My Approach To CAD-RADS 2.0 in the Assessment of Coronary Artery Disease by CT Angiogram

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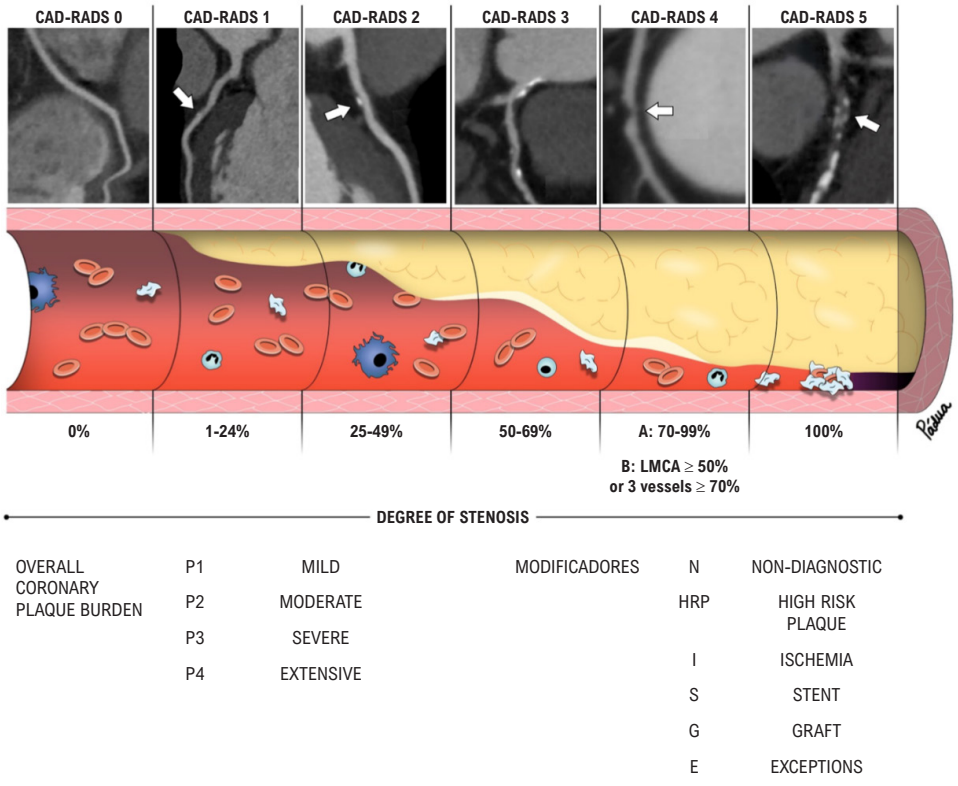
Central Illustration: My Approach To CAD-RADS 2.0 in the Assessment of Coronary Artery Disease by CT Angiogram



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CAD-RADS: Coronary Artery Disease-Reporting and Data System; LMCA: left main coronary artery.

Keywords

Chest Pain; Tomography; Coronary Artery Disease.

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Abstract

Coronary artery disease (CAD) is a common cause of chest pain, frequently seen in emergency departments and during elective consultations, and remains the leading cause of death worldwide. Coronary computed tomography angiography (CCTA) has become an established diagnostic tool for evaluating stable angina and acute chest pain in patients with low or intermediate risk. In this setting, CAD-RADS (Coronary Artery Disease-

Reporting and Data System) was introduced as a CCTA reporting model, first published in 2016 and updated in 2022, with the aim of standardizing the description of imaging findings, improving communication between imaging specialists and clinicians, and providing guidance on patient management. This article reviews the CAD-RADS classification categories, which are based on the degree of stenosis, atherosclerotic plaque burden, and other modifying findings related to coronary abnormalities while also addressing certain exceptional situations. Through clinical cases, examples of structured reports, and recommendations for clinical management in different scenarios, we examine the objectives, benefits, limitations, and future potential of this classification, which remains underutilized in clinical practice.

Introduction

Cardiovascular diseases are the leading cause of death both in Brazil and globally, with coronary artery disease (CAD) and its complications being particularly significant.[1] Recent technological advances in cardiac imaging, particularly the increased availability of CT scanners with 64 or more detector rows, have expanded the use of coronary computed tomography angiography (CCTA) in assessing CAD in patients with or without acute chest pain. Today, CCTA is considered a validated exam for this purpose, supported by large international clinical studies and integrated into clinical guidelines worldwide.[2,3] Several of these studies, including SCOT-HEART and PROMISE, have proven the prognostic value of CCTA by correlating its findings with some unfavorable outcomes, including death and non-fatal infarction.[4]

CCTA is a non-invasive imaging method based on tomographic image acquisition with thin slices (0.25-0.5 mm), synchronized to the cardiac cycle by the electrocardiogram, and with intravenous injection of non-ionic contrast medium with a high iodine concentration.[2] Its indication should, therefore, consider the use of ionizing radiation and issues related to the use of iodinated contrast, highlighting contrast-induced nephropathy and allergic reactions. Prior to image acquisition, controlling heart rate (typically with beta-blockers) and inducing coronary vasodilation (usually with Isordil) are recommended to reduce motion artifacts and improve image quality, provided there are no clinical contraindications.

In the evaluation of CAD, this method is particularly beneficial for patients with low or intermediate risk based on clinical stratification, due to its high negative predictive value (NPV) and high sensitivity, which can reach up to 96%, depending on the prevalence of CAD in the study population.[2,5-7] For chest pain evaluation, CCTA plays a critical role in ruling out coronary disease when results are normal, thus avoiding the need for invasive procedures and reducing both morbidity and healthcare costs.

In this context, the CAD-RADS classification was introduced to standardize and systematize imaging findings in CCTA, along with recommendations for clinical management. Its purpose is to optimize the communication between imaging specialists and clinicians, serving as an additional tool for decision-making and guiding appropriate patient management. The classification was initially developed in 2016 based on a consensus from leading American cardiovascular imaging societies[5] — Society for Cardiovascular Computed Tomography (SCCT), American College of Radiology (ACR), and North American Society for Cardiovascular Imaging (NASCI) — and was updated in 2022 to include factors such as plaque burden, ischemia, and non-atherosclerotic coronary abnormalities.[6] In this review, we will share our institutional experience through clinical cases with structured CAD-RADS reports, focusing on the advantages, limitations, and future potential of this classification.

Categorization

CAD-RADS Categories

The CAD-RADS classification is based on the degree of stenosis, as determined by the Society of Cardiovascular Computed Tomography (SCCT) system,[8] having five categories, ranging from absence of atherosclerosis (CAD-RADS 0) to the presence of at least one total occlusion (CAD-RADS 5) for vessels larger than 1.5 mm in diameter. The 2022 update added the grading of plaque burden through P categories (Table 1), depending on the coronary calcium score, or the degree and number of segments affected by atherosclerosis.[6] There was also the inclusion of ischemia findings by FFR (fractional flow reserve) or myocardial perfusion tomography, which is scored as positive, negative, or indeterminate. Another update of the 2022 version was the inclusion of coronary abnormalities unrelated to atherosclerosis, considered in the "E" (Exceptions) modifier.[6]

Tables 2 and 3 show the evaluation of findings by the CAD-RADS classification in scenarios of stable (Table 2) or acute (Table 3) chest pain, with their specific management suggestions, which involve the need for complementary methods or specific treatments. Thus, the CAD-RADS category, along with its modifiers (as shown in Figures 1 to 8), can be included at the end of the report as complementary information to the diagnostic impression, which remains essential, as it includes critical details for clinical decision-making, such as vessel caliber, the location and extent of stenosis, and other relevant data not covered by the CAD-RADS system.

Modifiers

Modifiers can supplement the CAD-RADS categories for cases in which technical limitations make the study non-diagnostic (N), in the presence of a stent (S), a graft (G), signs of plaque vulnerability (HRP - high-risk plaque), ischemia (I), and exceptions (E). When there is more than one modifier, a slash ("/") is used between the letters, in the following order:

- N (non-diagnostic)
- HRP (high risk plaque)

Table 1 – Methods for Categorizing Overall Coronary Plaque Burden

	Overall Coronary Plaque Burden	Calcium Score	Involved Segment Score	Visual
P1	Mild	1-100	≤ 2	1-2 vessels with low plaque burden
P2	Moderate	101-300	3-4	1-2 vessels with moderate involvement or 3 vessels with low plaque burden
P3	Severe	301-999	5-7	3 vessels with moderate plaque burden or 1 vessel with high plaque burden
P4	Extensive	> 1000	≥ 8	2 or 3 vessels with high plaque burden

Source: Modified from Radiology: Cardiothoracic Imaging 2022; 4(5):e220183

Table 2 – CAD-RADS for Patients With Stable Chest Pain

Category	Degree of Stenosis	Interpretation	Further Investigation	Management Considerations
CAD-RADS 0	0% (absence of plaque or stenosis)	Absence of CAD	None	Reassure. Consider non-atherosclerotic causes for symptom
CAD-RADS 1	1-24% (minimal stenosis or stenosis-free plaque)	Minor non-obstructive CAD	None	Consider the non-atherosclerotic cause of symptom P1: Consider risk factor modification and preventive drug therapy P2: Risk factor modification and preventive drug therapy P3 or P4: Risk factor modification and aggressive preventive drug therapy
CAD-RADS 2	25-49% (Mild stenosis)	Mild non-obstructive CAD	None	Consider non-atherosclerotic causes for symptom P1 or P2: Risk factor modification and preventive drug therapy P3 or P4: Risk factor modification and aggressive preventive drug therapy
CAD-RADS 3	50-69% (Moderate stenosis)	Moderate stenosis	Consider functional testing	P1, P2, P3 or P4: Risk factor modification and aggressive preventive drug therapy Other treatments should be considered according to specific guidelines (including antianginals) I+: consider coronary angiography, especially if optimized therapy
CAD-RADS 4	A: 70-99% or B: LMCA ≥ 50% or 3 vessels ≥ 70%	Significant stenosis	A: Consider coronary angiography or functional testing B: Coronary angiography recommended	P1, P2, P3 or P4: Risk factor modification and aggressive preventive drug therapy Other treatments should be considered according to specific guidelines (including antianginals and revascularization options)
CAD-RADS 5	100% (total occlusion)	Total or subtotal occlusion	Consider coronary angiography, functional testing, or viability assessment	P1, P2, P3 or P4: Risk factor modification and aggressive preventive drug therapy Other treatments should be considered according to specific guidelines (including antianginals)
CAD-RADS N	Nondiagnostic	Obstructive CAD cannot be excluded	Additional evaluation may be necessary	

CAD: coronary artery disease; CAD-RADS: Coronary Artery Disease-Reporting and Data System. Source: Modified from Radiology: Cardiothoracic Imaging 2022; 4(5):e220183

Table 3 – CAD-RADS 2.0 for Patients With Acute Chest Pain

Category	Degree of Stenosis	Interpretation	Additional Cardiac Investigation	Management Considerations
CAD-RADS 0	0%	ACS very unlikely	None If troponin (+), consider other causes	Reassure
CAD-RADS 1	1-24%	ACS unlikely	None If troponin (+), consider other causes	P1 or P2: refer for risk factor follow-up and preventive drug therapy P3 or P4: refer for risk factor follow-up and aggressive preventive drug therapy
CAD-RADS 2	25-49%	ACS somewhat unlikely	None If troponin (+), high suspicion or risk factors, consider hospital admission and cardiologist evaluation	P1 or P2: refer for risk factor follow-up and preventive drug therapy P3 or P4: refer for risk factor follow-up and aggressive preventive drug therapy
CAD-RADS 3	50-69%	ACS possible	Consider hospital admission and cardiologist evaluation Consider functional testing	P1, P2, P3 or P4: Preventive treatment, including aggressive preventive drug therapy. Other treatments should be considered, including anti-anginal drugs according to specific guidelines. I+: Consider coronary angiography
CAD-RADS 4	A: 70-99% or B: LMCA ≥ 50% or 3 vessels ≥ 70%	ACS likely	Hospital admission with cardiologist evaluation A: Consider coronary angiography or functional testing A: Consider coronary angiography or functional testing	P1, P2, P3 or P4: Preventive treatment, including aggressive preventive drug therapy. Other treatments should be considered, including anti-anginal drugs and revascularization options according to specific guidelines.
CAD-RADS 5	100% (total occlusion)	ACS very likely	Hospital admission with cardiologist evaluation Urgent coronary angiography and revascularization if acute occlusion is suspected	P1, P2, P3 or P4: Preventive treatment, including aggressive preventive drug therapy. Other treatments should be considered, including anti-anginal drugs and revascularization options according to specific guidelines.
CAD-RADS N	Nondiagnostic	ACS cannot be excluded	Additional evaluation may be necessary	

ACS: acute coronary syndrome; CAD-RADS: Coronary Artery Disease-Reporting and Data System; LMCA: left main coronary artery. Source: Modified from Radiology: Cardiothoracic Imaging 2022; 4(5):e220183

- I (ischemia)
- S (stent)
- G (graft)
- E (exceptions).

Modifier N (Non-Diagnostic Study)

To be used when at least one segment (with a caliber equal to or greater than 1.5 mm) cannot be reliably evaluated. It can be applied as a category or as a modifier depending on the degree of stenosis in the other segments. In the context of at least moderate stenosis (≥50%) in some other segment, the "N" flag should be used as a modifier (e.g., CAD-RADS 3/P2/N), since the recommendations for anti-ischemic therapy and prevention apply, regardless of any additional studies that may be necessary. In the scenario where other segments have at most mild stenosis, it should be included as a category and precede the P category (e.g., CAD-RADS N).

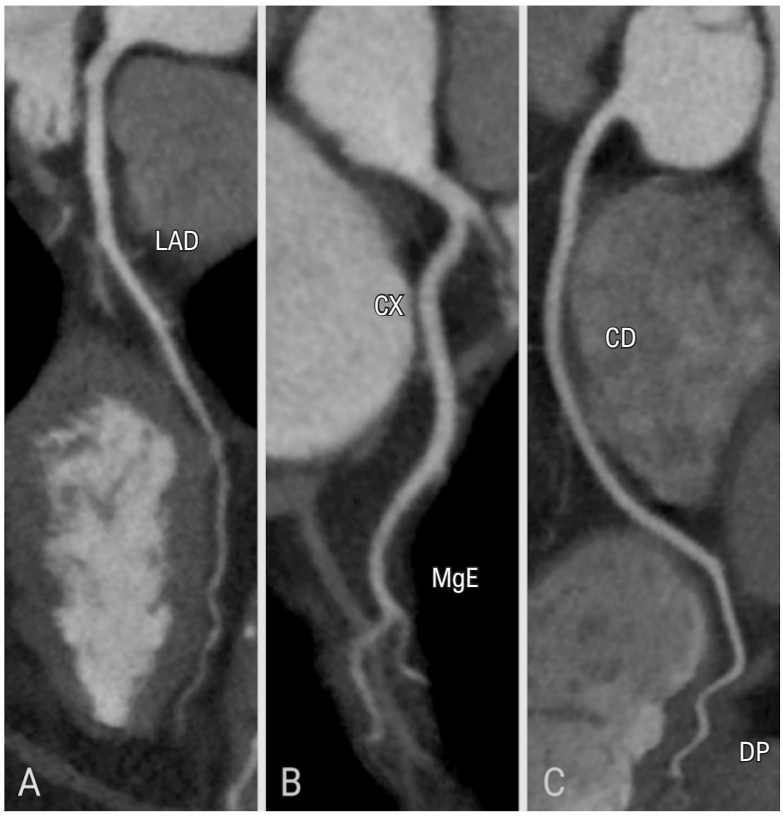

Figure 1 - *CAD-RADS 0. Absence of coronary luminal reduction. Absence of calcified and non-calcified plaque. Source: authors' personal collection. LAD: left anterior descending artery; CX: circumflex; MgE: left marginal; DP: posterior descending; CD: right coronary.*

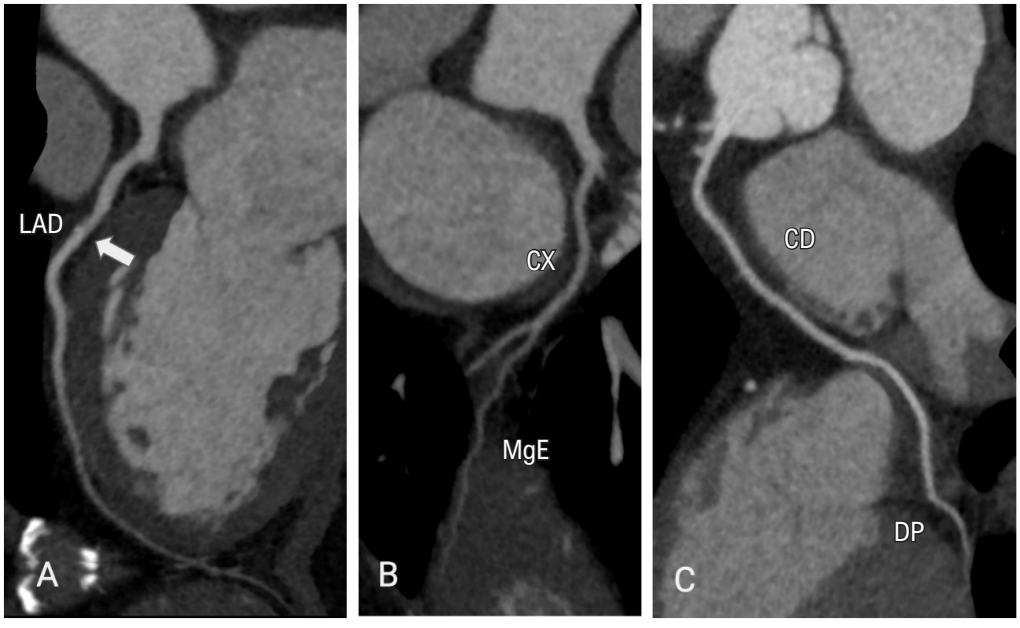

Figure 2 – *CAD-RADS 1/P1. Image A shows a small, calcified plaque (white arrow) in the middle segment of the LAD, determining minimal luminal reduction (1-24%). Images B and C, respectively, show the Cx and RC arteries without visible luminal reduction. P1: Mild plaque burden. Source: authors' personal collection. LAD: left anterior descending artery; CX: circumflex; MgE: left marginal; DP: posterior descending; CD: right coronary.*

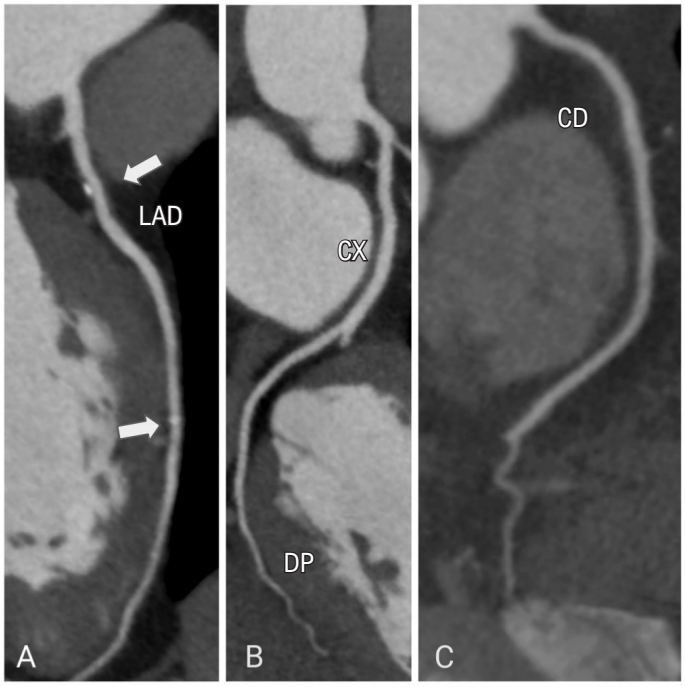

Figure 3 – *CAD-RADS 2/P1. Image A shows LAD with small, calcified plaques (white arrows) with mild stenoses (25-49%). Image B shows the Cx artery without luminal reduction. Image C shows the RCA without stenosis. P1: mild plaque burden in two vessels. Source: authors' personal collection. LAD: left anterior descending artery; DP: posterior descending; CD: right coronary.*

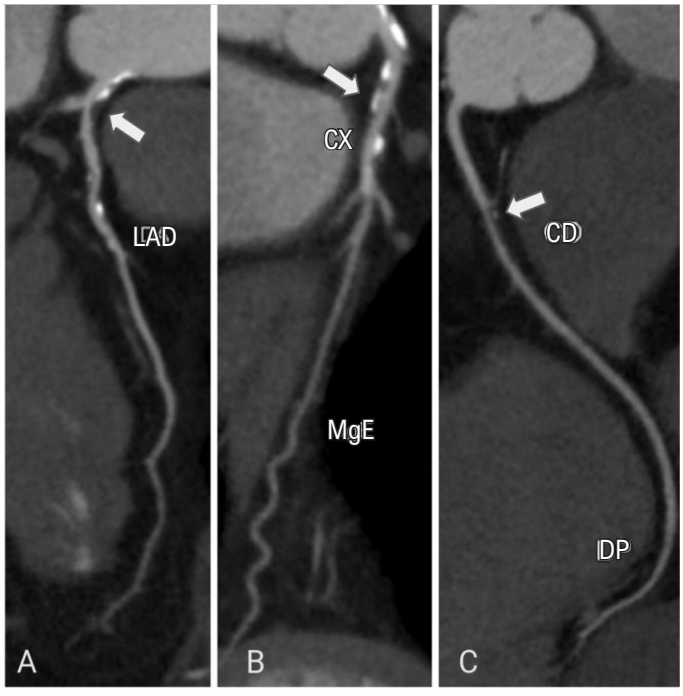

Figure 4 – *CAD-RADS 3/P2. Image A shows a mild stenosis in the LMCA and predominantly non-calcified plaque in the ostioproximal segment of the LAD (white arrow) and moderate luminal narrowing (50-69%). Image B shows predominantly calcified plaques in the Cx, with mild stenosis. Image C shows partially calcified plaque in the RCA with moderate luminal narrowing (50-69%). P2: Moderate plaque burden. Source: authors' personal collection. LAD: left anterior descending artery; CX: circumflex; MgE: left marginal; DP: posterior descending; CD: right coronary.*

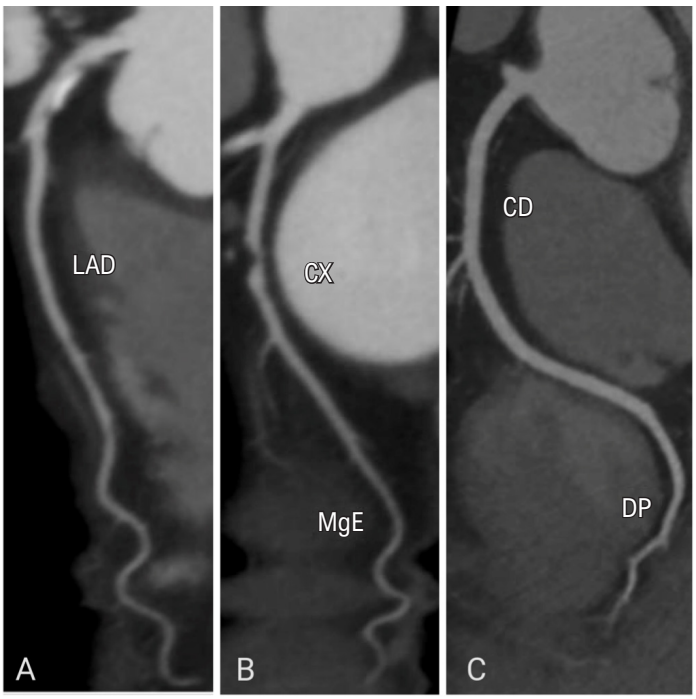

Figure 5 – *CAD-RADS 4A/P2. Image A shows a LMCA with mild luminal narrowing (<50%). Image B shows a significant stenosis (70-99%) in the Cx. Image C with RCA without luminal narrowing. P2: moderate plaque burden in two vessels (LAD and Cx). Source: authors' personal collection. LAD: left anterior descending artery; CX: circumflex; MgE: left marginal; DP: posterior descending; CD: right coronary.*

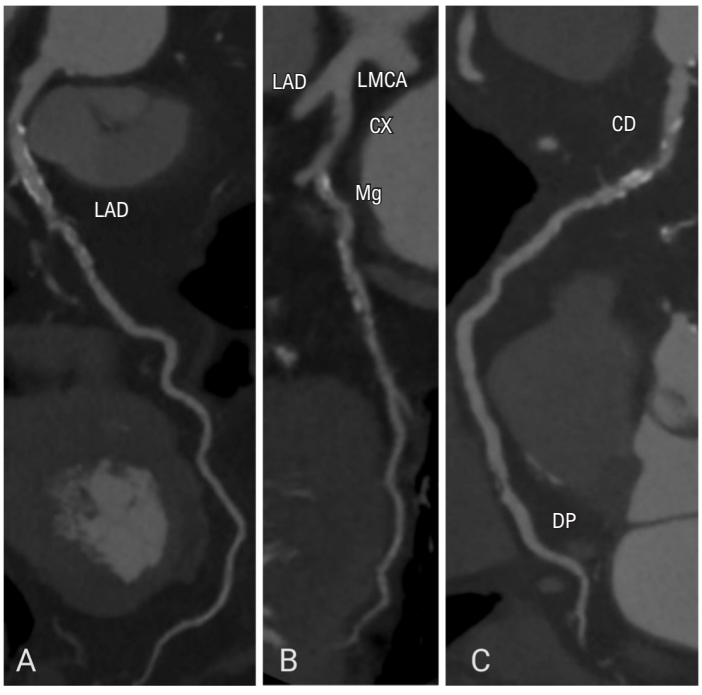

Figure 6 – *CAD-RADS 4B/P4. Images A, B, and C show, respectively, LAD, Cx and RCA arteries with significant luminal reduction (70-99%). P4: extensive plaque burden. Source: authors' personal collection. LAD: left anterior descending artery; LMCA: left main coronary artery; CX: circumflex; Mg: marginal; CD: right coronary; DP: posterior descending.*

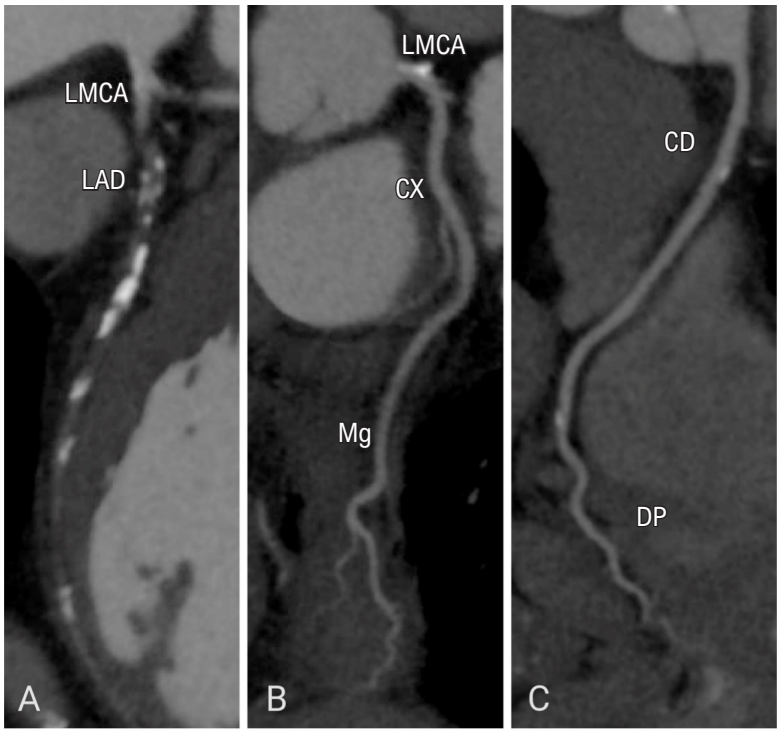

Figure 7 – *CAD-RADS 5/P3. Image A shows an occluded/sub-occluded LAD in the proximal segment. Images B and C shows, respectively, LMCA-Cx and RCA with mild luminal reduction (2549%). P3: severe plaque burden. Source: authors' personal collection. LAD: left anterior descending artery; LMCA: left main coronary artery; CX: circumflex; Mg: marginal; CD: right coronary; DP: posterior descending.*

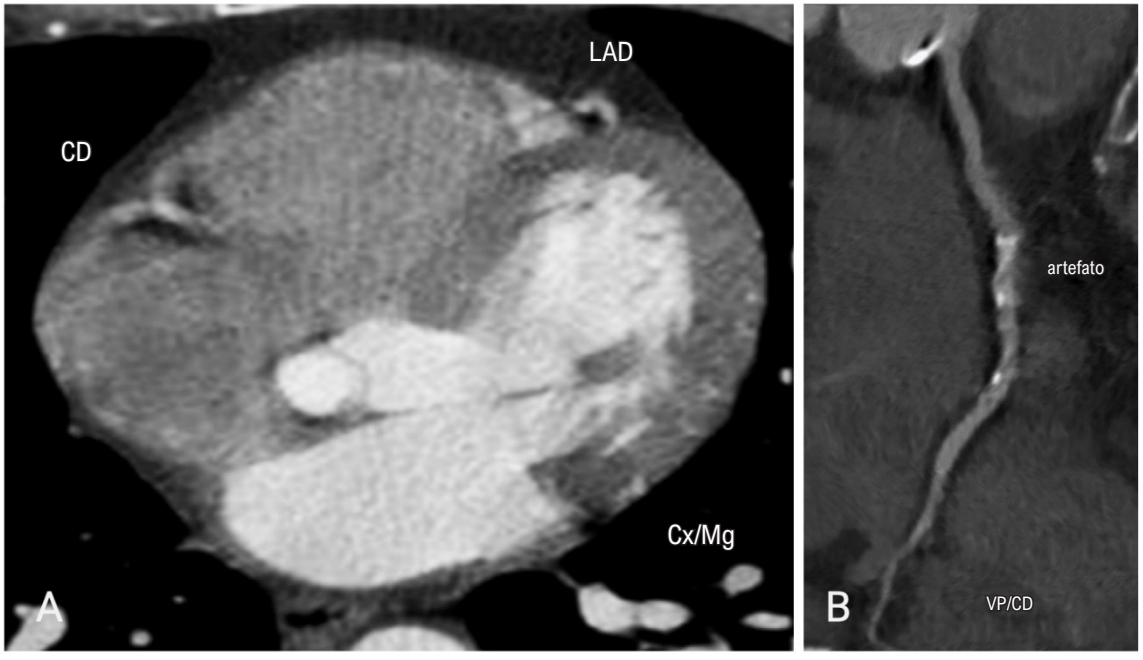

Figure 8 – *CAD-RADS N. Image A shows the heart in an axial coronary CT angiography exam with severe motion artifact in all coronary arteries. Image B shows the RCA artery with artifacts that limit luminal evaluation of predominantly calcified plaques. Source: authors' personal collection. LAD: left anterior descending artery; CX/Mg: circumflex/marginal; VP/CD: posterior ventricular/right coronary.*

Modifier HRP

In addition to the degree of stenosis, some imaging characteristics are associated with a higher risk of plaque instability and progression to acute coronary syndrome. The positive remodeling, presence of plaque with attenuation below 30 HU, eccentric spotty calcification and the napkin ring sign stands out in Figure 9.[9,10] Therefore, the HRP modifier should be included in the report when two or more high-risk characteristics are present, and these features should be detailed within the report body. Additionally, the presence of this modifier should lead to more aggressive risk factor management in cases of stable chest pain, or hospital admission and extended observation in cases of acute chest pain, as it is linked to a higher incidence of serious cardiovascular events.

Modifier I (ischemia)

Initially, CCTA only provided anatomical information with the assessment of luminal stenosis and atherosclerotic burden. With a growing understanding of the importance of coronary disease physiology and the development of techniques enabling functional assessment through tomography, CAD-RADS was expanded to include the categorization of ischemia in cases involving FFR-CT and stress perfusion. In cases in which FFR-CT and myocardial perfusion tomography are nondiagnostic, modifier N can also be applied.

FFR-CT (Modifier I)

FFR-CT was introduced as a non-invasive method to assess pressure in the coronary tree using machine learning techniques and fluid dynamics analysis, with similar accuracy to invasive FFR (via catheterization).[11] It is recommended in cases of stenosis between 50-90%, particularly in CAD-RADS 3 and 4A, or in cases of CAD-RADS 2 with proximal lesions and the presence of high-risk features (HRP), being considered positive with values $\leq$ 0.75, when complementation with coronary angiography is considered in the appropriate clinical context. FFR-CT $>$ 0.8 is considered negative (Figure 10), with no need for complementation with coronary catheterization. Values between 0.76 and 0.80 are considered indeterminate and require additional assessment of the lesion site, symptoms and the translesional gradient between 1-2 cm proximal and 1-2 cm distal to the stenosis (significant when $\geq$ 0.12), when invasive coronary angiography is suggested.[6,12,13]

Myocardial Perfusion CT (Modifier I)

In the context of acute, stable chest pain, several studies have validated myocardial perfusion computed tomography compared with myocardial scintigraphy, cardiac perfusion magnetic resonance imaging, invasive coronary angiography, invasive FFR, and cardiac biomarkers. Its complementary use to CCTA has better diagnostic accuracy in patients at intermediate to high risk. It allows the detection of hemodynamically significant lesions by identifying areas of reversible myocardial ischemia. It also allows ischemia to be ruled out in stenotic lesions between 50-69% and lesions above 70% densely calcified, eliminating the need for additional complementary exams.[6,14,15] It may also identify a fixed perfusion defect, suggesting a previous myocardial infarction; however, this finding should be described within the body of the report, rather than labeled as modifier

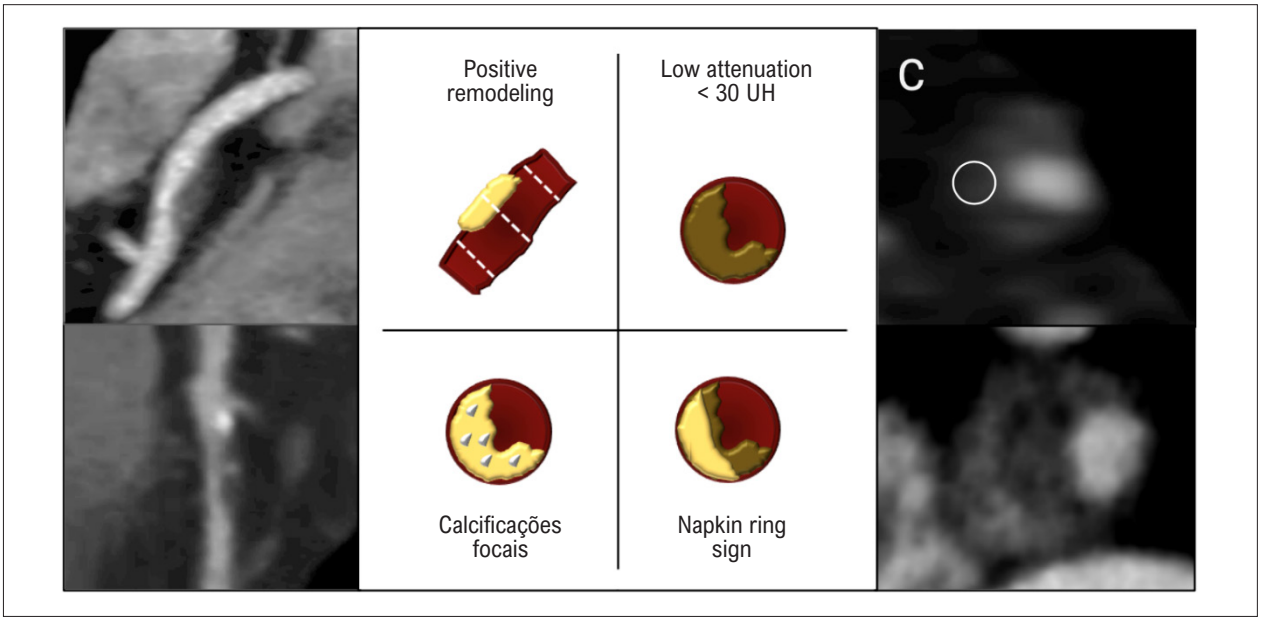

Figure 9 – *HRP modifier. Image A shows a coronary artery with non-calcified plaque and positive remodeling. Image B shows partially calcified plaque with focal eccentric calcifications. Image C shows a short axis of the coronary artery with predominantly non-calcified plaque (white arrows) with areas of low attenuation (circle). Image D shows the short axis of the coronary artery with the "napkin ring" sign, characterized by high attenuation at the outer edge, with central hypoattenuation adjacent to the contrasted lumen. Source: authors' personal collection. UH: Hounsfield unit.*

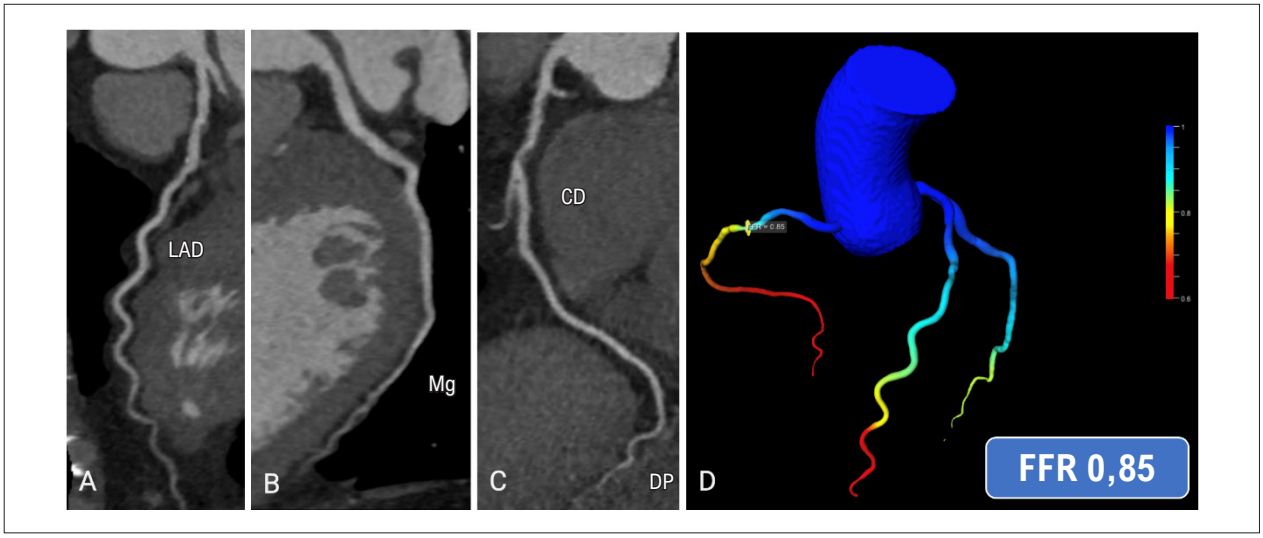

Figure 10 – *Modifier I. CAD-RADS 3/P1/I-. Image A shows LAD with mild stenosis (25-49%). Image B shows the Cx artery without luminal reduction. Image C shows the RC artery with moderate luminal reduction (50-69%). P1: mild plaque burden, affecting two vessels. Image D shows FFR-CT with a value of 0.85, negative for ischemia. Source: kindly provided by Thamara Carvalho de Morais, MD. LAD: left anterior descending artery; FFR: fractional flow reserve; Mg: marginal; CD: right coronary; DP: posterior descending.*

I. Positive ischemia (I+) refers to cases where there is a reversible perfusion alteration between stress and rest (figure 11) or in cases of peri-infarction ischemia, where the perfusion defect during the stress phase is larger compared to the at rest phase. Negative ischemia (I-) is defined by either the absence of perfusion changes or a fixed/non-reversible perfusion defect, which may indicate myocardial infarction and/or fibrosis without evidence of ischemia. Doubtful cases are classified as indeterminate (I+/-).

Modifier S (Stent)

Indicates the presence of at least one stent, as an independent indicator. In this context, the modifier does not specify whether the stenosis is related to the same vessel as the stent (Figure 12). For instance, significant stenosis in the left main coronary artery (LMCA), along with a stent in the right coronary artery that shows no signs of restenosis, is classified as CAD-RADS 4B/P3/S. If the evaluation of the stent's lumen is compromised but there are no stenoses greater than 50%, the suggested CAD-RADS classification is N/S.

Modifier G (graft)

Indicates the presence of at least one myocardial revascularization graft. In this scenario, it is worth noting that any stenoses in the segment transposed by the bypass should be excluded from the CAD-RADS analysis (Figure 13), considering the lumen of the graft for interpretation purposes. For example, in the case of a graft in the left anterior descending artery (LAD) with no evidence of stenosis greater than 50% — whether in the graft itself, the anastomosis, the distal native bed, or other coronary segments — the classification would be CAD-RADS 2/P2/G, even if there is significant stenosis in the crossed LAD segment. The evaluation of the graft lumen follows the same rationale as for the other segments.

Modifier E (Exceptions)

The CAD-RADS classification is not typically applied to non-atherosclerotic coronary abnormalities, such as origin or course anomalies, aneurysms or pseudoaneurysms, vasculitis, dissections, fistulas, extrinsic compression, and others (Figure 14). Although these causes of coronary obstruction are much less common, they remain important differential diagnoses that require specific approaches. Modifier E is designated for these cases, indicating that the CAD-RADS classification and its usual clinical recommendations do not encompass all coronary abnormalities.

Examples of Structured CAD-RADS Reports

Example 1: Absence of obstructive lesions, moderate plaque burden, stent with limited luminal assessment. Classification: CAD-RADS N / P2 / S.

Example 2: Diffuse moderate stenoses, severe plaque burden, high-risk features and presence of stent. Classification: CAD-RADS 3 / P3 / HRP / S.

Example 3: Limited luminal assessment, severe plaque burden, presence of stent and myocardial graft. Classification: CAD-RADS N / P3 / S / G.

Example 4: Significant stenosis in proximal LAD, mild stenoses in RCA and Cx, extensive plaque burden, left internal mammary graft for LAD. Classification: CAD-RADS 2 / P4 / G.

Example 5: Significant stenosis in proximal LAD and limited luminal assessment of mid-RCA, severe plaque burden. Classification: CAD-RADS 4A / P3 / N.

Example 6: Moderate stenosis in mid-LAD, severe plaque burden, FFR-CT < 0.75. Classification: CAD-RADS 3 / P3 / I+.

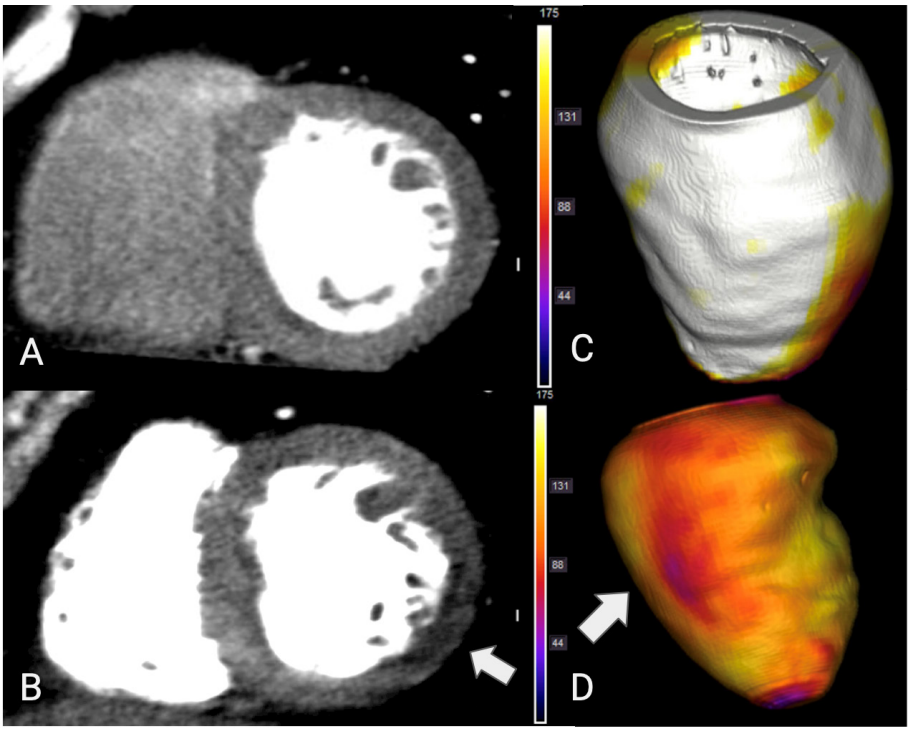

Figure 11 – *Modifier I. Images A and C show, respectively, short axis and normal 3D rendering of the heart, without areas of hypoattenuation, configuring negative ischemia (I-). Images B and D show, respectively, short axis and 3D rendering of the heart with areas of hypoattenuation (white arrow), determining positive ischemia (I+). Source: kindly provided by Roberto Nery Dantas Junior, MD.*

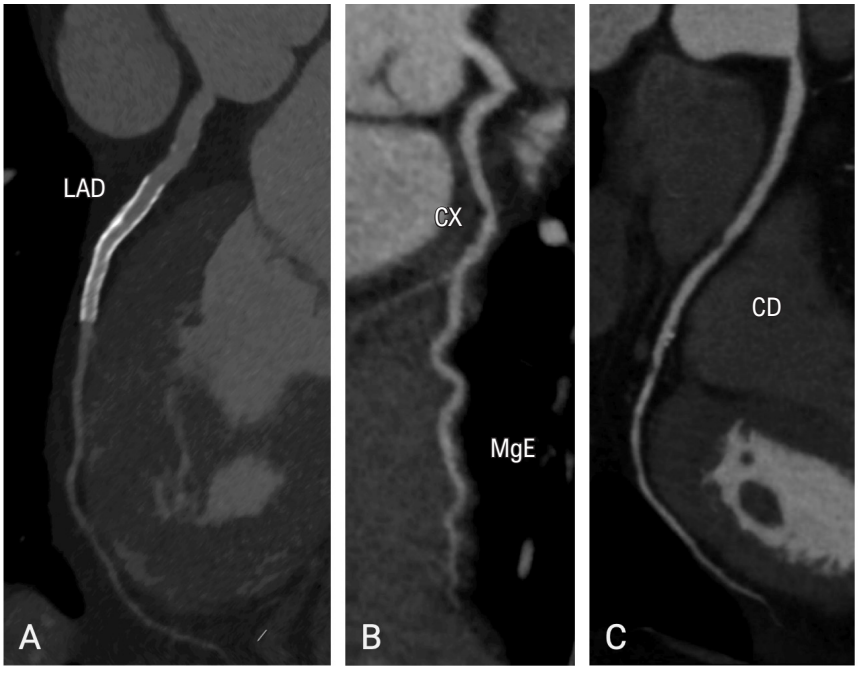

Figure 12 – *Modifier S. CAD-RADS 3/S. Image A shows a patent stent in the LAD without significant stenosis. Image B shows Cx with mild stenosis (25-49%). Image C shows RCA with moderate stenosis (50-69%). Source: authors' personal collection. LAD: left anterior descending artery; CX: circumflex; MgE: left marginal; CD: right coronary.*

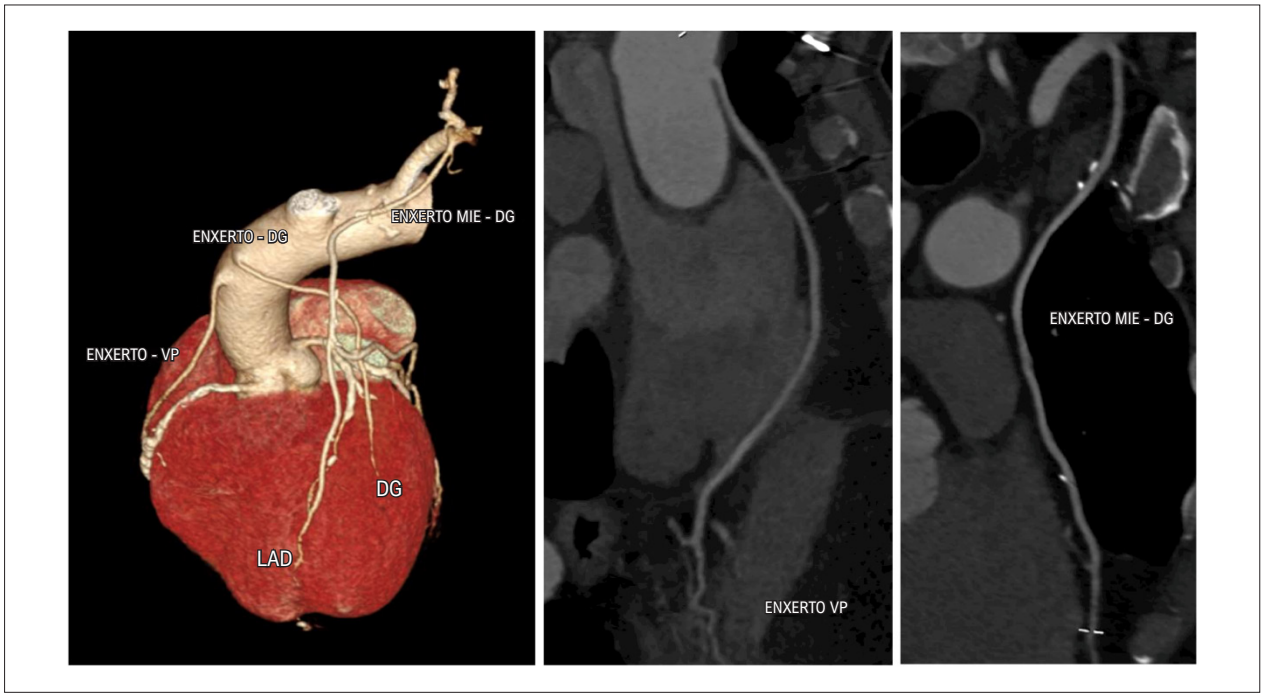

Figure 13 – *Modifier G. CAD-RADS 2/P2/G. Image A shows a 3D rendering of the heart with grafts for the SVP, DG and LIMA-LAD. Images B and C show, respectively, patent grafts for the SVP and LIMA-LAD of the same patient, with slight luminal reduction of the distal segments. Source: authors' personal collection. LAD: left anterior descending artery; VP: posterior ventricular; Dg: diagonal.*

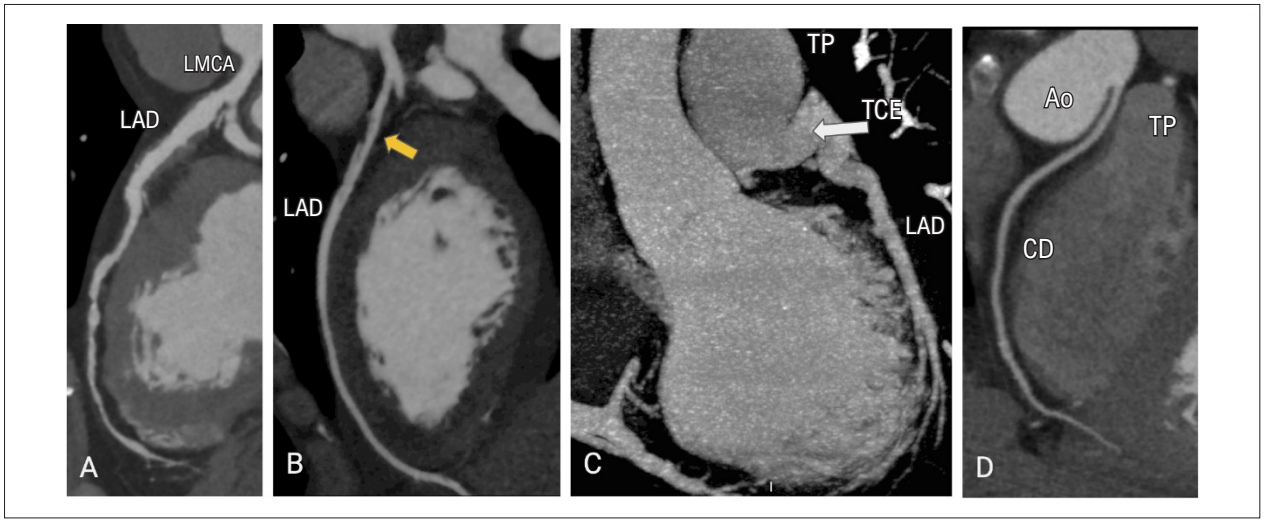

Figure 14 – *Modifier E. Image A requires a coronary aneurysm with partial thrombosis in the proximal segment of the LAD artery, associated with an atherosclerotic plaque in the middle segment with significant stenosis (CAD-RADS 4A/P2/E). Image B with dissection image (yellow arrow) in the proximal segment of the LAD (CAD-RADS 2/E). Image C of a coronary anomaly with LMCA originating from the pulmonary trunk (ALCAPA - CAD-RADS 0/E). Image D with interarterial course of the right coronary artery (CAD-RADS 1/P1/E). Source: authors' personal collection. LAD: left anterior descending artery; LMCA: left main coronary artery; TP: pulmonary trunk; CD: right coronary; Ao: aorta.*

Example 7: Significant stenosis in distal LAD, moderate plaque burden, absence of reversible ischemia on myocardial perfusion CT. Classification: CAD-RADS 4A / P2 / I-.

Clinical cases

Clinical Case 1: Patient at high cardiovascular risk with recent-onset angina. In 2019, an elective invasive coronary angiography was performed, revealing moderate stenosis in the mid-LAD segment, which was managed with clinical treatment resulting in good symptomatic control. Atypical chest pain recurred in 2022, prompting a coronary angiotomography that demonstrated moderate stenosis (50-69%) in the mid-LAD segment, accompanied by high-risk characteristics (spotty calcification). A non-invasive ischemia test was performed

using FFR-CT with a value of 0.87, considered negative for ischemia. CAD-RADS 3/P2/HRP/I- (Figure 15), suggesting optimized clinical treatment and early follow-up.

Clinical Case 2: Male patient, 50 years old, intermediate risk, with controlled hypertension and atypical chest pain for 6 months. CCTA identified the anomalous origin of the LMCA in the left coronary sinus, with a subpulmonary course, without luminal reduction at rest, unavailable FFR-CT and perfusion tomography. CAD-RADS 0/E (Figure 16). According to the CAD-RADS classification, the usual recommendations do not address exceptional cases such as coronary anomalies. It was decided to perform a non-invasive functional test with myocardial scintigraphy, with a negative result for ischemia. The patient was kept under clinical observation, with control of cardiovascular risk factors.

Clinical Case 3: Male patient, 70 years old, with dyslipidemia and a family history of coronary disease. Sought emergency care due to typical chest pain and tightness, starting three weeks ago. Physical examination revealed no changes, and troponin levels were negative. Report of recent scintigraphy without ventricular dysfunction and ischemia. CCTA identified significant stenosis in LAD and RCA (right coronary artery) with signs of HRP and Cx without stenosis, configuring CAD-RADS 4A/P3/HRP (Figure 17). In an acute context, this was classified according to CAD-RADS as probable acute coronary syndrome, leading to a recommendation for hospital admission, evaluation by a cardiologist, and consideration of coronary angiography or functional testing along with revascularization options based on specific guidelines. Invasive coronary angiography was chosen, with confirmation of lesions and angioplasty of LAD and RCA with drug-eluting stents was performed, with good evolution.

Clinical Case 4: Male patient, 65 years old, active smoker, with intermediate risk, under outpatient follow-up for typical chest pain, which had started one month ago. CCTA identified significant stenosis of the LMCA and the LAD-Dg bifurcation, as well as moderate luminal reduction of the RCA and Cx without stenosis. Graded as CAD-RADS 4B/P3 (Figure 18) and, according to the classification, cineangiography was recommended and referred for hospitalization for discussion regarding revascularization strategies. The patient is a Jehovah's Witness who refused conventional revascularization surgery due to the risk of blood transfusion, and percutaneous treatment with a drug-eluting stent of the LMCA and LAD-Dg bifurcation was chosen without complications.

Discussion

The CAD-RADS classification was developed based on scientific data, the consensus of cardiac imaging experts, and a multidisciplinary effort involving several societies of radiologists and cardiologists. In recent years, this classification has been validated in various clinical scenarios, showcasing its clinical utility in both stable CAD and acute conditions, with accuracy comparable to that of invasive coronary angiography in selected cases. Furthermore, CAD-RADS has shown prognostic value, with a potential impact on clinical decision-making.

It aims to provide a standardized report that offers evidence-based recommendations and is continuously refined, enabling cardiovascular imaging specialists to convey results more concisely and clearly. This standardization of reporting intends to enhance information accessibility and align it with the latest evidence. Therefore, it is advised that CCTA reports utilize the CAD-RADS classification alongside

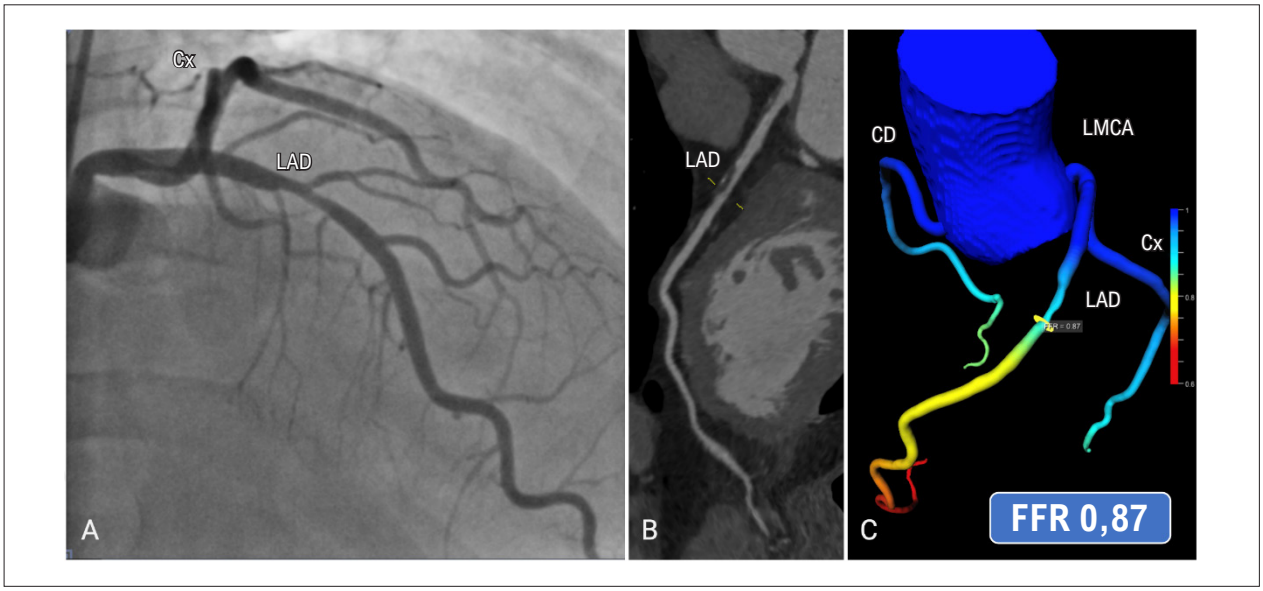

Figure 15 – *Clinical Case 1. Image A shows a coronary angiography image with moderate stenosis (50-69%) in the middle segment of the LAD in 2019. Image B shows a coronary CT angiography image from 2022 with moderate luminal reduction of the same patient and signs of HRP (spotty calcification and low attenuation). Image C shows FFR-CT 0.87 in the mid-segment of the LAD. CAD-RADS 3/P2/HRP/I. Source: kindly provided by Thamara Carvalho de Morais, MD. LAD: left anterior descending artery; LMCA: left main coronary artery; FFR: fractional flow reserve; Cx: circumflex; CD: right coronary.*

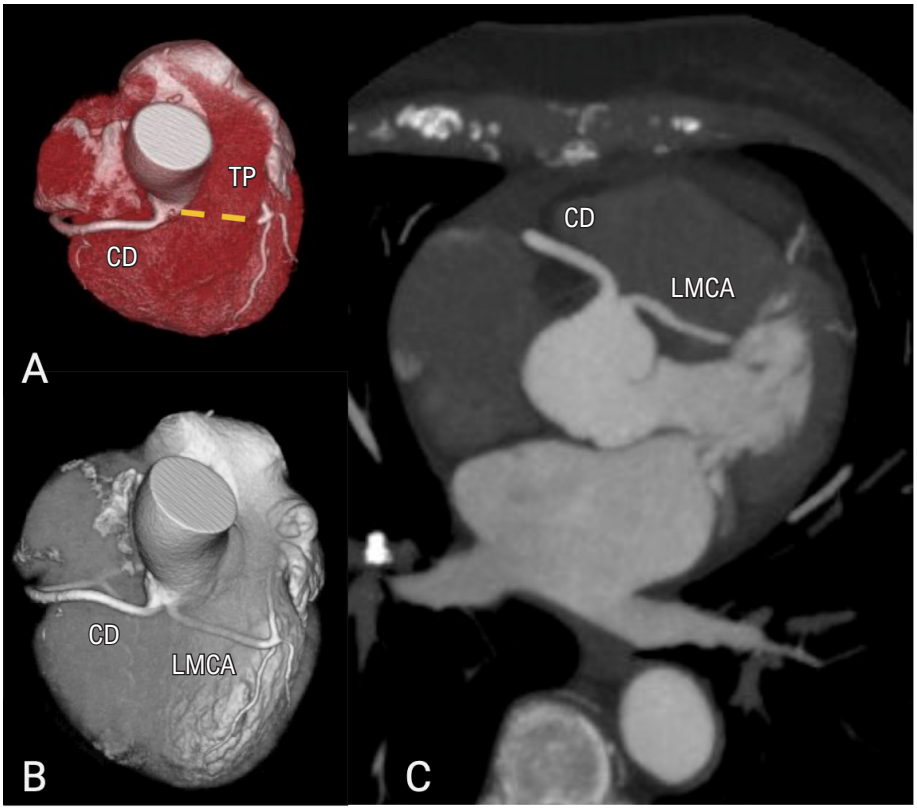

Figure 16 – *Clinical Case 2. Image A shows a 3D rendering of the heart with anomalous origin of the LMCA from the right coronary sinus and subpulmonary path (yellow dashed line). Image B shows the LMCA path with the translucency of the right ventricular outflow tract. Image C shows the adjacent origin of the RCA and LMCA in the right coronary sinus. CAD-RADS 0/E. Source: authors' personal collection. LMCA: left main coronary artery; CD: right coronary; TP: pulmonary trunk.*

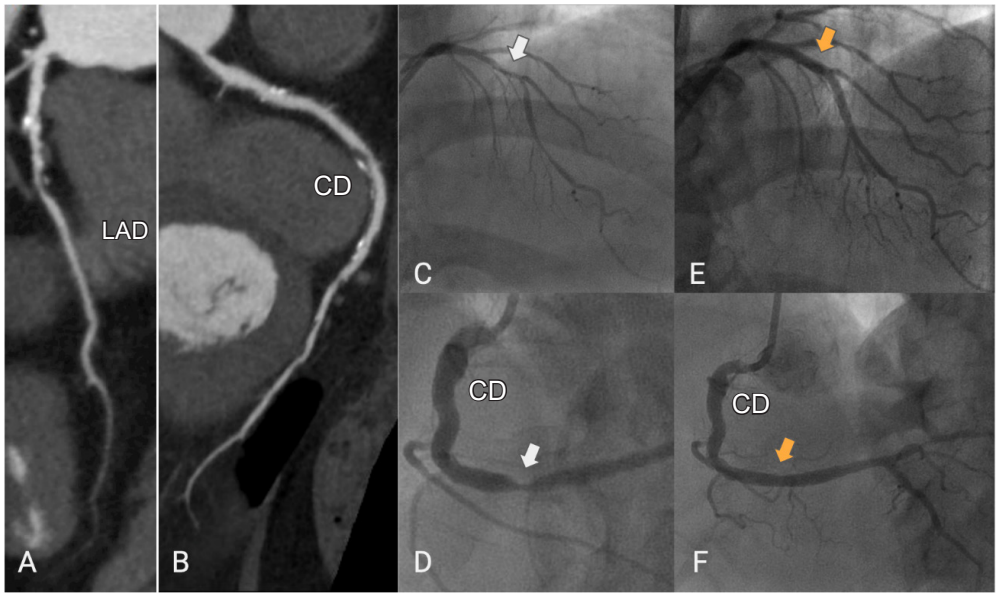

Figure 17 – *Clinical Case 3. Images A and B show, respectively, LAD and RCA with plaques having high-risk characteristics (spotty calcification and low attenuation) and significant stenosis (70-99%). CAD-RADS 4A/P3/HRP. Images C and D show diagnostic cineangiography, respectively, of LAD and RCA. Figures E and F show the result after angioplasty with stent (yellow arrows). Source: authors' personal collection. LAD: left anterior descending artery; CD: right coronary.*

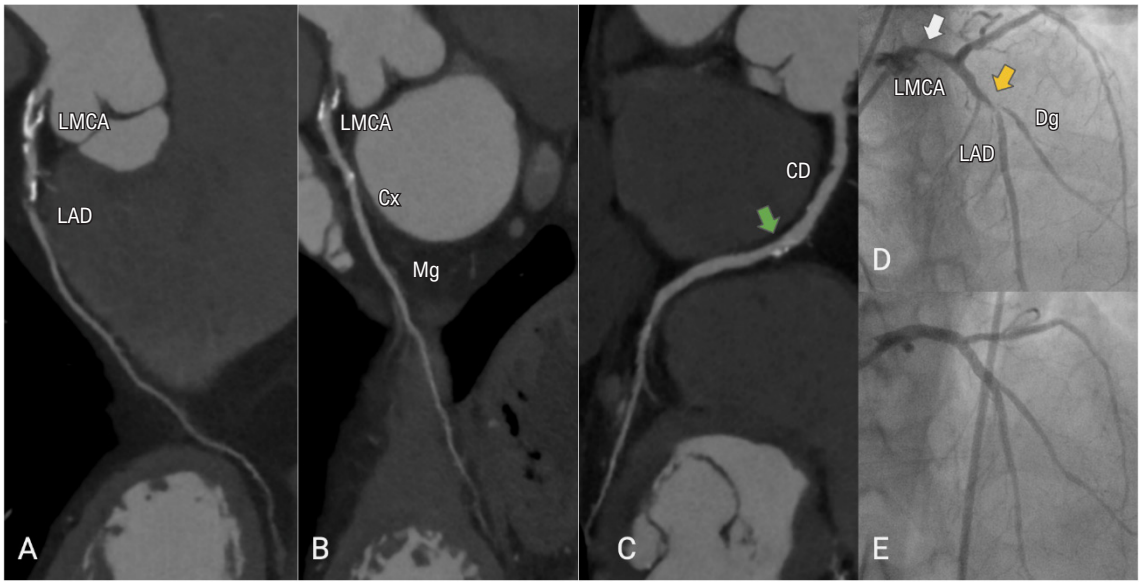

Figura 18 – *Clinical Case 4. Image A shows partially calcified plaques, determining significant stenosis of the LMCA (> 50%) and LAD (70-99%). Image B shows significant stenosis of the LMCA and Cx arteries with mild stenosis (2549%). Image C shows RCA with moderate stenosis (green arrow), concluding CAD-RADS 4B/P3. Image D shows cineangiography confirming significant stenoses in the LMCA (white arrow) and the LAD-Dg bifurcation (yellow arrow). Image E shows the result after angioplasty of the LMCA and LAD-Dg. Source: authors' personal collection. LAD: left anterior descending artery; LMCA: left main coronary artery; Mg: marginal; CD: right coronary; Dg: diagonal.*

the diagnostic impression, as it alone does not encompass all the necessary information for effective patient management. Furthermore, the push for standardization may facilitate the reproducible recording of data for future research studies, including those utilizing artificial intelligence, enhancing data exchange and increasing the reproducibility of the method.

However, some limitations deserve attention. Among the factors of coronary evaluation not covered by the CAD-RADS categories is the quantification of atheromatosis – for example, for a single plaque with stenosis of less than 25% or multiple plaques determining the same degree of stenosis, the final classification will be the same (CAD-RADS 2). Another significant limitation is that the system does not provide clinical recommendations for exceptional modifiers, such as the presence of coronary anomalies and other extra-cardiac findings like pulmonary thromboembolism, mediastinal masses, or aortic aneurysms.

Conclusion

The CAD-RADS classification has been increasingly used and has been gaining progressive notoriety among radiologists and cardiologists worldwide. It is expected that its use will become more frequent in the coming years, with continuous improvement of this standardized reporting system. In addition to analyzing the degree of luminal stenosis, this classification has incorporated plaque burden and new modifiers into the report, which include characteristics for HRP, assessment of ischemia by FFR-CT and/or myocardial perfusion by CT.

It is important to note that CAD-RADS does not eliminate the necessity of recording descriptive impressions of the examination, and an additional classification should be included at the end of the report. Additionally, for the full potential of this classification to be integrated into clinical practice, radiologists and cardiologists need to be well-acquainted with its application and interpretation, as well as its primary limitations.

Author Contributions

Conception and design of the research and supply of figures: Fuzissima BM, Torres RVA; acquisition of data: Fuzissima BM; writing of the manuscript: Fuzissima BM, Couto RM; critical revision of the manuscript for intellectual content: Fuzissima BM, Torres RVA, Couto RM, Farias LPG, Oliveira B, Araújo Filho JAB; artistic creation of the central figure: Farias LPG.

Potential Conflict of Interest

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Study Association

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Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

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