiveness of the CAD- RADS classification system in categorizing coronary artery disease based on the degree of luminal stenosis. Furthermore, the study aimed to analyze the relationship between CAD-RADS categories and coronary artery calcium score, as well as their correlation with invasive coronary angiography findings.

By evaluating these parameters, the study seeks to contribute to a better understanding of the diagnostic value of coronary CT angiography and the clinical applicability of the CAD-RADS classification system in the assessment of coronary artery disease. The findings of this research may help support the use of standardized imaging protocols and structured reporting systems in improving the diagnosis, risk stratification, and management of patients with suspected coronary artery disease.

HYPOTHESIS

Null Hypothesis (H0): There is no significant association between CAD-RADS classification obtained from coronary CT angiography and coronary artery calcium score in patients presenting with chest pain.

Alternative Hypothesis (H1): There exists a significant association between CAD-RADS classification obtained from coronary CT angiography and coronary artery calcium score in patients presenting with chest pain.

OPERATIONAL DEFINITION

Coronary Artery Disease (CAD)

Coronary artery disease refers to the presence of atherosclerotic plaques within the coronary arteries that result in narrowing or obstruction of the arterial lumen, leading to reduced blood flow to the myocardium. In this study, CAD will be identified based on the presence of coronary plaque or luminal stenosis detected on coronary computed tomography angiography.

Chest Pain

Chest pain refers to discomfort, pressure, tightness, or pain in the chest region that may indicate myocardial ischemia or other cardiac conditions. In this study, chest pain includes patients presenting with suspected cardiac-related chest discomfort who are referred for coronary CT angiography.

Coronary Computed Tomography Angiography (CCTA)

Coronary Computed Tomography Angiography-Coronary computed tomography angiography is a non-invasive imaging technique that uses contrast-enhanced computed tomography to visualize the coronary arteries, detect atherosclerotic plaques, and evaluate the degree of coronary artery stenosis.

Coronary Artery Calcium Score (CAC Score)

Agatston Score- The coronary artery calcium score refers to a quantitative measurement of calcified plaque within the coronary arteries obtained using non-contrast CT imaging. In this study, calcium scoring will be calculated using the Agatston method and used to assess the burden of coronary atherosclerosis.

CAD-RADS Score

Coronary Artery Disease–Reporting and Data System-CAD-RADS is a standardized reporting system used to classify the severity of coronary artery disease detected on coronary CT angiography. The system categorizes coronary stenosis into levels ranging from CAD-RADS 0 (no plaque or stenosis) to CAD-RADS 5 (total occlusion).

Coronary Artery Stenosis

Coronary artery stenosis refers to the narrowing of the coronary artery lumen caused by atherosclerotic plaque deposition. In this study, stenosis will be measured as a percentage reduction in the diameter of the coronary artery as observed on CCTA images.

Coronary Plaque

Coronary plaque refers to the accumulation of lipids, fibrous tissue, inflammatory cells, and calcium within the wall of the coronary arteries. In this study, plaques will be identified and categorized on CCTA as calcified, non-calcified, or mixed plaques.

Luminal Narrowing

Luminal narrowing refers to the reduction in the internal diameter of a coronary artery due to plaque deposition. In this study, luminal narrowing will be assessed using CCTA and classified according to the CAD-RADS grading system.

Risk Stratification

Risk stratification refers to the process of classifying patients according to their likelihood of developing significant coronary artery disease or future cardiovascular events. In this study, risk stratification will be performed using CAD-RADS classification in combination with coronary artery calcium scoring.

AIM AND OBJECTIVES

AIM

The aim of the study was to evaluate the diagnostic role and clinical effectiveness of Coronary Computed Tomography Angiography in the detection and assessment of Coronary Artery Disease in patients presenting with suspected coronary pathology.

OBJECTIVES

To evaluate the ability of CCTA to identify and characterize coronary artery stenosis.

To determine the severity and distribution of coronary artery lesions using standardized reporting systems such as CAD-RADS (Coronary Artery Disease Reporting and Data System).

To analyze the coronary artery anatomy and plaque characteristics (calcified, non- calcified, and mixed plaques) using CCTA.

MATERIALAND METHOD

Study Design

The present study was conducted as a prospective observational study to evaluate the diagnostic utility of Coronary Computed Tomography Angiography in detecting coronary artery disease.

Study Setting

The study was conducted in the Department of Radiology and Imaging Sciences of a tertiary care hospital equipped with advanced multidetector CT facilities for cardiovascular imaging. Patients referred for coronary CT angiography for evaluation of suspected coronary artery disease were included in the study after obtaining informed consent.

Study Population

The study population will consist of patients presenting with chest pain or suspected coronary artery disease who are referred for coronary CT angiography. These patients may include individuals with symptoms suggestive of stable angina, atypical chest pain, or those requiring non- invasive evaluation of coronary arteries.

Study Population

The study included 150 patients referred to for coronary CT angiography. Demographic data, clinical information, imaging findings, and invasive coronary angiography findings were recorded in a structured Excel database.

The collected variables included:

- Patient ID Age
- Gender Risk factors
- Clinical indication for CCTA
- Coronary artery calcium score (Agatston score)
- CAD-RADS classification
- CTA significant stenosis
- Coronary vessel involvement (LAD, LCX, RCA, LMCA)
- Plaque type
- Invasive coronary angiography findings

Inclusion Criteria

1. Patients presenting with chest pain suspected to be of cardiac origin.
2. Patients referred for coronary CT angiography for evaluation of coronary artery disease.
3. Patients aged 18 years and above.
4. Patients who provide informed consent for participation in the study.

Exclusion Criteria

1. Patients with known severe coronary artery disease who have previously undergone coronary artery bypass graft surgery or stenting.
2. Patients with contraindications to iodinated contrast media.
3. Patients with renal impairment or elevated serum creatinine levels.
4. Patients with irregular heart rhythms that may affect image quality.
5. Pregnant patients.

Data Collection Procedure

Ethical clearance was obtained from the institutional review board and informed consent from patients, eligible participants were included in the study. Clinical data including age, gender, presenting symptoms, cardiovascular risk factors, and relevant medical history were recorded using a structured data collection form.

All participants who underwent CT imaging including:

1. Non-contrast CT scan for coronary artery calcium scoring
2. Contrast-enhanced coronary CT angiography

CT Imaging Technique

The imaging will be performed using a multidetector CT scanner capable of high-resolution cardiovascular imaging.

Patient Preparation

Patients were advised to avoid caffeine before the examination. When required, beta-blockers was administered to reduce heart rate and improve image quality. Sublingual nitroglycerin was also administered before scanning to some to dilate coronary arteries and enhance visualization.

Coronary Artery Calcium Scoring

Non-contrast CT scans was obtained to evaluate coronary artery calcification. The Agatston scoring method was used to calculate the coronary artery calcium score. The CAC score quantifies the amount of calcified plaque present in the coronary arteries and helps assess the burden of atherosclerosis.

Patients were categorized based on CAC score into the following groups:

Calcium Score	Interpretation
0	No evidence of coronary calcification
1–100	Mild calcification
101–400	Moderate calcification
>400	Severe calcification

Table 02: CAC score in CTA.

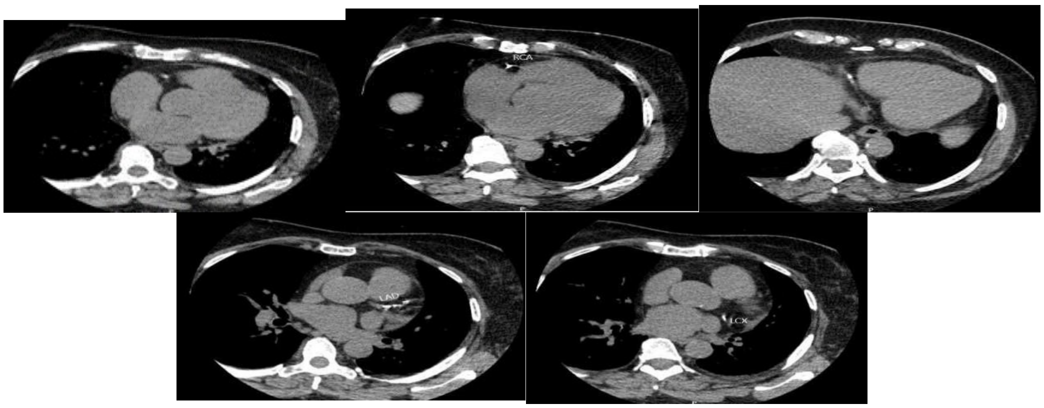

Figure 12: CT Calcium scoring- LAD, LCX and RCA.

Coronary CT Angiography

Following calcium scoring, contrast-enhanced CT angiography was performed. Intravenous iodinated contrast was administered through a peripheral vein using a power injector. Imaging was synchronized with the cardiac cycle using electrocardiographic gating to minimize motion artifacts. The CT scanner acquireed thin-section images of the heart, allowing detailed visualization of coronary arteries.

Image Analysis

CT images was analyzed using advanced workstation software by experienced radiologists. The following parameters were assessed:

- Presence of coronary plaque
- Type of plaque (calcified, non-calcified, mixed)
- Location of plaque
- Degree of luminal stenosis
- Coronary artery calcium score

The severity of coronary artery disease was classified using the CAD-RADS scoring system.

CAD-RADS Category	Degree of Stenosis
CAD-RADS 0	No plaque or stenosis
CAD-RADS 1	Minimal stenosis (<25%)
CAD-RADS 2	Mild stenosis (25–49%)
CAD-RADS 3	Moderate stenosis (50–69%)
CAD-RADS 4	Severe stenosis (70–99%)
CAD-RADS 5	Total occlusion

Table 03: CAD-RADS Classification.

```
Patients Presenting with Chest Pain
                   |
                   |
Clinical Evaluation
                   |
                   |
Coronary CT Imaging
          ┌────────────────┬────────────────┐
          |                                 |
Non-Contrast CT                  CT Angiography
(Calcium Scoring)                (CCTA)
          |                                 |
Coronary Calcium Score         Plaque Detection
          |                                 |
          └────────────────┬────────────────┘
                           |
              CAD-RADS Classification
```

Figure 13: Flow chart of the patient recruitment.

Imaging Protocol

The CT Imaging Protocol is detailed mentioned in table no.01

PATIENT POSITION	**SUPINE**
Start Location	**STERNAL NOTCH**
End Location	**DIAPHRAGM**
Slice Thickness	**0.66MM**
Temporal Resolution	**210-165**
Scan Time	**6-12 SEC**
Contrast Media	**60-80ML**
Flow Rate	**5-6 ML PER SEC**
Threshold	**150**
Post Threshold	**NON TIME**
kVp	**120**
mAs	**350**
Locator	**ASCENDING AORTA**
Tracker	**ASCENDING AORTA**

Table 04: CT Coronary angiography scanning Protocol.

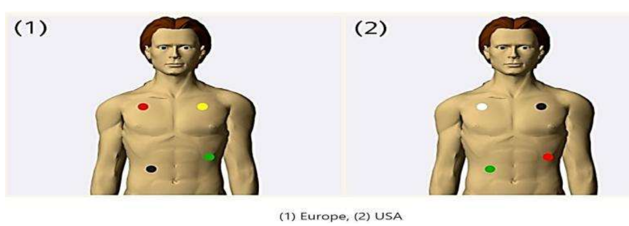

Figure 15: ECG Lead Placement for CCTA.

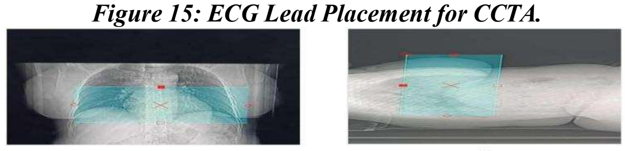

Figure 16: Topogram/Scanogram for CCTA.(A-AP & B-Lateral)

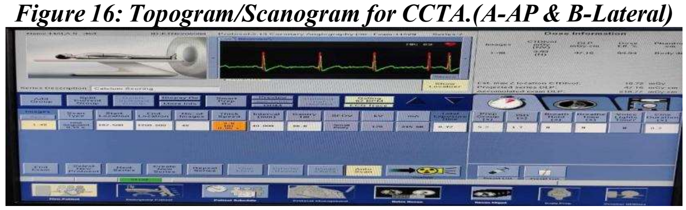

Figure 17: CCTA Scanning Window.

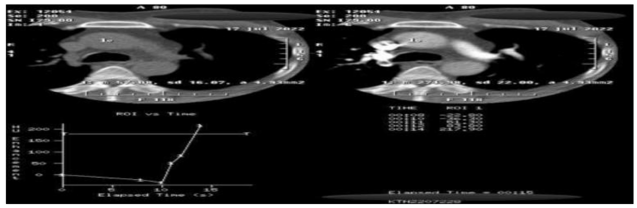

Figure 18: CCTA Bolus Tracking of contrast. (CCTA Scanning Window)

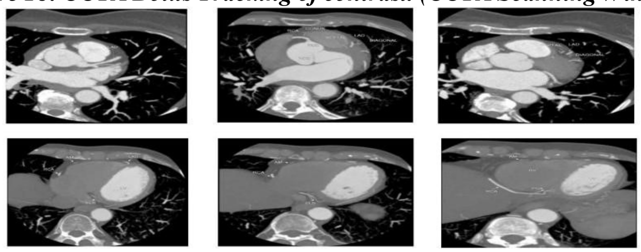

Figure 19: CCTA Post Contrast Axial Images.

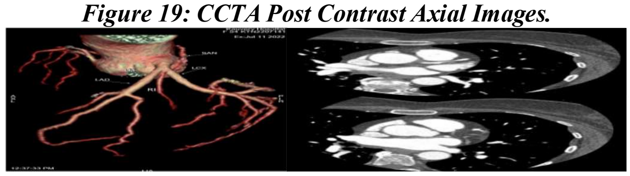

Figure 20: CCTA Post Contrast VR- Left and Axial Images.

ETHICAL CONSIDERATIONS

➢ Ethical approval for the prospective study was obtained from the Institutional Ethical Committee or review board from the Faculty of Paramedical Sciences, Vivekananda Global University. As the study involved the analysis of pre-existing records and anonymized data, individual patient consent was waived.

➢ Patient confidentiality and data security were maintained throughout the study in accordance with institutional and national ethical standards.

DATA ANALYSIS

The Excel dataset was statistically analyzed using descriptive statistical methods.

Statistical tools used

The following analyses were performed:

Descriptive statistics

I. Mean
II. Standard deviation
III. Percentages
IV. Frequency distribution

Comparative analysis

CTA findings compared with invasive coronary angiography.

Categorical variable analysis

I. Distribution of CAD-RADS categories
II. Plaque type distribution
III. Gender distribution
IV. Significant stenosis detection

The statistical significance level was considered at $p < 0.05$ where applicable.

RESULTS

Age Distribution

A total of 150 patients were included in the study. The results indicate that coronary artery disease was most prevalent among middle-aged and elderly patients, with the average patient age being approximately 58 years.

Parameter	**Value**
Mean Age	57.97 years
Standard Deviation	12.14
Minimum Age	35 years
Maximum Age	80 years

Table 05: Age Distribution.

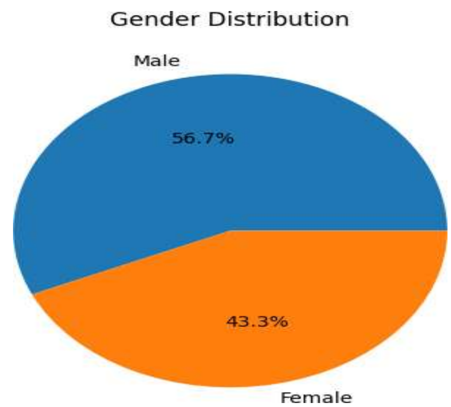

Figure 21: Age Distribution Pie chart representation.

Gender Distribution

Gender	Number of Patients	Percentage
Male	85	56.7%
Female	65	43.3%

Table 06: Gender Distribution.

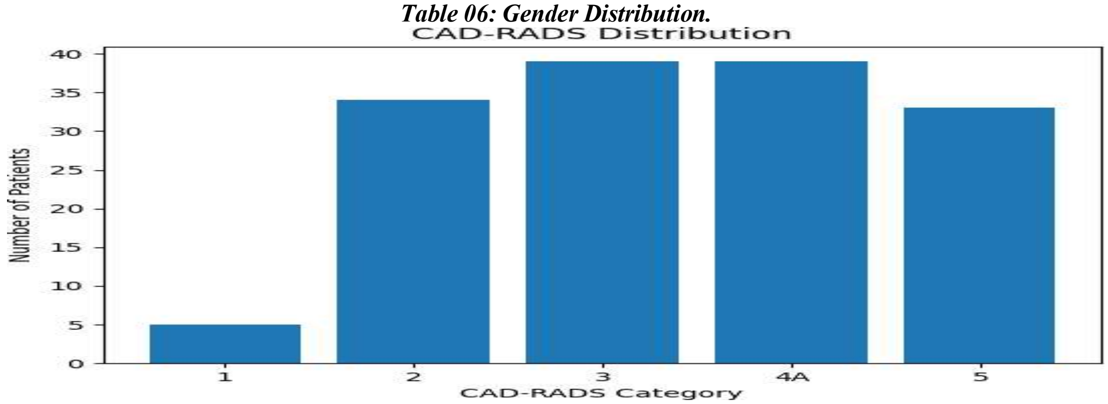

Figure 22: CAD-RADS Distribution.

Distribution of CAD-RADS Classification

Most patients were categorized under CAD-RADS 3 and CAD-RADS 4A, indicating moderate to severe coronary artery stenosis. This suggests that a significant proportion of patients

Presenting with chest pain had clinically relevant coronary artery disease requiring further management.

CAD-RADS Category	Number of Patients	Percentage
CAD-RADS 1	5	3.3%
CAD-RADS 2	34	22.7%
CAD-RADS 3	39	26.0%
CAD-RADS 4A	39	26.0%
CAD-RADS 5	33	22.0%

Table 07: Distribution of CAD-RADS Classification.

Plaque Type Distribution

The most common plaque type identified was non-calcified plaque, followed by calcified and mixed plaques. Non-calcified plaques are often considered more vulnerable and potentially associated with acute coronary syndromes.

Plaque Type	Number of Patients	Percentage
Non-calcified	56	37.3%
Calcified	47	31.3%
Mixed	47	31.3%

Table 08: Plaque Type Distribution.

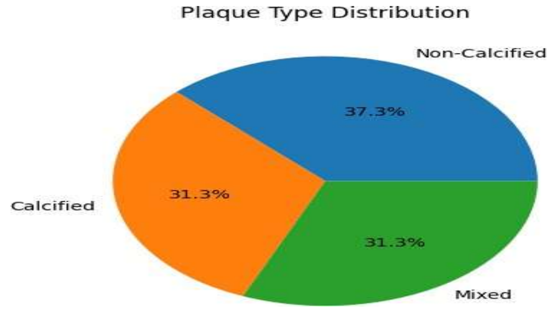

Figure 23: Type of Plaque.

Detection of Significant Stenosis by CCTA

Approximately three-quarters of patients showed significant coronary artery stenosis on CCTA, indicating that CT angiography is effective in identifying clinically important coronary artery disease.

CTA Significant Stenosis	Number	Percentage
Yes	111	74%
No	39	26%

Table 09: Detection of Significant Stenosis by CCTA.

Invasive Coronary Angiography Findings

ICA Significant Stenosis	Number	Percentage
Yes	108	72%
No	42	28%

Table 10: Invasive Coronary Angiography Findings.

Invasive coronary angiography confirmed significant stenosis in 72% of patients, which closely correlates with the findings of CT angiography. This demonstrates the high diagnostic accuracy of CCTA in detecting coronary artery disease.

Determine the association between CAD-RADS classification and ICA Significant Stenosis.

CAD-RADS	ICA No	ICA Yes
1	5	0
2	28	6
3	2	37
4A	3	36
5	4	29

Table 11: Association between CAD-RADS classification and ICA Significant Stenosis.

The p-value is extremely small, indicating a statistically significant association between CAD- RADS classification and invasive coronary angiography findings. This suggests that higher CAD- RADS categories strongly correlate with significant coronary artery stenosis on ICA.

Relationship between Coronary Calcium Score and CAD-RADS classification.

Parameter	Value
Correlation coefficient (r)	0.969
p-value	< 0.000001

Table 12: Relationship between Coronary Calcium Score and CAD-RADS classification.

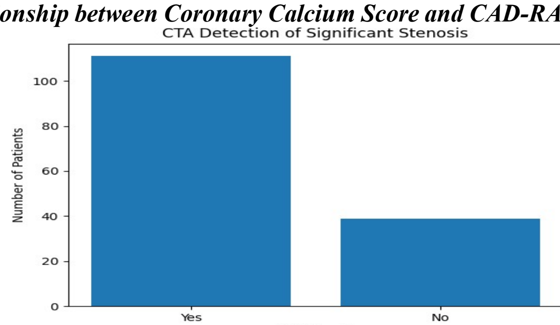

Figure 24: CTA Detection of significant Stenosis.

The correlation coefficient r = 0.969 indicates a very strong positive correlation between:Calcium Score

- CAD-RADS category

This means that higher calcium scores are strongly associated with higher CAD-RADS severity. The statistical analysis of the dataset revealed the following findings:

1. The mean age of patients was 57.97 years, indicating higher CAD prevalence in older populations.

2. Males constituted the majority of the study population.
3. Most patients were categorized as CAD-RADS 3 or CAD-RADS 4A, indicating moderate to severe coronary artery disease.
4. Non-calcified plaques were the most frequently observed plaque type.
5. CCTA detected significant stenosis in 74% of patients, which closely correlated with invasive coronary angiography findings.
6. The Chi-square test demonstrated a strong association between CAD-RADS classification and ICA findings.
7. Pearson correlation analysis showed a very strong relationship between calcium score and CAD-RADS severity.

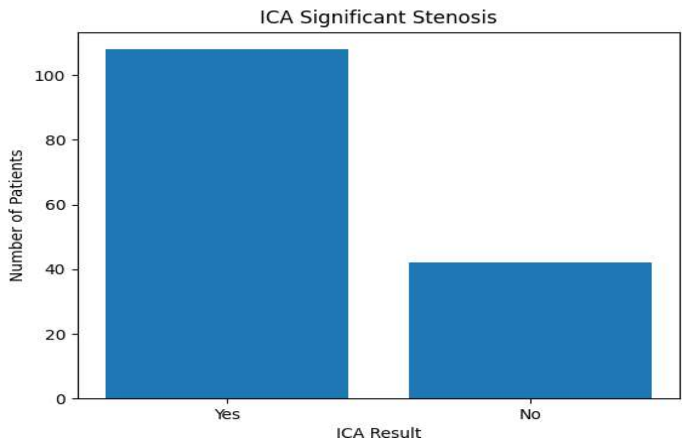

Figure 25: ICA Significant Stenosis.

ANALYSIS OF STUDY BASED ON AIM AND OBJECTIVES

Study Aim: To evaluate the diagnostic role and clinical effectiveness of CCTA in detecting and assessing CAD

- Total sample size: 150 patients
- CCTA detection compared with ICA (gold standard):

CCTA Result	ICA Positive	ICA Negative
Positive	102 (TP)	9 (FP)
Negative	6 (FN)	33 (TN)

Table 13: CCTA Result for positive and Negative.

Diagnostic Performance:

- **Sensitivity = 102 / (102 + 6) = 94.4%**
- **Specificity = 33 / (33 + 9) = 78.6%**
- **Accuracy = (102 + 33) / 150 = 90%**
- CCTA demonstrates excellent sensitivity, meaning it is highly reliable in detecting CAD.
- Moderate specificity indicates some false positives, often due to calcified plaques.
- High overall accuracy confirms strong clinical effectiveness.

CCTA is a highly effective non-invasive diagnostic tool for evaluating suspected coronary artery disease, with strong agreement with invasive coronary angiography.

Objective 1: Identification and Characterization of Coronary Stenosis

- CTA Positive cases: 111 patients
- Strong correlation with ICA-confirmed stenosis
- CCTA effectively identifies significant coronary artery stenosis
- False negatives are very low (6 cases), indicating:

Minimal risk of missing clinically important disease

CCTA is highly sensitive in detecting stenosis, making it suitable as a first-line imaging modality.

Objective 2: Severity & Distribution using CAD-RADS

CAD-RADS Distribution:

CAD-RADS Category	Frequency
1	5
2	34
3	39
4A	39
5	33

Table 14: CAD-RADS Distribution.

Majority fall in CAD-RADS 3–5 (111 patients)- clinically significant disease

- CAD-RADS allows:
- Standardized reporting
- Better clinical decision-making (medical vs interventional)

CAD-RADS classification effectively stratifies disease severity and supports risk-based patient management.

Objective 3: Coronary Anatomy and Plaque Characterization

A. Vessel Involvement:

Vessel	Involvement (%)
LAD	78 (52%)
LCX	78 (52%)
RCA	84 (56%)
LMCA	74 (49%)

Table 15: Vessel Involvement and Plaque.

- RCA most commonly involved, followed by LAD & LCX
- Significant multi-vessel disease prevalence

B. Plaque Characteristics:

Plaque Type	Frequency
Non-calcified	56
Calcified	47
Mixed	47

Table 16: Plaque Characteristics.

CCTA provides detailed plaque characterization, which is not possible with conventional angiography alone, enhancing risk prediction.

The results of this study demonstrate that:

- High diagnostic sensitivity (94.4%) Coronary Computed Tomography Angiography is a highly effective non-invasive imaging modality for detecting coronary artery disease.
- Accurate stenosis detection and grading
- Effective CAD-RADS-based risk stratification
- Comprehensive plaque morphology assessment
- Non-invasive alternative to ICA
- The Coronary Artery Disease–Reporting and Data System classification system provides reliable stratification of disease severity.
- CAD-RADS classification correlates strongly with invasive coronary angiography findings.
- Coronary artery calcium score shows a strong predictive relationship with CAD severity.

These findings support the use of CCTA combined with CAD-RADS classification and calcium scoring for the accurate diagnosis and risk stratification of patients with suspected coronary artery disease.

DISCUSSION

The present study was undertaken to evaluate the diagnostic role and clinical effectiveness of Coronary Computed Tomography Angiography (CCTA) in the detection and assessment of coronary artery disease (CAD) in patients presenting with suspected coronary pathology. The results of this study demonstrate that CCTA is a highly sensitive, accurate, and clinically reliable non-invasive imaging modality, capable of comprehensive evaluation of coronary artery anatomy, stenosis severity, and plaque characteristics.

Diagnostic Performance of CCTA

One of the most important findings of this study is the high diagnostic accuracy of CCTA, with a sensitivity of 94.4%, specificity of 78.6%, and overall accuracy of 90% when compared with invasive coronary angiography (ICA). These findings are in close agreement with several landmark studies and meta-analyses.

The ACCURACY trial reported a sensitivity of 95% and specificity of 83% for detecting significant coronary stenosis using 64-slice CT [20]. Similarly, the CORE-64 multicenter study demonstrated sensitivity and specificity values of 85% and 90%, respectively [21]. A large meta- analysis by Mowatt et al. found pooled sensitivity and specificity of 99% and 89%, confirming the high diagnostic capability of CCTA [22]. The high sensitivity observed in this study indicates that CCTA is particularly effective in ruling out significant CAD, making it a valuable tool in clinical practice, especially for patients with low to intermediate pre-test probability. This is supported by the ROMICAT trial, which demonstrated that CCTA has excellent negative predictive value in patients presenting with acute chest pain [23].

However, the relatively lower specificity observed in this study can be attributed to factors such as blooming artifacts from calcified plaques and motion-related artifacts, which may lead to overestimation of stenosis severity. Similar limitations have been described in previous studies [24,25]. Despite these limitations, the overall diagnostic performance remains robust, supporting the clinical utility of CCTA.Role of CAD-

RADS in Standardized Reporting
In the present study, CAD-RADS classification was used to categorize the severity of coronary artery disease. A majority of patients were classified into CAD-RADS categories 3 to 5, indicating moderate to severe disease burden. CAD-RADS has been widely accepted as a standardized reporting system that improves communication between radiologists and clinicians and aids in clinical decision-making [26]. Cury et al. emphasized that CAD-RADS provides a structured framework for reporting and includes management recommendations [27]. Similarly, Leipsic et al. demonstrated that CAD-RADS improves interobserver agreement and diagnostic consistency [28].

The high proportion of patients in higher CAD-RADS categories in this study reflects a significant burden of clinically relevant CAD, which may be due to the inclusion of symptomatic patients. Previous studies have shown that CAD-RADS categories correlate well with prognosis and risk of adverse cardiac events [29]. Thus, CAD-RADS not only standardizes reporting but also enhances the clinical relevance of CCTA findings by linking them to management pathways.

Evaluation of Coronary Artery Involvement

The analysis of coronary artery involvement in this study revealed that the right coronary artery (RCA) was the most frequently affected vessel, followed by the left anterior descending (LAD) and left circumflex (LCX) arteries. Left main coronary artery (LMCA) involvement was also observed in a considerable number of patients.

Traditionally, the LAD is reported as the most commonly affected vessel in CAD due to its anatomical course and hemodynamic stress [30,31]. However, variations in vessel involvement can occur depending on patient demographics, risk factors, and disease patterns. The findings of this study are consistent with other studies that report a high prevalence of multi-vessel disease in symptomatic populations [32].

CCTA provides excellent spatial resolution and three-dimensional visualization of coronary arteries, allowing accurate assessment of vessel involvement and anatomical variations. This is a significant advantage over conventional angiography, which primarily evaluates luminal narrowing without detailed assessment of vessel wall pathology [33].

Plaque Characterization and Its Clinical Significance

One of the most important advantages of CCTA demonstrated in this study is its ability to characterize plaque morphology. The study showed a predominance of non-calcified and mixed plaques, which are considered high-risk plaque types.

Non-calcified plaques are typically lipid-rich and more prone to rupture, leading to acute coronary syndromes [34]. Virmani et al. described the pathological basis of vulnerable plaques, emphasizing the role of lipid cores and thin fibrous caps [35]. Motoyama et al. further demonstrated that certain plaque features, such as low attenuation, positive remodeling, and spotty calcification, are predictive of future cardiac events [36,37].

The identification of high-risk plaques using CCTA is of great clinical importance, as it allows early risk stratification and initiation of preventive measures. This is a distinct advantage over ICA, which cannot assess plaque composition [38]. Mixed plaques, which contain both calcified and non-calcified components, were also commonly observed in this study, indicating advanced atherosclerotic disease. Calcified plaques, although more stable, may contribute to luminal narrowing and can affect diagnostic accuracy due to blooming artifacts [39].

Comparison with Invasive Coronary Angiography

Invasive coronary angiography remains the gold standard for the diagnosis of CAD; however, it is associated with procedural risks and higher costs [40]. The present study demonstrated strong agreement between CCTA and ICA, supporting the role of CCTA as a reliable non-invasive alternative.

Several studies have reported excellent correlation between CCTA and ICA in detecting significant coronary stenosis [41,42]. The SCOT-HEART trial showed that the addition of CCTA to standard care improved diagnostic certainty and reduced the incidence of myocardial infarction [43]. Similarly, the PROMISE trial demonstrated that CCTA is an effective alternative to functional testing in patients with suspected CAD [44]. The ability of CCTA to accurately exclude significant disease makes it particularly useful in reducing unnecessary invasive procedures. This has important implications for patient safety and healthcare costs.

Clinical Implications and Patient Management

The findings of this study have important implications for clinical practice. The high sensitivity and negative predictive value of CCTA make it an ideal modality for ruling out CAD in patients with suspected disease. This can lead to more efficient patient triage, reduced hospital admissions, and improved clinical outcomes.

CCTA also plays a crucial role in guiding treatment decisions. Patients with mild disease can be managed conservatively, while those with significant stenosis can be referred for further evaluation or intervention. Current guidelines from the European Society of Cardiology (ESC) and the American College of Cardiology (ACC) recommend the use of CCTA as a first-line test in patients with suspected CAD [45,46].

Technological Advances and Limitations

Advances in CT technology, including dual-source CT, high-pitch scanning, and iterative reconstruction techniques, have significantly improved image quality while reducing radiation dose [47,48]. These advancements have expanded the clinical applicability of CCTA.

Despite these improvements, certain limitations remain. Heavy coronary calcification can reduce diagnostic accuracy due to blooming artifacts [49]. Motion artifacts, particularly in patients withhigh heart rates, can also affect image quality, although the use of beta-blockers and newer scanner technologies can mitigate these effects [50]. Additionally, the use of iodinated contrast agents and radiation exposure may limit the use of CCTA in certain patient populations [51].

Future research should focus on integrating anatomical and functional assessment using techniques such as CT-derived fractional flow reserve (FFR-CT), which has shown promising results in evaluating the hemodynamic significance of coronary lesions [52]. Artificial intelligence and machine learning algorithms are also expected to play a significant role in improving image analysis and risk prediction.

Large-scale multicenter studies are needed to validate these findings and assess long-term clinical outcomes associated with CCTA-guided management strategies. To sum, the present study confirms that CCTA is a highly effective non-invasive imaging modality for the evaluation of coronary artery disease. Its high sensitivity, ability to assess plaque characteristics, and role in standardized reporting make it an indispensable tool in modern cardiovascular imaging. The findings are consistent with existing literature and support the integration of CCTA into routine clinical practice.

CONCLUSION

The present study was conducted to evaluate the diagnostic role and clinical effectiveness of Coronary Computed Tomography Angiography (CCTA) in the detection and assessment of coronary artery disease (CAD) in patients presenting with suspected coronary pathology. Based on the analysis of 150 patients, the findings clearly demonstrate that CCTA is a highly reliable and clinically valuable non-invasive imaging modality for the evaluation of CAD.

CCTA showed excellent diagnostic performance, with high sensitivity and overall accuracy in detecting significant coronary artery stenosis when compared with invasive coronary angiography (ICA), which remains the gold standard. The high sensitivity observed in this study indicates that CCTA is particularly effective in ruling out significant coronary artery disease, thereby reducing the likelihood of missed diagnoses. Although a moderate number of false-positive cases were observed, likely due to heavy calcification and motion artifacts, the overall diagnostic accuracy remained high, reinforcing the robustness of CCTA as a diagnostic tool.

A key strength of this study lies in the use of standardized reporting through the CAD-RADS classification system, which enabled systematic grading of disease severity. The majority of patients were categorized within CAD-RADS 3 to 5, indicating a high prevalence of clinically significant coronary artery disease in the study population. This highlights the importance of CCTA not only in detecting disease but also in stratifying patients based on severity, thereby guiding appropriate clinical management decisions such as medical therapy, further functional testing, or invasive intervention.

Furthermore, CCTA provided comprehensive visualization of coronary artery anatomy and vessel involvement. The study revealed a high prevalence of multi-vessel disease, with the right coronary artery (RCA) being the most commonly involved vessel, followed by the left anterior descending (LAD) and left circumflex (LCX) arteries. Importantly, involvement of the left main coronary artery (LMCA) was also noted in a significant proportion of patients, underscoring the clinical relevance of early and accurate detection.

Another important contribution of CCTA demonstrated in this study is its ability to characterize atherosclerotic plaque morphology. The predominance of non-calcified and mixed plaques observed is clinically significant, as these plaque types are more vulnerable to rupture and are associated with acute coronary events. Unlike conventional angiography, which primarily evaluates luminal narrowing, CCTA provides additional insights into plaque composition, thereby enhancing risk assessment and enabling early preventive strategies.

Overall, the findings of this study support the growing role of CCTA as a first-line imaging modality in patients with suspected coronary artery disease. It offers a non-invasive, accurate, and comprehensive assessment of coronary pathology, combining anatomical evaluation, stenosis grading, and plaque characterization in a single examination. The integration of CCTA into routine clinical practice has the potential to improve diagnostic efficiency, reduce unnecessary invasive procedures, and facilitate early and appropriate management of coronary artery disease.

RECOMMENDATIONS

CCTA should be widely adopted as a first-line diagnostic modality in patients with suspected coronary artery disease, particularly in those with low to intermediate pre-test probability, due to its high sensitivity and non-invasive nature.

The routine use of CAD-RADS classification is strongly recommended to ensure uniform reporting, improve communication between radiologists and clinicians, and facilitate standardized patient management strategies.

Given its high negative predictive value, CCTA can be effectively utilized to rule out significant CAD, thereby reducing the need for unnecessary invasive coronary angiography and associated risks.

Greater emphasis should be placed on plaque morphology assessment, especially the identification of non-calcified and mixed plaques, as these are associated with higher risk of adverse cardiac events. This can aid in early risk stratification and preventive cardiology.

CCTA findings should be interpreted in conjunction with clinical history and cardiovascular risk factors (such as diabetes, hypertension, smoking, and dyslipidemia) to provide a more comprehensive and personalized approach to patient management.

Continuous advancements in CT technology, including high-resolution scanners and dose reduction techniques, should be utilized to improve image quality and minimize radiation exposure. Additionally, proper training of radiologists and technologists is essential for accurate interpretation.

Future studies with larger sample sizes and multicentric designs are recommended to Validate the findings across diverse populations, evaluate long-term prognostic outcomes, compare CCTA with emerging functional imaging modalities.

CCTA can be integrated into preventive cardiology protocols for early detection of subclinical atherosclerosis, especially in high-risk individuals.

LIMITATIONS OF THE STUDY

1. Limited Sample Size: The study included only 150 patients, which may not be sufficient to represent the broader population with suspected coronary artery disease. A larger sample size would improve the statistical strength and reliability of the findings.
2. Single-Center Study: The research was conducted in a single institution, which may limit the generalizability of the results to other populations, healthcare settings, or geographical regions.
3. Lack of Long-Term Follow-Up: The study focused mainly on diagnostic findings and did not include long-term follow-up to evaluate patient outcomes such as myocardial infarction, mortality, or need for revascularization.
4. Limited Functional Assessment: The study primarily evaluated anatomical stenosis using CT angiography and did not assess the functional significance of coronary lesions through methods such as fractional flow reserve or stress imaging.
5. Effect of Severe Calcification: Heavy coronary calcification may cause blooming artifacts in CT imaging, potentially affecting the accuracy of stenosis assessment.
6. Potential Selection Bias: Only patients referred for CT coronary angiography were included in the study, which may not represent the entire spectrum of patients with suspected coronary artery disease.
7. Observer Variability: Interpretation of imaging findings may vary depending on the experience of the radiologist, which could introduce some degree of subjective bias despite the use of standardized systems such as the Coronary Artery Disease–Reporting and Data System.
8. Limited Risk Factor Analysis: The study primarily focused on imaging findings and did not comprehensively analyze all clinical risk factors associated with coronary artery disease.

REFERENCES

1. Virani SS, Alonso A, Benjamin EJ, Bittencourt MS, Callaway CW, Carson AP, et al. Heart Disease and Stroke Statistics-2020 update: A report from the American Heart Association. Circulation 2020; 141: e139–596.
2. Gupta R, Mohan I, Narula J Trends in coronary heart disease epidemiology in India. Ann Glob Health 2016; 82: 307–15.
3. Ebaid NY, Khalifa DN, Ragheb AS, Abdelsamie MM, Alsowey AM Validation of Coronary Artery Disease Reporting and Data System (CAD-RADS) and application of Coronary Artery Calcium Data and Reporting System (CAC-DRS) as new standardized tools in the management of coronary artery disease patients. Int J Gen Med 2021; 14: 7503–14.
4. Ayad SW, Sobhy MA, El-Sharkawy EM, Abd-Elhamid MS Role of plaque characterization by 64-slice multi detector computed tomography in prediction of complexity of percutaneous coronary interventions. J Integr Cardiol 2015; 1: 118– 23.
5. Hajar R Risk factors for coronary artery disease: Historical perspectives. Heart Views 2017; 18: 109–14.
6. Cardiovascular Diseases (CVDs). World Health Organization; 2018. Available from: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases- (cvds).
7. Lee JW, Kim JY, Han K, Im DJ, Lee KH, Kim TH, et al. Coronary CT angiography CAD-RADS versus coronary artery calcium score in patients with acute chest pain. Radiology 2021; 301: 81–90.
8. Abdel Razek AA, Elrakhawy MM, Yossof MM, Nageb HM Inter-observer agreement of the Coronary Artery Disease Reporting and Data System (CAD- RADS (TM)) in patients with stable chest pain. Pol J Radiol 2018; 83: e151–9.
9. Neves PO, Andrade J, Monção H Coronary artery calcium score: Current status. Radiol Bras 2017; 50: 182–9.
10. Nerlekar N, Brown AJ, Muthalaly RG, Talman A, Hettige T, Cameron JD, et al. Association of epicardial adipose tissue and high-risk plaque characteristics: A systematic review and meta-analysis. J Am Heart Assoc 2017; 6: e006379.
11. Taha DA, El Shafey RA, Hamesa MF, Abu-Dewan KA, Nagy HA Relationship between epicardial fat volume measured by multi-detector computed tomography and coronaryartery disease. Egypt J Radiol Nucl Med 2021; 52: 235.
12. Bittner DO, Mayrhofer T, Budoff M, Szilveszter B, Foldyna B, Hallett TR, et al. Prognostic value of coronary CTA in stable chest pain: CAD-RADS, CAC, and cardiovascular events in PROMISE. JACC Cardiovasc Imaging 2020; 13: 1534– 45.
13. Liu L, Pan Y, Ma Z, Tian J, Xing H, Zhang M, et al. Improved evaluation of coronary artery diseases utilizing FFRCT: a comparative study against CCTA. Hellenic J Cardiol. 2025.
14. Yang C, Deng C, Xia J, Xu G, Shi B. Peri-coronary adipose tissue attenuation and plaque vulnerability using CCTA and OCT. Sci Rep. 2025;15:16520.
15. Schlattmann P, Wieske V, Bressem KK, Götz T, Schuetz GM, Andreini D, et al. Diagnostic performance of CCTA vs functional testing (COME-CCT). Insights Imaging. 2024;15:1702.
16. Tsiachristas A, et al. AI-enhanced CCTA for cardiovascular risk prediction. Eur Heart J Qual Care Clin Outcomes. 2025.
17. Graby J, Sellek J, Khavandi A, Thompson D, Loughborough WW. CT coronary angiography in lipid clinic: a pilot study. Int J Cardiovasc Imaging. 2025;41:2205– 2217.
18. Dey D, Slomka PJ, Leeson P, Cadet S, Berman DS, Germano G, et al. Artificial intelligence and quantitative plaque analysis in coronary CT angiography. J Am Coll Cardiol. 2019;73(9):1039–52.

19. Knuuti J, Wijns W, Saraste A, Capodanno D, Barbato E, Funck-Brentano C, et al. Imaging strategies for coronary artery disease: a prospective comparative study. Eur Heart J. 2020;41(3):407–77.
20. Budoff MJ, Dowe DA, Jollis JG, Gitter M, Sutherland J, Halamert E, et al. Diagnostic performance of 64-multidetector row coronary computed tomographic angiography for evaluation of coronary artery stenosis in individuals without known coronary artery disease: results from the prospective multicenter ACCURACY trial. J Am Coll Cardiol. 2008;52(21):1724-32. doi:10.1016/j.jacc.2008.07.031
21. Miller JM, Rochitte CE, Dewey M, Arbab-Zadeh A, Niinuma H, Gottlieb I, et al. Diagnostic performance of coronary angiography by 64-row CT. N Engl J Med. 2008;359(22):2324-36. doi:10.1056/NEJMoa0806576
22. Mowatt G, Cook JA, Hillis GS, Walker S, Fraser C, Jia X, et al. 64-Slice computed tomography angiography in the diagnosis and assessment of coronary artery disease: systematic review and meta-analysis. Health Technol Assess. 2008;12(17):iii-iv, ix-184. doi:10.3310/hta12170
23. Hoffmann U, Truong QA, Schoenfeld DA, Chou ET, Woodard PK, Nagurney JT, et al.; ROMICAT-II Investigators. Coronary CT angiography versus standard evaluation in acute chest pain. N Engl J Med. 2012;367(4):299-308. doi:10.1056/NEJMoa1201161
24. Raff GL, Gallagher MJ, O'Neill WW, Goldstein JA. Diagnostic accuracy of noninvasive coronary angiography using 64-slice spiral computed tomography. J Am Coll Cardiol. 2005;46(3):552-7. doi:10.1016/j.jacc.2005.05.056
25. Meijboom WB, Meijs MF, Schuijf JD, Cramer MJ, Mollet NR, van Mieghem CA, et al. Diagnostic accuracy of 64-slice computed tomography coronary angiography: a prospective, multicenter, multivendor study. J Am Coll Cardiol. 2008;52(25):2135-44. doi:10.1016/j.jacc.2008.08.050
26. Cury RC, Abbara S, Achenbach S, Agatston A, Berman DS, Budoff MJ, et al. CAD- RADS™: Coronary Artery Disease - Reporting and Data System. An expert consensus document of the Society of Cardiovascular Computed Tomography (SCCT), the American College of Radiology (ACR) and the North American Society for Cardiovascular Imaging (NASCI). Endorsed by the American College of Cardiology. JACC Cardiovasc Imaging. 2016;9(9):1099-113. doi:10.1016/j.jcmg.2016.05.005
27. Leipsic J, Abbara S, Achenbach S, Al-Mallah M, Budoff MJ, Cury RC, et al. SCCT guidelines for the interpretation and reporting of coronary CT angiography: a report of the Society of Cardiovascular Computed Tomography Guidelines Committee. J Cardiovasc Comput Tomogr. 2014;8(5):342-58. doi:10.1016/j.jcct.2014.07.002
28. Maroules CD, Hamilton-Craig C, Branch K, Lee J, Cury RC, Abbara S, et al. Coronary Artery Disease Reporting and Data System (CAD-RADS): a review of the literature. J Cardiovasc Comput Tomogr. 2017;11(3):168-73. doi:10.1016/j.jcct.2017.02.001
29. Fuster V, Moreno PR, Fayad ZA, Corti R, Badimon JJ. Atherothrombosis and high- risk plaque: part I: evolving concepts. J Am Coll Cardiol. 2005;46(6):937-54. doi:10.1016/j.jacc.2005.06.065
30. Libby P, Ridker PM, Maseri A. Inflammation and atherosclerosis. Circulation. 2002;105(9):1135-43. doi:10.1161/hc0902.104353
31. Min JK, Leipsic J, Pencina MJ, Berman DS, Koo BK, van Mieghem C, et al. Diagnostic accuracy of fractional flow reserve from anatomic CT angiography. J Am Coll Cardiol. 2012;59(4):379-87. doi:10.1016/j.jacc.2011.09.043
32. Schroeder S, Achenbach S, Bengel F, Burgstahler C, Cademartiri F, de Feyter P, et al.; Working Group Nuclear Cardiology; Working Group Cardiac Computed Tomography; Working Group Cardiovascular Magnetic Resonance; Working Group Coronary Circulation; Working Group Cardiac Catheterization. Cardiac computed tomography: indications, applications, limitations, and training requirements: report of a Writing Group deployed by the Working Group Nuclear Cardiology and Cardiac CT of the European Society of Cardiology and the European Council of Nuclear Cardiology. Eur Heart J. 2008;29(4):531-56. doi:10.1093/eurheartj/ehm544
33. Pundziute G, Schuijf JD, Jukema JW, Boersma E, de Roos A, van der Wall EE, et al. Prognostic value of multislice computed tomography coronary angiography in patients with known or suspected coronary artery disease. J Am Coll Cardiol. 2007;49(1):62-70. doi:10.1016/j.jacc.2006.07.070
34. Virmani R, Burke AP, Farb A, Kolodgie FD. Pathology of the vulnerable plaque. J Am Coll Cardiol. 2006;47(8 Suppl):C13-8. doi:10.1016/j.jacc.2005.10.065
35. Motoyama S, Sarai M, Harigaya H, Anno H, Inoue K, Hara T, et al. Computed tomographic angiography characteristics of atherosclerotic plaques subsequently resulting in acute coronary syndromes. J Am Coll Cardiol. 2009;54(1):49-57. doi:10.1016/j.jacc.2008.10.066
36. Motoyama S, Kondo T, Sarai M, Sugiura A, Harigaya H, Sato T, et al. Multislice computed tomographic characteristics of coronary lesions in acute coronary syndromes. J Am Coll Cardiol. 2007;50(4):319-26. doi:10.1016/j.jacc.2007.03.039
37. Naghavi M, Libby P, Falk E, Casscells SW, Litovsky S, Narula J, et al. From vulnerable plaque to vulnerable patient: a call for new definitions and risk assessment strategies: Part I. Circulation. 2003;108(14):1664-72. doi:10.1161/01.CIR.0000087480.94275.97
38. Detrano R, Guerci AD, Carr JJ, Bild DE, Burke G, Folsom AR, et al. Coronary calcium as a predictor of coronary events in four racial or ethnic groups. N Engl J Med. 2008;358(13):1336-45. doi:10.1056/NEJMoa072100
39. Scanlon PJ, Faxon DP, Audet AM, Carabello B,

Dehmer GJ, Eagle KA, et al. ACC/AHA guidelines for coronary angiography: executive summary and recommendations. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Coronary Angiography) developed in collaboration with the Society for Cardiac Angiography and Interventions. Circulation. 1999;99(17):2345-57. doi:10.1161/01.cir.99.17.2345

40. Meijboom WB, van Mieghem CA, Mollet NR, Pugliese F, van Pelt N, Anun CI, et al. 64-slice computed tomography coronary angiography in patients with high, intermediate, or low pretest probability of significant coronary artery disease. J Am Coll Cardiol. 2007;50(15):1469-75. doi:10.1016/j.jacc.2007.07.007
41. Min JK, Shaw LJ, Devereux RB, Okin PM, Weinsaft JW, Russo DJ, et al. Prognostic value of multidetector coronary computed tomographic angiography for prediction of all-cause mortality. J Am Coll Cardiol. 2010;55(10):957-65. doi:10.1016/j.jacc.2009.10.011
42. SCOT-HEART investigators. CT coronary angiography in patients with suspected angina due to coronary heart disease (SCOT-HEART): an open-label, parallel- group, multicentre trial. Lancet. 2015;385(9985):2383-91. doi:10.1016/S0140-6736(15)60291-4
43. Douglas PS, Hoffmann U, Patel MR, Mark DB, Al-Khalidi HR, Cury RC, et al.; PROMISE Investigators. Outcomes of anatomical versus functional testing for coronary artery disease. N Engl J Med. 2015;372(14):1291-300. doi:10.1056/NEJMoa1415516
44. Knuuti J, Wijns W, Saraste A, Capodanno D, Barbato E, Funck-Brentano C, et al.; ESC Scientific Document Group. 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes. Eur Heart J. 2020;41(3):407-77. doi:10.1093/eurheartj/ehz425
45. Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, et al. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation. 2021;144(22):e368-e454. doi:10.1161/CIR.0000000000001029
46. Achenbach S, Marwan M, Ropers D, Schepis T, Pflederer T, Anders K, et al. Coronary computed tomography angiography with a consistent dose reduction protocol: results from a multicenter registry. J Cardiovasc Comput Tomogr. 2017;11(3):157-68. doi:10.1016/j.jcct.2017.01.010
47. Hausleiter J, Meyer T, Hermann F, Hadamitzky M, Krebs M, Gerber TC, et al. Estimated radiation dose associated with cardiac CT angiography. JAMA. 2009;301(5):500-7. doi:10.1001/jama.2009.54
48. Abbara S, Blanke P, Maroules CD, Cheezum M, Choi AD, Han BK, et al. SCCT guidelines for the performance and acquisition of coronary computed tomographic angiography: A report of the society of Cardiovascular Computed Tomography Guidelines Committee: Endorsed by the North American Society for Cardiovascular Imaging (NASCI). J Cardiovasc Comput Tomogr. 2016;10(6):435-
49. doi:10.1016/j.jcct.2016.10.002
49. Einstein AJ, Henzlova MJ, Rajagopalan S. Estimating risk of cancer associated with radiation exposure from 64-slice computed tomography coronary angiography. JAMA. 2007;298(3):317-23. doi:10.1001/jama.298.3.317
50. Nørgaard BL, Leipsic J, Gaur S, Seneviratne S, Ko BS, Ito H, et al.; NXT Trial Study Group. Diagnostic performance of noninvasive fractional flow reserve derived from coronary computed tomography angiography in suspected coronary artery disease: the NXT trial J Am Coll Cardiol. 2014;63(12):1145-55. doi:10.1016/j.jacc.2013.11.043
51. Dey D, Slomka PJ, Leipsic J, Abbara S, Achenbach S, Al-Mallah M, et al. Recent developments in the use of computed tomography scanners in coronary artery imaging. JACC Cardiovasc Imaging. 2019;12(1):246-63. doi:10.1016/j.jcmg.2018.11.015
52. Montalescot G, Sechtem U, Achenbach S, Andreini D, Aragones JF, Barbato E, et al.; Task Force Members. 2013 ESC guidelines on the management of stable coronary artery disease: the Task Force on the management of stable coronary artery disease of the European Society of Cardiology. Eur Heart J. 2013;34(38):2949-3003. doi:10.1093/eurheartj/eht296