SISTEMA SANITARIO REGIONALE
AZIENDA OSPEDALIERO-UNIVERSITARIA SANT'ANDREA

Cardio-TC/RM WEBINAR FAD

Dal 16 maggio 2024 all'11 Luglio 2024

PROGRAMMA

16 Maggio – ore 17.00/18.00
Introduzione al Corso (A. Laghi)
Saluti Direzione Generale AOUSA (D. Donetti)
Tecnica di acquisizione della Cardio TC/Utilizzo del Mdc e Triple-rule-out (D. Caruso)

23 Maggio – ore 17.00/18.00
Anatomia coronarica (L. Pugliese)

30 Maggio – ore 17.00/18.00
Caratteristiche di placca: calcifica, non calcifica, vulnerabile (D. De Santis)

6 Giugno – ore 17.00/18.00
La definizione della stenosi secondo CAD-RADS v.2 (D. De Santis)

13 Giugno – ore 17.00/18.00
Indicazione alla Cardio RM, protocollo di acquisizione e sequenze principali (D. De Santis)

27 Giugno – ore 17.00/18.00
Patologia infiammatoria (miocarditi, pericarditi) (D. De Santis)

4 Luglio – ore 17.00/18.00
Cardiopatia ischemica (L. Pugliese)

11 Luglio – ore 17.00/18.00
Cardiomiopatie (ipertrofica, dilatativa, aritmogena) e patologie da Accumulo (L. Pugliese)

SAPIENZA UNIVERSITÀ DI ROMA

Il **Corso Webinar CardioTC** e **CardioRM** del Sant'Andrea 2024 è un corso di Cardio TC (Tomografia Computerizzata) e Cardio RM (Risonanza Magnetica) progettato per fornire ai discenti una comprensione approfondita delle due principali tecniche di imaging cardiaco utilizzate nella pratica clinica moderna.
Questo corso mira a fornire una panoramica completa dei principi di base, delle applicazioni cliniche e delle sfide associate all'uso della TC e della RM nel contesto della valutazione cardiaca. Il corso inizia con una discussione delle tecniche di acquisizione della Cardio TC, compreso l'uso dei mezzi di contrasto e i protocolli come il "Triple-rule- out". I discenti impareranno a interpretare le immagini TC per valutare l'anatomia coronarica, identificare caratteristiche delle placche aterosclerotiche e definire stenosi coronariche secondo il sistema CAD-RADS.
Successivamente, il focus si sposta sulla Cardio RM, esplorando le indicazioni per questo tipo di imaging, i protocolli di acquisizione e le sequenze principali utilizzate per valutare la struttura e la funzione cardiaca per diagnosticare patologie cardiache, tra cui infiammazioni miocardiche, cardiomiopatie e malattie da accumulo.

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Segreteria Scientifica
Prof. Andrea Laghi – Dott. Damiano Caruso
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SISTEMA SANITARIO REGIONALE
AZIENDA OSPEDALIERO-UNIVERSITARIA SANT'ANDREA

La Definizione della Stenosi Secondo CAD-RADS v.2

Dr. Domenico De Santis, MD
Dept of Medical-Surgical Science and Translational Imaging
Sapienza - University of Rome
domenico.desantis@uniroma1.it

PROMISE TRIAL

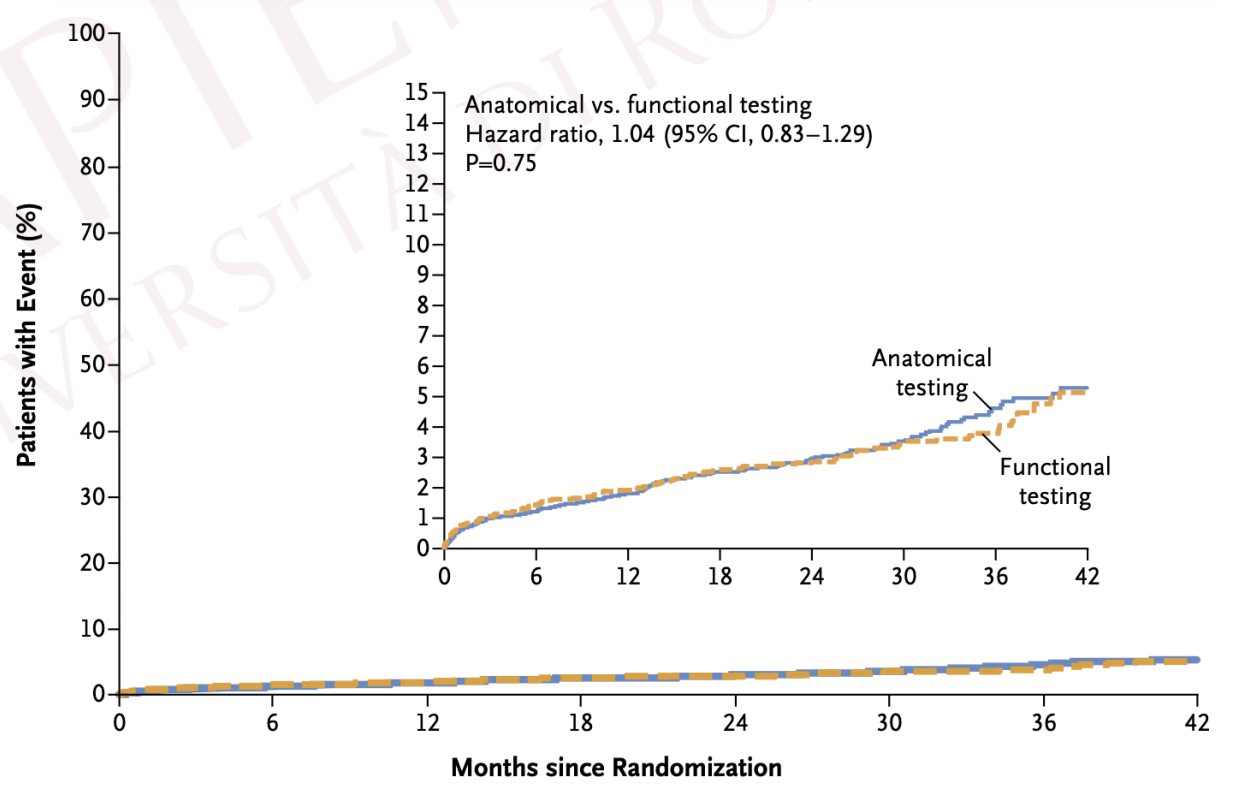
10.003 pts
with CAD symptoms

4996 pts
CTA Group

5007 pts
Funct. tests group

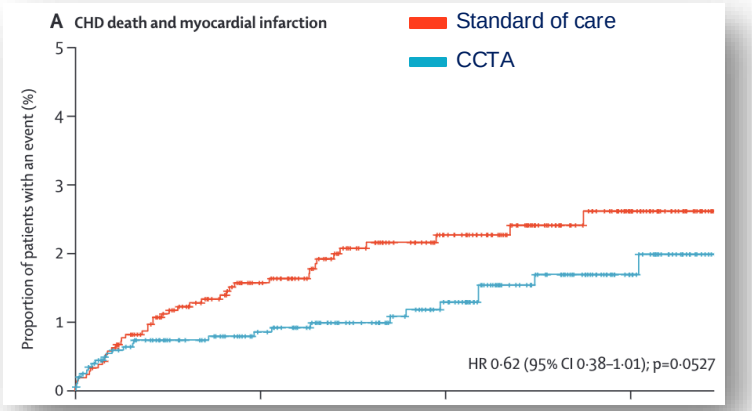
CONCLUSIONS

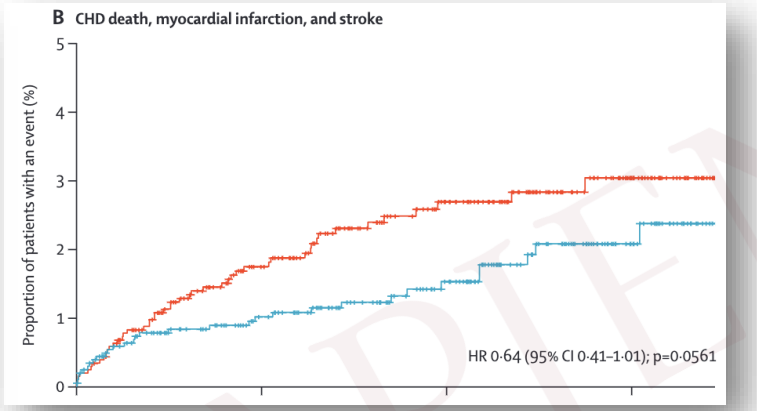
In symptomatic patients with suspected CAD who required noninvasive testing, a strategy of initial CTA, as compared with functional testing, did not improve clinical outcomes over a median follow-up of 2 years. (Funded by the National Heart, Lung, and Blood Institute; PROMISE ClinicalTrials.gov number, NCT01174550.)

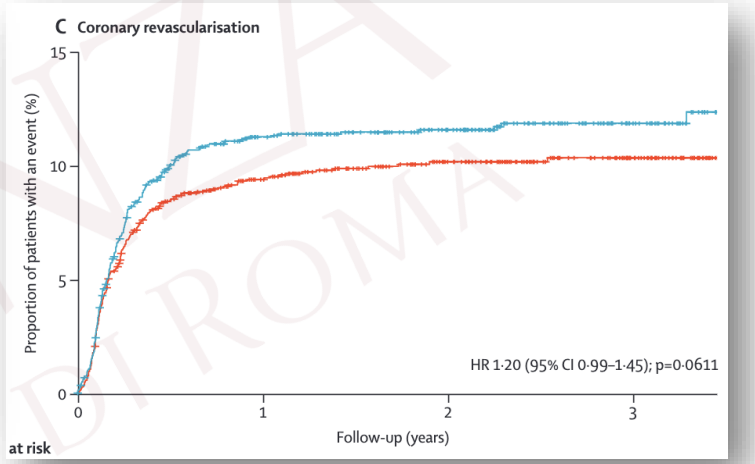


Douglas PS et al. N Engl J Med. 2015 Apr 2;372(14):1291-300. doi: 10.1056/NEJMoa1415516

SCOT-HEART TRIAL







4146 pts
with suspected angina

2073 pts
Standard care

2073 pts
Standard care + CCTA

At 6 weeks CCTA reclassified the diagnosis of angina due to coronary heart disease in 23% patients (standard care in 1%; p<0.0001); this changed planned investigations (15% vs 1%; p<0.0001) and treatments (23% vs 5%; p<0.0001)

SCOT-HEART investigators. Lancet. 2015 Jun 13;385(9985):2383-91. doi: 10.1016/S0140-6736(15)60291-4

CT-COMPARE TRIAL

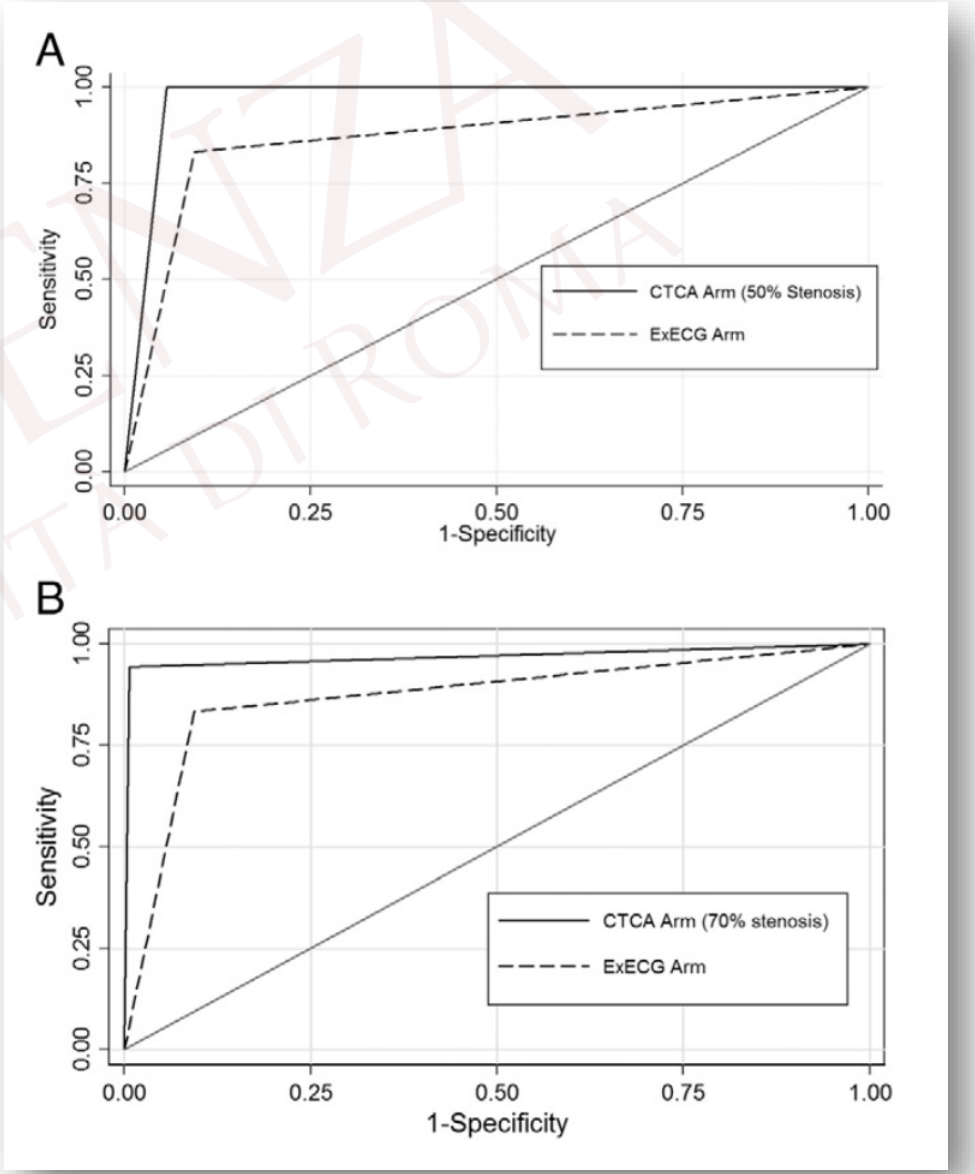
562 pts
with chest pain (trop -)

322 pts
CCTA

240 pts
Exercise stress ECG

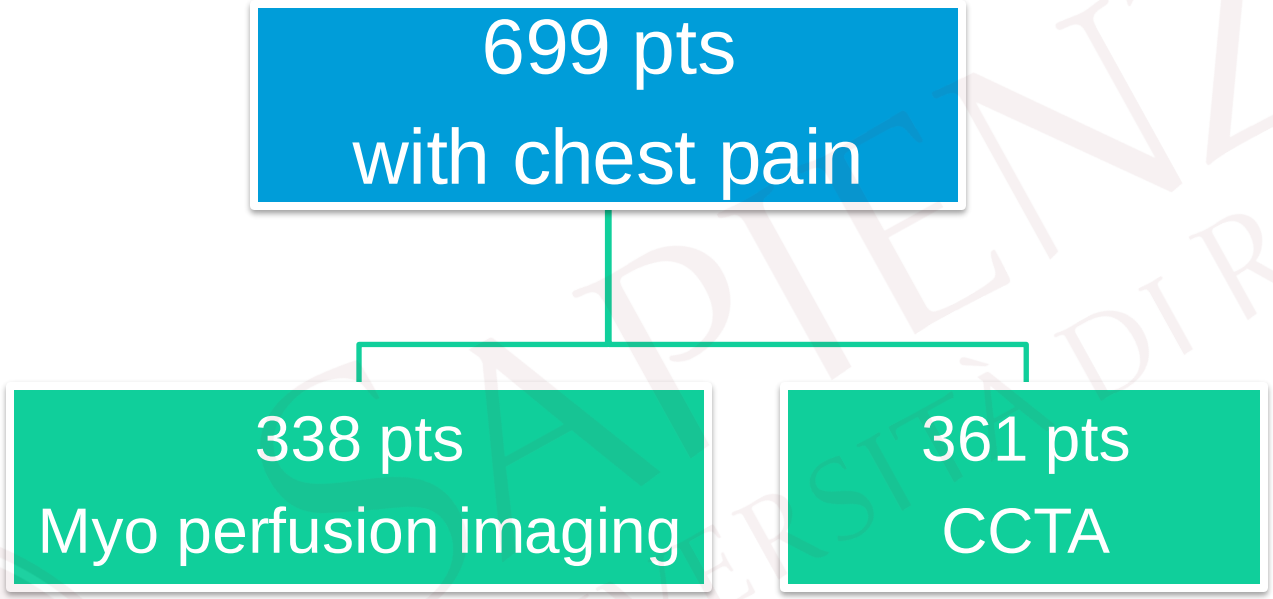
Study endpoints.

	CCTA (n = 322)	ExECG (n = 240)	p-Value
Length of stay (hours, 95% CI)	13.5 (11.2–15.7)	19.7 (17.3–22.0)	0.003
Inpatient admission (%)	10.2	10.8	0.800
Downstream testing (%)	10.8	5.8	0.020
Invasive angiography	7.1	3.3	0.028
Echocardiography	2.2	1.3	0.300
Re-presentation (%)	12.7	10.5	0.300
Cost ($AUD, 95% CI)			
All comers	$2193 (1997–2389)	$2704 (2555–2853)	<0.001
Discharged from ED	$1669 (1612–1726)	$2459 (2397–2521)	<0.001



Hamilton-Craig C et al. Int J Cardiol. 2014 Dec 20;177(3):867-73. doi: 10.1016/j.ijcard.2014.10.090

CT-STAT TRIAL



Outcomes	CCTA Group (n = 361)	MPI Group (n = 338)	p Value
Time to diagnosis, h	2.9 (2.1–4.0)	6.2 (4.2–19.0)	<0.0001
Total ED costs, $	2,137 (1,660–3,077)	3,458 (2,900–4,297)	<0.0001
MACE in patients with normal index test	2/268 (0.8%)	1/266 (0.4%)	0.29

Goldstein JA et al. J Am Coll Cardiol. 2011 Sep 27;58(14):1414-22. doi: 10.1016/j.jacc.2011.03.068

ACRIN-PA TRIAL

1370 pts
with possible ACS

462 pts
Standard care

908 pts
CCTA

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

CT Angiography for Safe Discharge of Patients with Possible Acute Coronary Syndromes

RESULTS

We enrolled 1370 subjects: 908 in the CCTA group and 462 in the group receiving traditional care. The baseline characteristics were similar in the two groups. Of 640 patients with a negative CCTA examination, none died or had a myocardial infarction within 30 days (0%; 95% confidence interval [CI], 0 to 0.57). As compared with patients receiving traditional care, patients in the CCTA group had a higher rate of discharge from the emergency department (49.6% vs. 22.7%; difference, 26.8 percentage points; 95% CI, 21.4 to 32.2), a shorter length of stay (median, 18.0 hours vs. 24.8 hours; P<0.001), and a higher rate of detection of coronary disease (9.0% vs. 3.5%; difference, 5.6 percentage points; 95% CI, 0 to 11.2). There was one serious adverse event in each group.

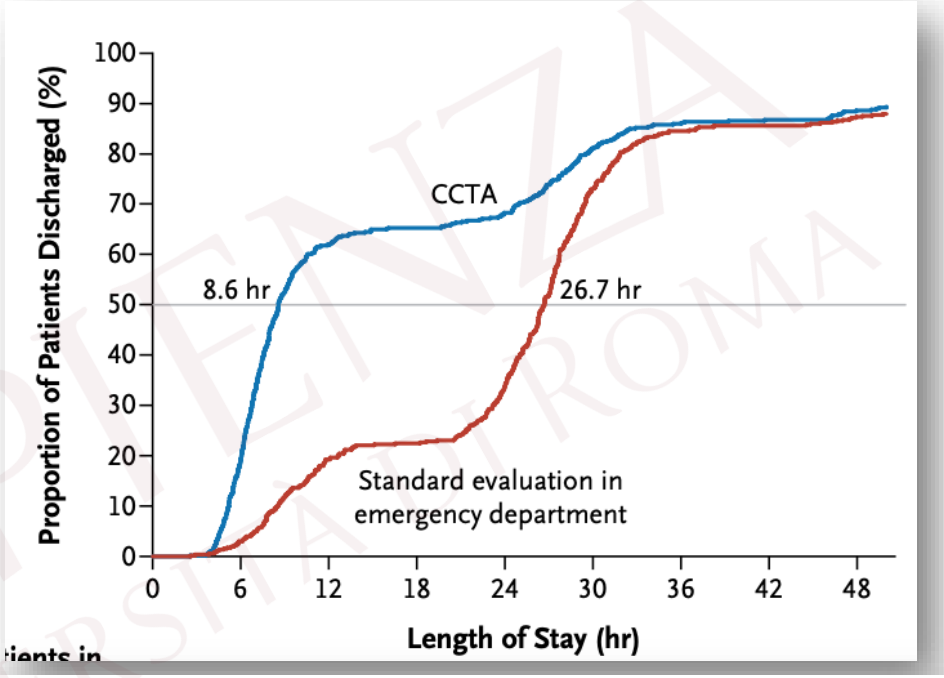
Litt HI et al. N Engl J Med. 2012 Apr 12;366(15):1393-403. doi: 10.1056/NEJMoa1201163

ROMICAT II TRIAL

1000 pts
with possible ACS

499 pts
Standard care

501 pts
CCTA



RESULTS

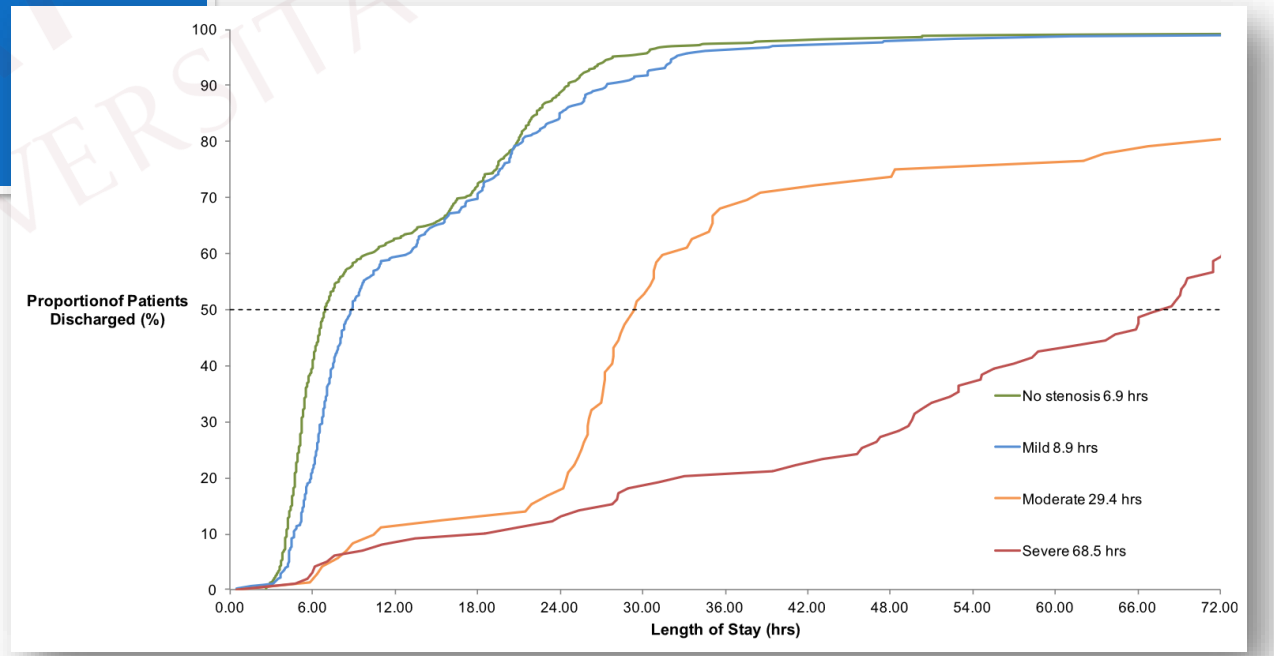
The rate of acute coronary syndromes among 1000 patients with a mean (±SD) age of 54±8 years (47% women) was 8%. After early CCTA, as compared with standard evaluation, the mean length of stay in the hospital was reduced by 7.6 hours (P<0.001) and more patients were discharged directly from the emergency department (47% vs. 12%, P<0.001). There were no undetected acute coronary syndromes and no significant differences in major adverse cardiovascular events at 28 days. After CCTA, there was more downstream testing and higher radiation exposure. The cumulative mean cost of care was similar in the CCTA group and the standard-evaluation group ($4,289 and $4,060, respectively; P=0.65).

Hoffmann U et al. N Engl J Med. 2012 Jul 26;367(4):299-308. doi: 10.1056/NEJMoa1201161

CCTA IN TRIAGE OF PATIENTS WITH SUSPECTED ACS

From RCT to clinical practice: 1022 pts in the ED, Expert Tertiary Care

- Median time to discharge home was 10.5 hours
- Only pts with reasonable risk of ACS were referred for CCTA
- Few pts undergo additional tests (18.8%) and ICA (7.6%)
- Median CT radiation exposure was 4.0 mSv
- No ACS was missed
- MACE at follow-up after negative CTA was 0.2 %



Ghoshhajra BB et al. Eur Radiol. 2017 Jul;27(7):2784-2793. doi: 10.1007/s00330-016-4562-5

ESC European Society of Cardiology

European Heart Journal (2020) **41**, 407–477
doi:10.1093/eurheartj/ehz425

ESC GUIDELINES

2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes

Non-invasive functional imaging for myocardial ischaemia or coronary CTA is recommended as the initial test for diagnosing CAD in symptomatic patients in whom obstructive CAD cannot be excluded by clinical assessment alone.	I
Coronary CTA should be considered as an alternative to invasive angiography if another non-invasive test is equivocal or non-diagnostic.	IIa

Knuuti J ET AL. Eur Heart J. 2020 Jan 14;41(3):407-477. doi: 10.1093/eurheartj/ehz425

ESC European Society of Cardiology

European Heart Journal (2023) **44**, 3720–3826
https://doi.org/10.1093/eurheartj/ehad191

ESC GUIDELINES

2023 ESC Guidelines for the management of acute coronary syndromes

Recommendations	Class[a]	Level[b]
In patients with suspected ACS, non-elevated (or uncertain) hs-cTn levels, no ECG changes and no recurrence of pain, incorporating CCTA or a non-invasive stress imaging test as part of the initial workup should be considered.[116,122–127]	IIa	A
Routine, early CCTA in patients with suspected ACS is not recommended.[117]	III	B

Byrne RA et al. Eur Heart J. 2023 Oct 12;44(38):3720-3826. doi: 10.1093/eurheartj/ehad191

GUIDELINES

Journal of Cardiovascular Computed Tomography 16 (2022) 54–122

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Journal of Cardiovascular Computed Tomography

journal homepage: www.JournalofCardiovascularCT.com

Practice guidelines

2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain

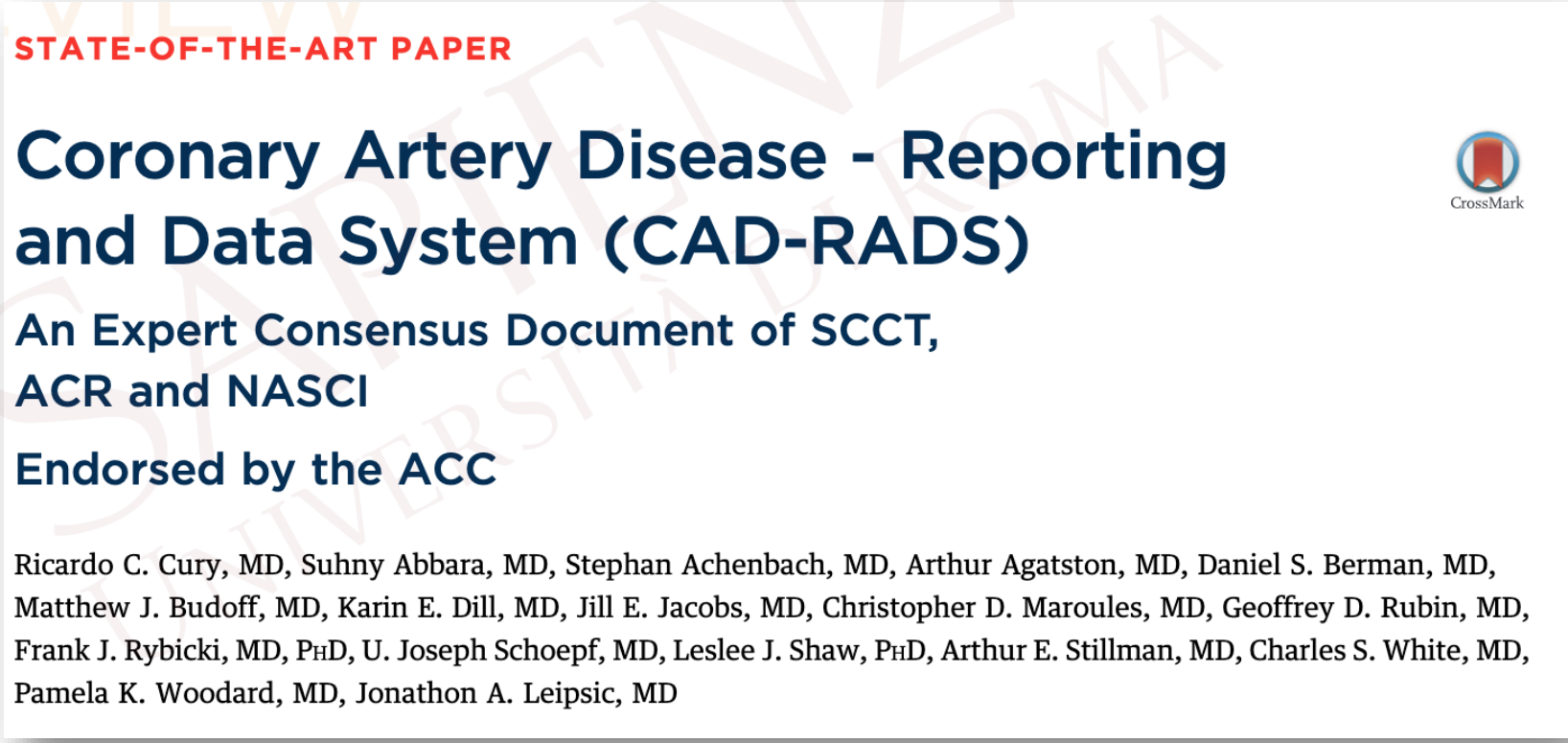
A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines

COR	LOE	Recommendations
Index Diagnostic Testing		
Anatomic Testing		
1	A	1. **For intermediate-risk patients with acute chest pain and no known CAD eligible for diagnostic testing after a negative or inconclusive evaluation for ACS, CCTA is useful for exclusion of atherosclerotic plaque and obstructive CAD** (1-11).

Writing Committee Members; J Cardiovasc Comput Tomogr. 2022 Jan-Feb;16(1):54-122. doi: 10.1016/j.jcct.2021.11.009

CAD-RADS CLASSIFICATION

- Applied on a per-patient basis for the clinically most relevant (usually highest-grade) stenosis.
- All vessels >1.5 mm in diameter should be graded for stenosis severity.
- CAD-RADS will not apply vessels <1.5 mm in diameter.



STATE-OF-THE-ART PAPER

Coronary Artery Disease - Reporting and Data System (CAD-RADS)

An Expert Consensus Document of SCCT, ACR and NASCI

Endorsed by the ACC

Ricardo C. Cury, MD, Suhny Abbara, MD, Stephan Achenbach, MD, Arthur Agatston, MD, Daniel S. Berman, MD, Matthew J. Budoff, MD, Karin E. Dill, MD, Jill E. Jacobs, MD, Christopher D. Maroules, MD, Geoffrey D. Rubin, MD, Frank J. Rybicki, MD, PhD, U. Joseph Schoepf, MD, Leslee J. Shaw, PhD, Arthur E. Stillman, MD, Charles S. White, MD, Pamela K. Woodard, MD, Jonathon A. Leipsic, MD

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

CAD-RADS CLASSIFICATION

TABLE 2 CAD-RADS Reporting and Data System for Patients Presenting With Stable Chest Pain

	Degree of Maximal Coronary Stenosis	Interpretation	Further Cardiac Investigation	Management
CAD-RADS 0	0% (No plaque or stenosis)	Documented absence of CAD*	None	Reassurance. Consider non-atherosclerotic causes of chest pain
CAD-RADS 1	1-24% - Minimal stenosis or plaque with no stenosis**	Minimal non-obstructive CAD	None	Consider non-atherosclerotic causes of chest pain Consider preventive therapy and risk factor modification
CAD-RADS 2	25-49% - Mild stenosis	Mild non-obstructive CAD	None	Consider non-atherosclerotic causes of chest pain Consider preventive therapy and risk factor modification, particularly for patients with non-obstructive plaque in multiple segments.
CAD-RADS 3	50-69% stenosis	Moderate stenosis	Consider functional assessment	Consider symptom-guided anti-ischemic and preventive pharmacotherapy as well as risk factor modification per guideline-directed care*** Other treatments should be considered per guideline-directed care***
CAD-RADS 4	**A** - 70-99% stenosis or **B** - Left main >50% or 3-vessel obstructive (≥70%) disease	Severe stenosis	A: Consider ICA**** or functional assessment B: ICA is recommended	Consider symptom-guided anti-ischemic and preventive pharmacotherapy as well as risk factor modification per guideline-directed care*** Other treatments (including options of revascularization) should be considered per guideline-directed care***
CAD-RADS 5	100% (total occlusion)	Total coronary occlusion	Consider ICA and/or viability assessment	Consider symptom-guided anti-ischemic and preventive pharmacotherapy as well as risk factors modification per guideline-directed care*** Other treatments (including options of revascularization) should be considered per guideline-directed care***
CAD-RADS N	Non-diagnostic study	Obstructive CAD cannot be excluded	Additional or alternative evaluation may be needed	

The CAD-RADS classification should be applied on a per-patient basis for the clinically most relevant (usually highest-grade) stenosis. All vessels greater than 1.5 mm in diameter should be graded for stenosis severity. CAD-RADS will not apply for smaller vessels (<1.5 mm in diameter). **MODIFIERS:** If more than one modifier is present, the symbol "/" (slash) should follow each modifier in the following order: First: modifier **N (non-diagnostic).** Second: modifier **S (stent).** Third: modifier **G (graft).** Fourth: modifier **V (vulnerability).** *CAD – coronary artery disease. **CAD-RADS 1 – This category should also include the presence of plaque with positive remodeling and no evidence of stenosis. ***Guideline-directed care per ACC Stable Ischemic Heart Disease Guidelines (Fihn et al. JACC 2012) (25). ****ICA – invasive coronary angiography.

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

CAD-RADS 0

Max Stenosis	• 0%
Interpretation	• No CAD
Further Test	• None
Management	• Consider alternative cause of chest pain

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

CAD-RADS 1

Max Stenosis	• 1-24%
Interpretation	• Minimal non-obstructive CAD
Further Test	• None
Management	• Consider alternative causes of chest pain • Consider preventive therapy and risk factor modification

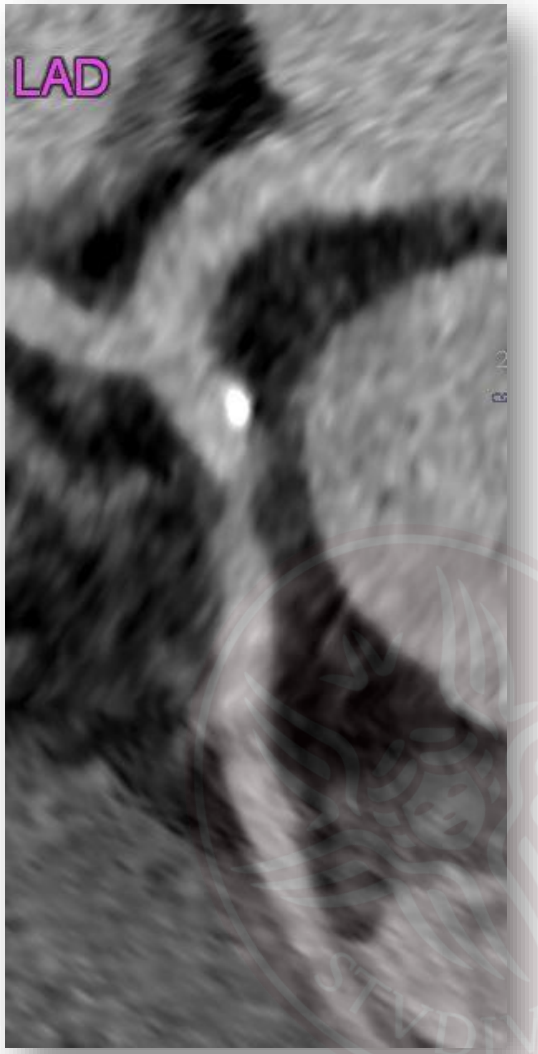
Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

CAD-RADS 2

Max Stenosis	• 25-50%
Interpretation	• Mild non-obstructive CAD
Further Test	• None
Management	• Consider alternative causes of chest pain • Consider preventive therapy and risk factor modification

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

CAD-RADS 3



Max Stenosis	• 50-69%
Interpretation	• Moderate CAD
Further Test	• Consider functional test
Management	•Consider symptom-guided anti-ischemic and preventive pharmacotherapy as well as risk factor modification per guideline-directed care •Other treatments should be considered per guideline-directed care

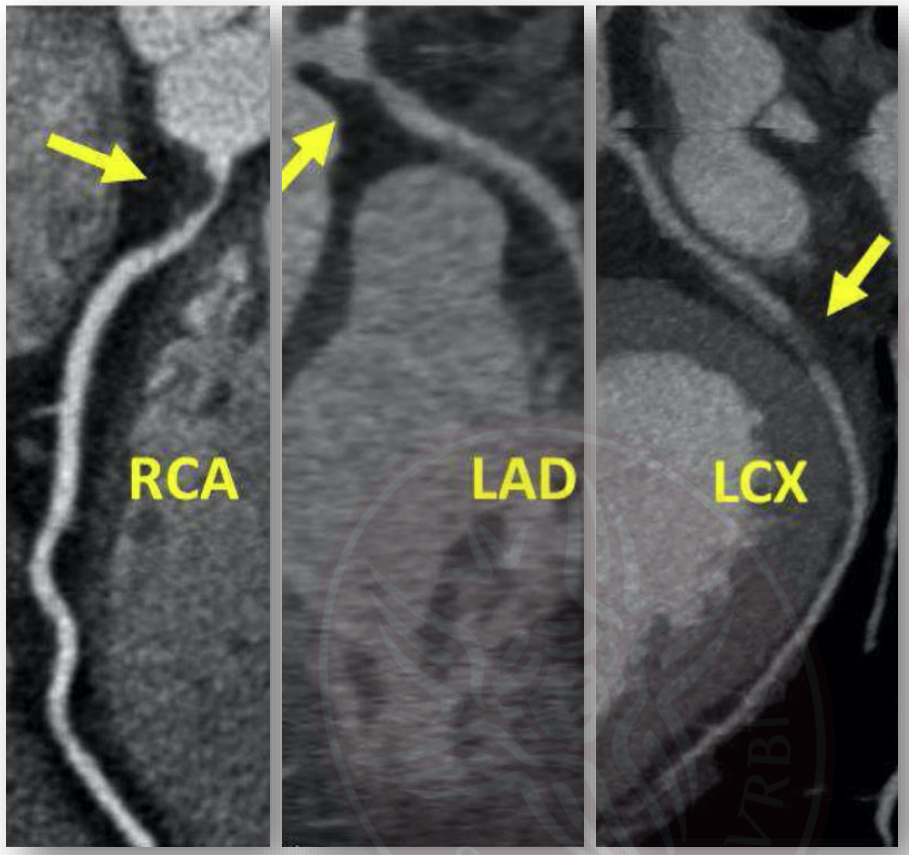
Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

CAD-RADS 4A

Max Stenosis	• 70-99%
Interpretation	• Severe stenosis
Further Test	• Consider ICA or functional test
Management	•Consider symptom-guided anti-ischemic and preventive pharmacotherapy as well as risk factor modification per guideline-directed care •Other treatments (incl. revascularization) should be considered per guideline-directed care

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

CAD-RADS 4B



Max Stenosis	• LM > 50% • 3-vessel ≥ 70%
Interpretation	• Severe stenosis
Further Test	• ICA is recommended
Management	•Consider symptom-guided anti-ischemic and preventive pharmacotherapy as well as risk factor modification per guideline-directed care •Other treatments (incl. revascularization) should be considered per guideline-directed care

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

CAD-RADS 5

Max Stenosis	• 100%
Interpretation	• Total coronary occlusion
Further Test	• Consider ICA and/or viability assessment
Management	•Consider symptom-guided anti-ischemic and preventive pharmacotherapy as well as risk factor modification per guideline-directed care •Other treatments (incl. revascularization) should be considered per guideline-directed care

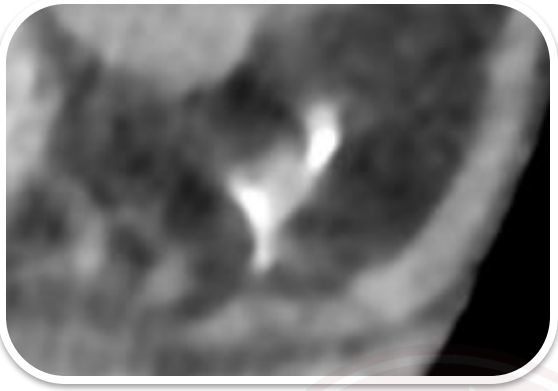
Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

CAD-RADS N

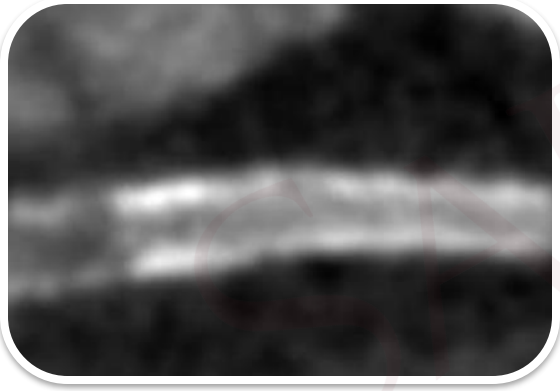
Max Stenosis	• Non diagnostic study
Interpretation	• CAD can’t be excluded
Further Test	• Additional or alternative evaluation
Management	

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

MODIFIERS

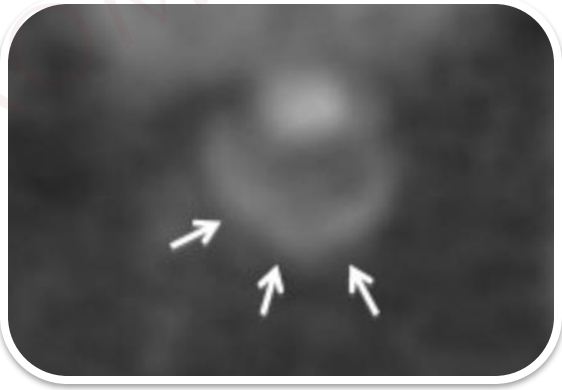


N
(Non-diagnostic)



S
(Stent)

G
(Graft)



V
(Vulnerability)

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

N (NON-DIAGNOSTIC STUDY)

“N” can be used as a modifier or as a CAD-RADS category.

Modifier

- If CAD-RADS is > 3 in interpretable segments

e.g. CAD-RADS 3/N

Category

- In pts with
  - no stenosis (0%)
  - minimal stenosis (1-24%)
  - mild stenosis (25-49%)

  in interpretable segments.

e.g. CAD-RADS N

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

S (STENT)

"S" indicates the presence of at least one coronary stent

CAD-RADS classification is based on highest-degree stenosis, irrespective if it is in the stented segment or not.

- E.g. Patient with stented LAD
  - Patent stent
  - Mild stenosis (25-49%) in LCX
  - Mild stenosis (25-49%) in RCA

  } **CAD-RADS 2/S**

  - Significant in-stent restenosis in LAD
  - Mild stenosis (25-49%) in LCX
  - Mild stenosis (25-49%) in RCA

  } **CAD-RADS 4A/S**

  - Patent stent
  - Severe stenosis (> 70%) in LCX
  - Mild stenosis (25-49%) in RCA

  } **CAD-RADS 4A/S**

  - Non-evaluable stent
  - Stenosis < 50% elsewhere

  } **CAD-RADS N/S**

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

G (BYPASS GRAFT)

“G” indicates the presence of at least one coronary artery bypass graft

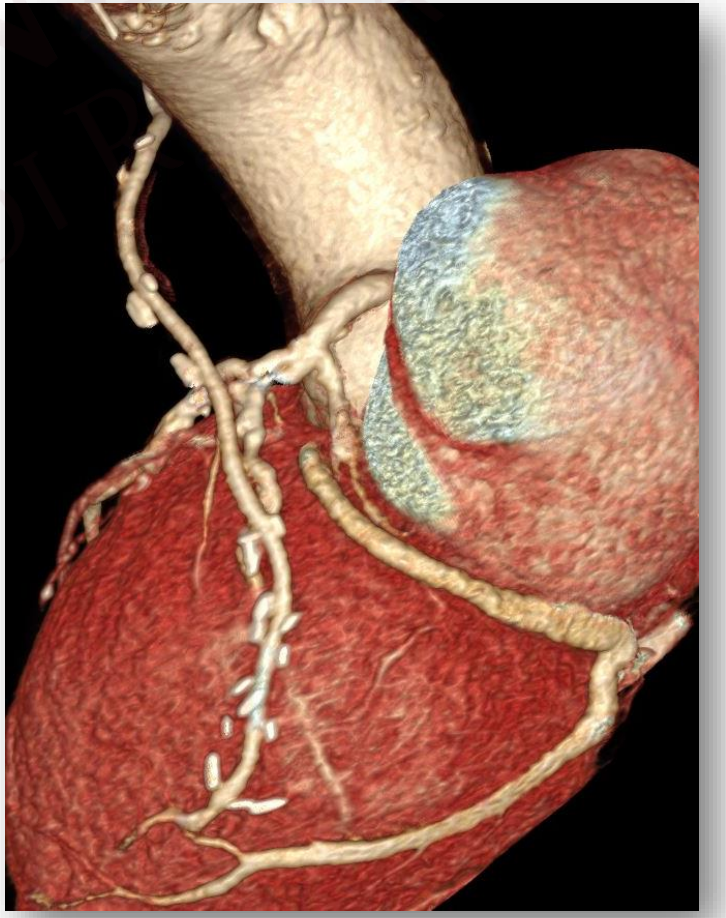
A stenosis bypassed by a fully patent graft is not considered for the CAD-RADS classification.

- E.g.
  - Graft to LAD
  - No significant stenoses in the graft, distal anastomosis and run-off vessel
  - Mild stenosis (25-49%) in the LCX and RCA
  - Severe stenosis (>70%) in proximal LAD

  } **CAD-RADS 2/G**

  - Total occlusion of graft to the RCA
  - Patent graft to LAD
  - Patent graft to LCX

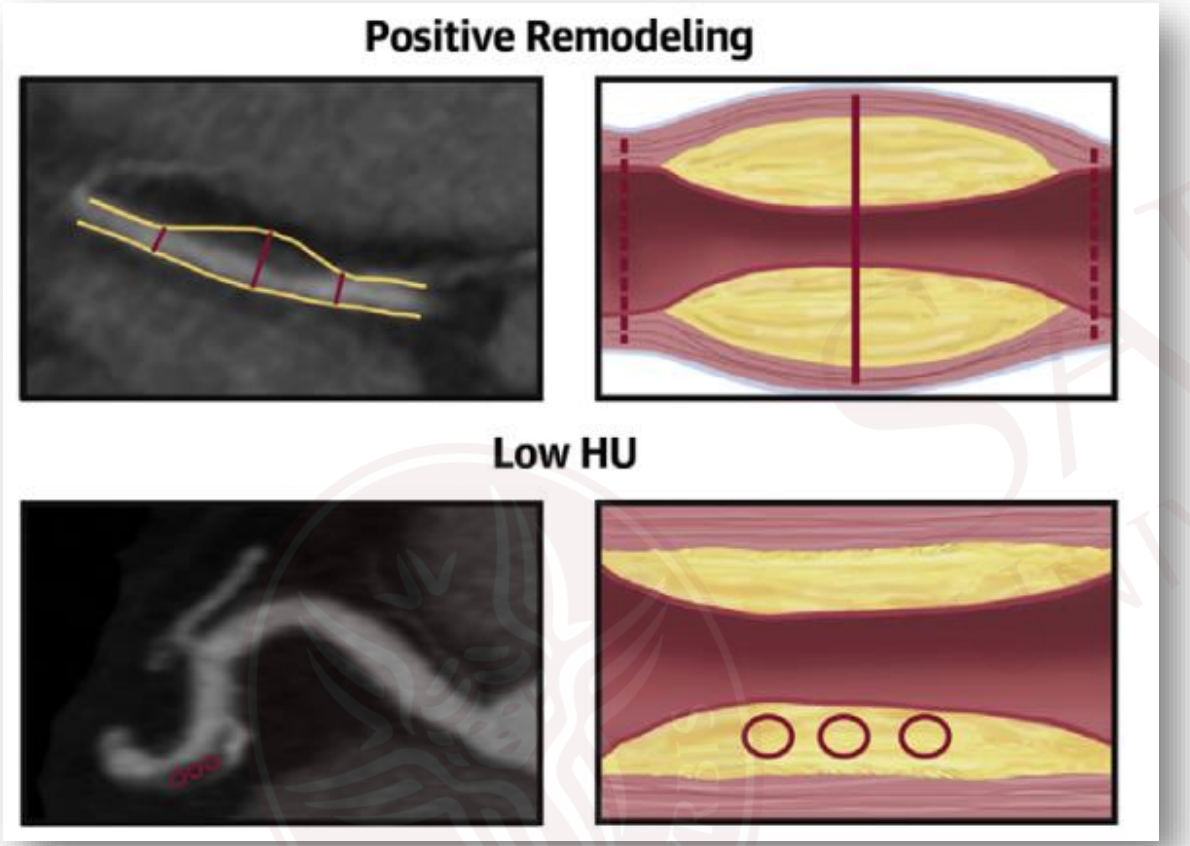
  } **CAD-RADS 5/G**

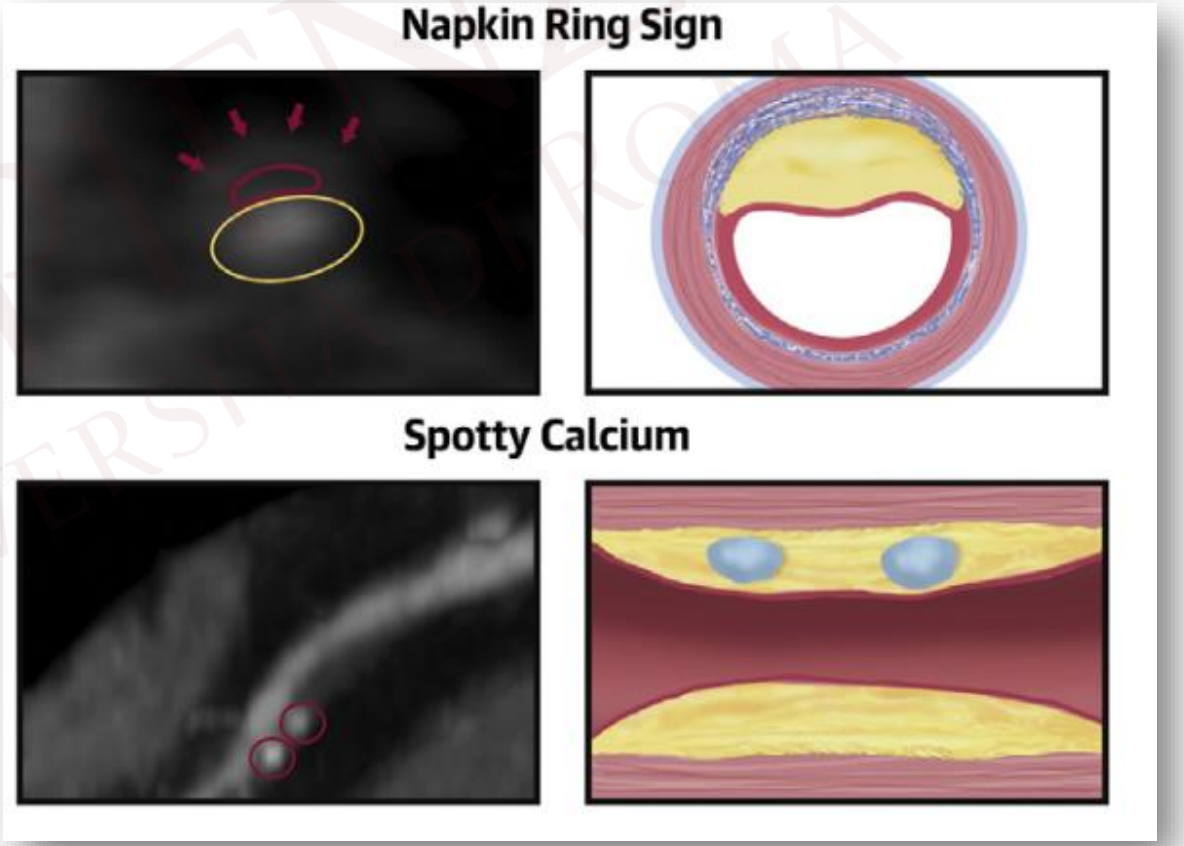


Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

V (VULNERABLE PLAQUE)

“V” indicates the presence of a plaque with 2 or more high-risk features





Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

Puchner SB et al. J Am Coll Cardiol. 2014 Aug 19;64(7):684-92. doi: 10.1016/j.jacc.2014.05.039

V (VULNERABLE PLAQUE)

“V” indicates the presence of a plaque with 2 or more high-risk features

- E.g. CAD RADS 2/V should be used for a patient with stenosis between 25-49% and plaque with two or more high-risk features.
- The features should be described
- There is not enough published data to guide the management of such patients. However, clinical and laboratory correlation and close observation is recommended. Consider hospital admission in high-risk clinical settings.
- If the patient is discharged, short-term clinical follow-up within a week is suggested.

- Studies coded with CAD-RADS 3/V should prompt consideration for more aggressive management than CAD-RADS 3, including consideration of ICA instead of non-invasive functional testing.

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

MORE THAN 1 MODIFIER

Use symbol "/"

Follow this order

e.g.

CAD-RADS 4A/S/G/V

- Pt with a severe stenosis in 1 or 2 vessels
- Pt has at least 1 stent and at least 1 CABG
- Pt has at high-risk plaques

Cury RC et al. JACC Cardiovasc Imaging. 2016 Sep;9(9):1099-1113. doi: 10.1016/j.jcmg.2016.05.005

CAD-RADS 2.0

Radiology: Cardiothoracic Imaging

SPECIAL REPORT

CAD-RADS™ 2.0 – 2022 Coronary Artery Disease – Reporting and Data System An Expert Consensus Document of the Society of Cardiovascular Computed Tomography (SCCT), the American College of Cardiology (ACC), the American College of Radiology (ACR) and the North America Society of Cardiovascular Imaging (NASCI)

Ricardo C. Cury[a] • Jonathon Leipsic[b] • Suhny Abbara[c] • Stephan Achenbach[d] • Daniel Berman[e] • Marcio Bittencourt[f] • Matthew Budoff[g] • Kavitha Chinnaiyan[h] • Andrew D. Choi[i] • Brian Ghoshhajra[j] • Jill Jacobs[k] • Lynne Koweek[l] • John Lesser[m] • Christopher Maroules[n] • Geoffrey D. Rubin[o] • Frank J. Rybicki[p] • Leslee J. Shaw[q] • Michelle C. Williams[r] • Eric Williamson[s] • Charles S. White[t] • Todd C. Villines[u] • Ron Blankstein[v]

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

CAD-RADS 2.0 – WHAT'S NEW?

Table 1: Grading scale for stenosis severity, plaque burden and ischemia.

Degree of luminal diameter stenosis	Terminology
0%	No visible stenosis
1–24%	Minimal stenosis
25–49%	Mild stenosis
50–69%	Moderate stenosis
70–99%	Severe stenosis
100%	Occluded
Grading Scale for plaque burden:	
Terminology	**Overall plaque burden**
P1	Mild amount of plaque
P2	Moderate amount of plaque
P3	Severe amount of plaque
P4	Extensive amount of plaque
Grading scale for Ischemia detection:	
Terminology	**Meaning**
Modifier I	Indicates that CT Ischemia test was performed either with CT-FFR or myocardial CTP
I+	Indicates that CT-FFR or CTP demonstrates lesion-specific ischemia or reversible perfusion defect
I−	Indicates that CT-FFR or CTP is negative for lesion specific ischemia or reversible ischemia[a]
I ±	Indicates that CT-FFR or CTP is borderline

[a] Patients with prior myocardial infarction and fixed perfusion defects without evidence of myocardial ischemia by CTP would be classified as I−. The presence of myocardial infarction should be documented in the impression of the report.

Plaque Burden

Ischemia

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

PLAQUE BURDEN

Table 2: Different methods to categorize the overall amount of coronary plaque.

	Overall amount of coronary plaque	CAC	SIS*	Visual*
P1	Mild	1-100	≤2	1-2 vessels with mild amount of plaque
P2	Moderate	101–300	3–4	1 -2 vessels with moderate amount; 3 vessels with mild amount of plaque
P3	Severe	301–999	5–7	3 vessels with moderate amount; 1 vessel with severe amount of plaque
P4	Extensive	>1000	≥8	2-3 vessels with severe amount of plaque

Note: categories may not always correspond across different scores; if discrepant use CAC = Coronary Artery Calcium or Total plaque burden quantification, if available.
SIS = Segment Involvement Score.
* Please note that CAD-RADS 0 denotes absence of stenosis or plaque, therefore P0 is not required as a classification.
* As there is currently no one single method that should be used to identify the overall amount of plaque, CAD-RADS recommends that imagers select the technique which is considered most appropriate at a given institution.
* see examples in Figures 2 to 6.

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

PLAQUE BURDEN - CaSC

Agatston score

P1	1 - 100
P2	101 - 300
P3	301 - 1000
P4	> 1000

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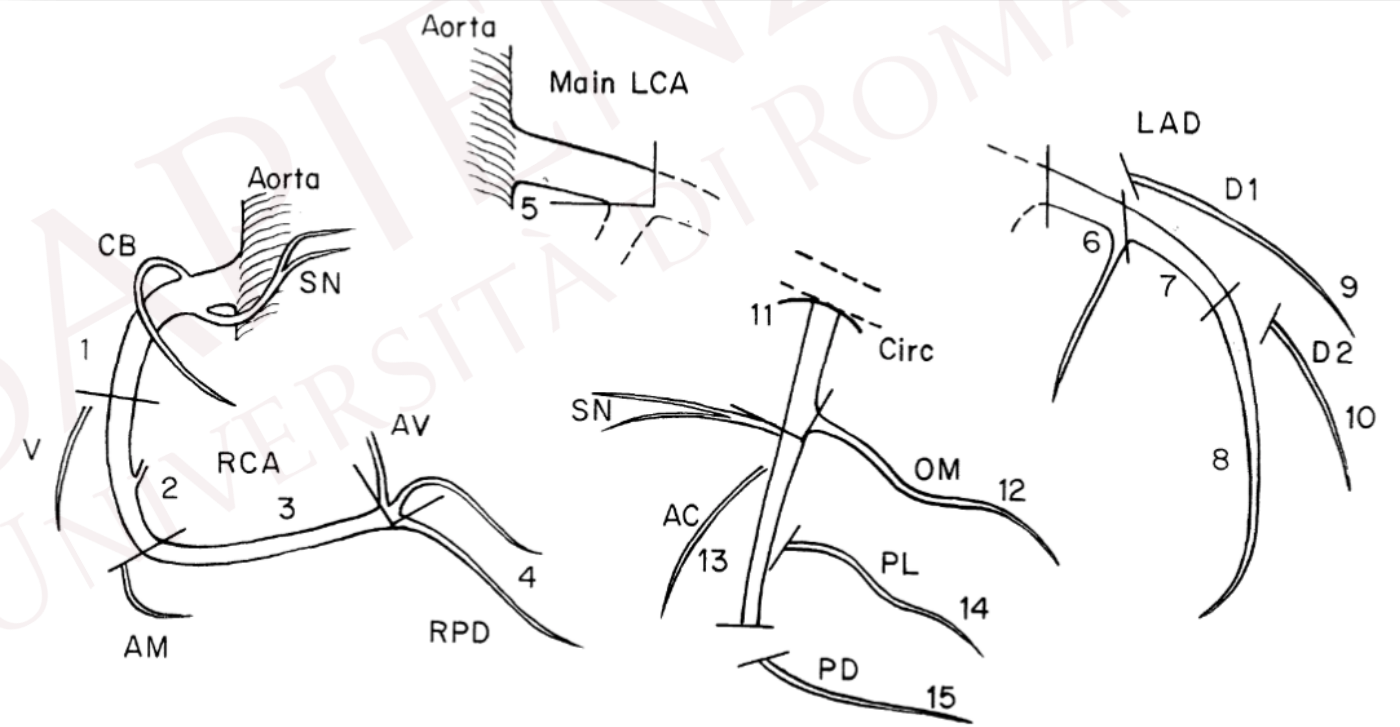
PLAQUE BURDEN - SIS

Segment Involvement Score

- **P1** ≤ 2
- **P2** 3 - 4
- **P3** 5 - 7
- **P4** ≥ 8



Austen WG et al. Circulation. 1975 Apr;51(4 Suppl):5-40. doi: 10.1161/01.cir.51.4.5

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

PLAQUE BURDEN – Visual Estimate

P1
1 – 2 vessels with mild amount of plaque

P2
- 1 – 2 vessels with moderate amount of plaque
- 3 vessels with mild amount of plaque

P3
- 3 vessels with moderate amount of plaque
- 1 vessel with severe amount of plaque

P4
2 -3 vessels with severe amount of plaque

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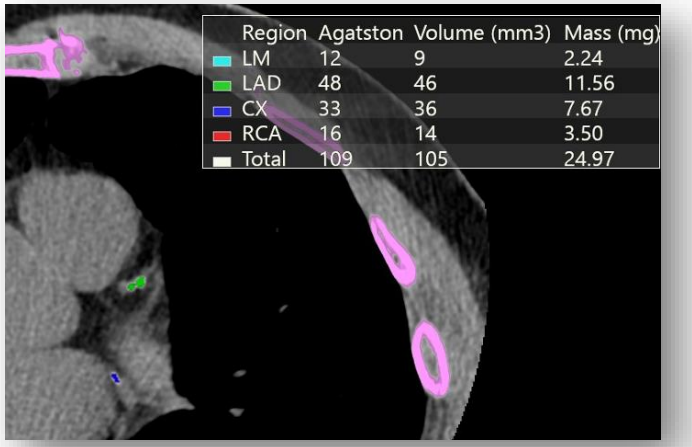
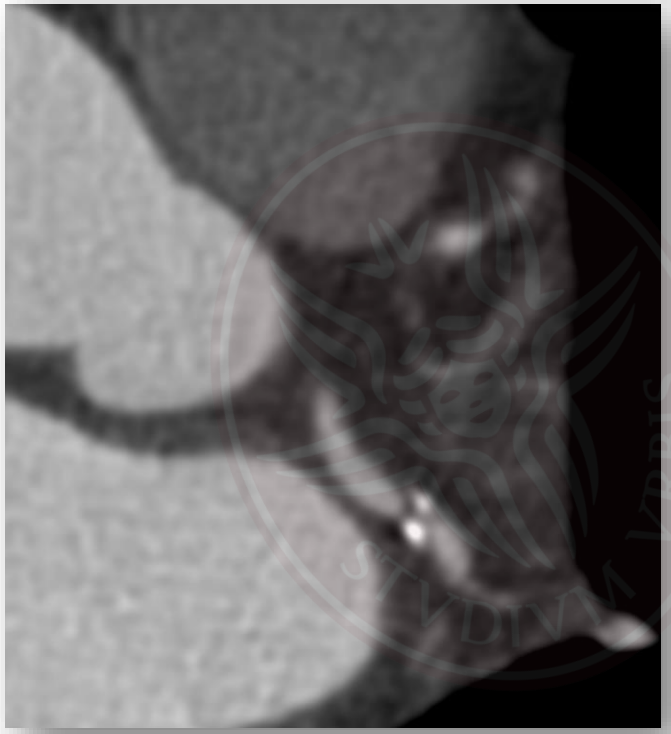
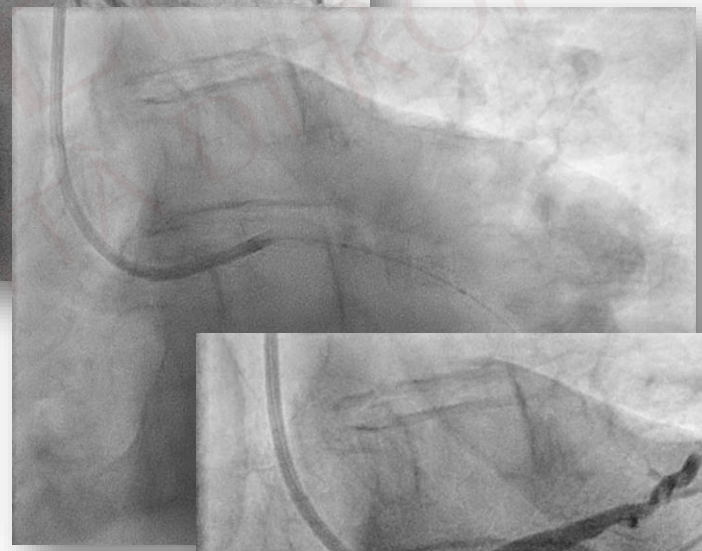
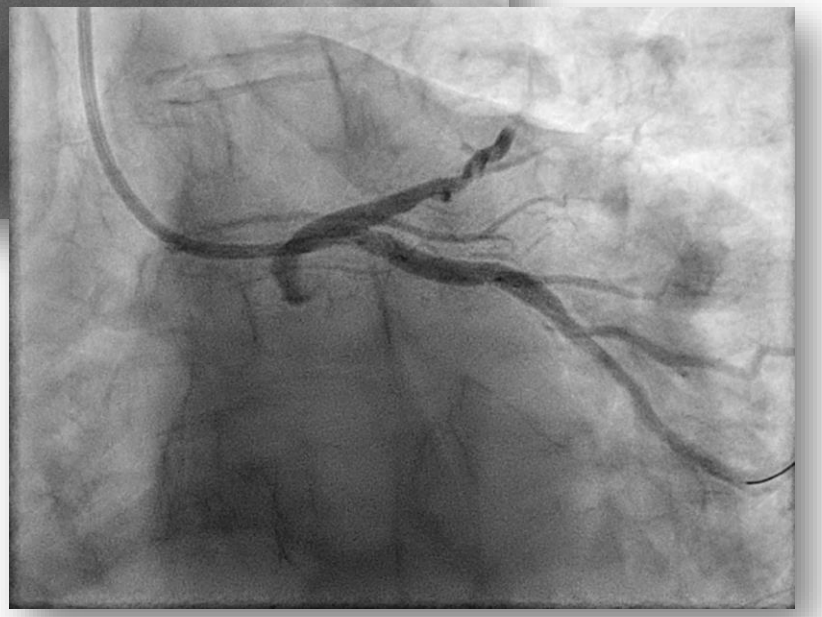
CASE EXAMPLE





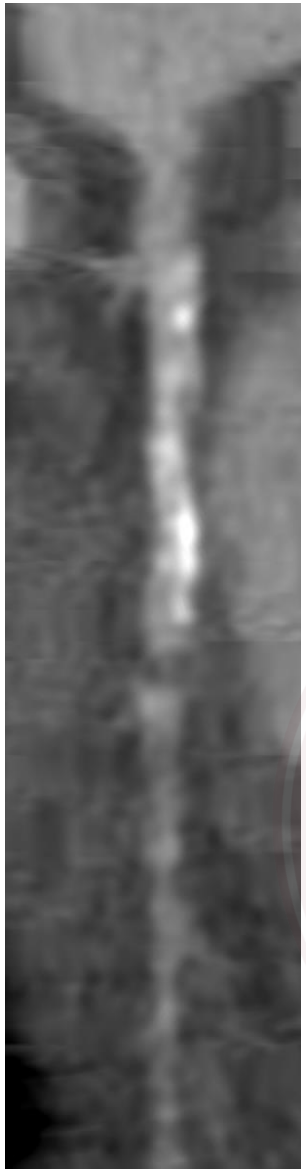


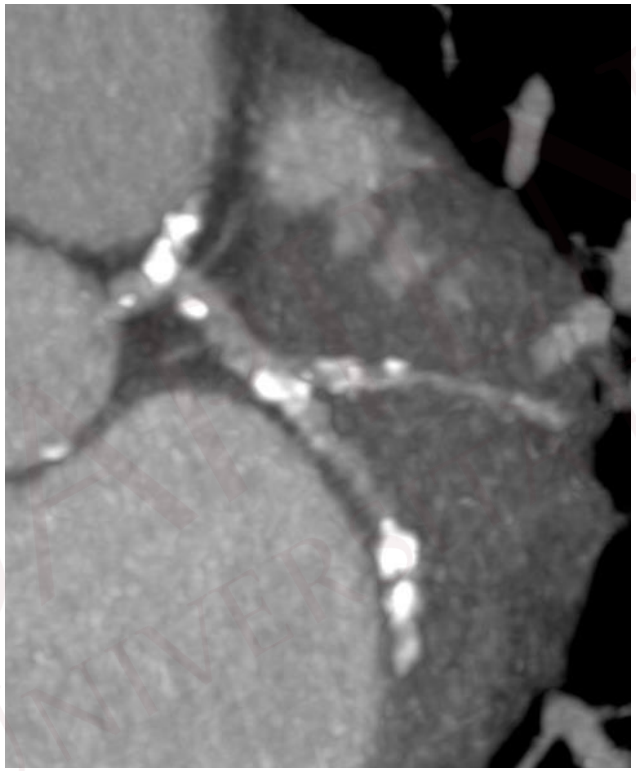


- LCx: stenosis > 70%
- Agaston score: 109

CAD RADS 4/P2

CASE EXAMPLE





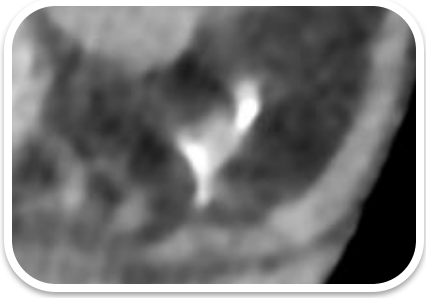
Region	Calcium Score (Agatston)	Volume (mm^3)	Mass (mg)
LM	4	7	1.29
LAD	466	368	121.11
CX	640	553	151.12
RCA	1026	821	297.65
PDA	---	---	---
Other1	---	---	---
Other2	---	---	---
Other3	---	---	---
Total	2136	1749	571.17

Total Calcium Score 2136

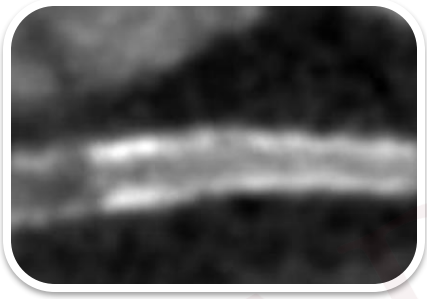
- RCA: occluded
- LCx and LAD: stenosis > 70%
- Agaston score: 2136

CAD RADS 5/P4

MODIFIERS

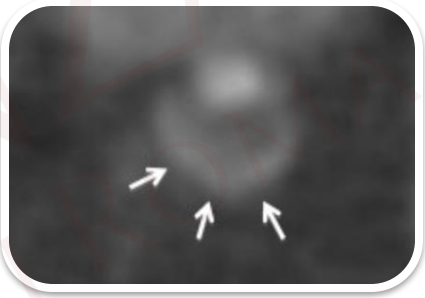


N
(Non-diagnostic)

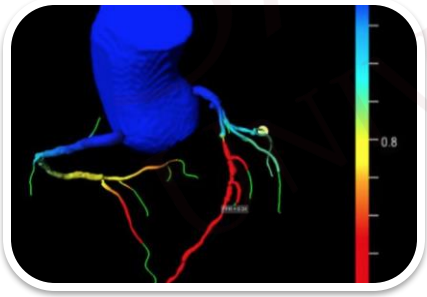


S
(Stent)

G
(Graft)



HRP
(High Risk Plaque)



I
(Ischemia)

E
(Exceptions)

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

CT-FFR and Stress CTP

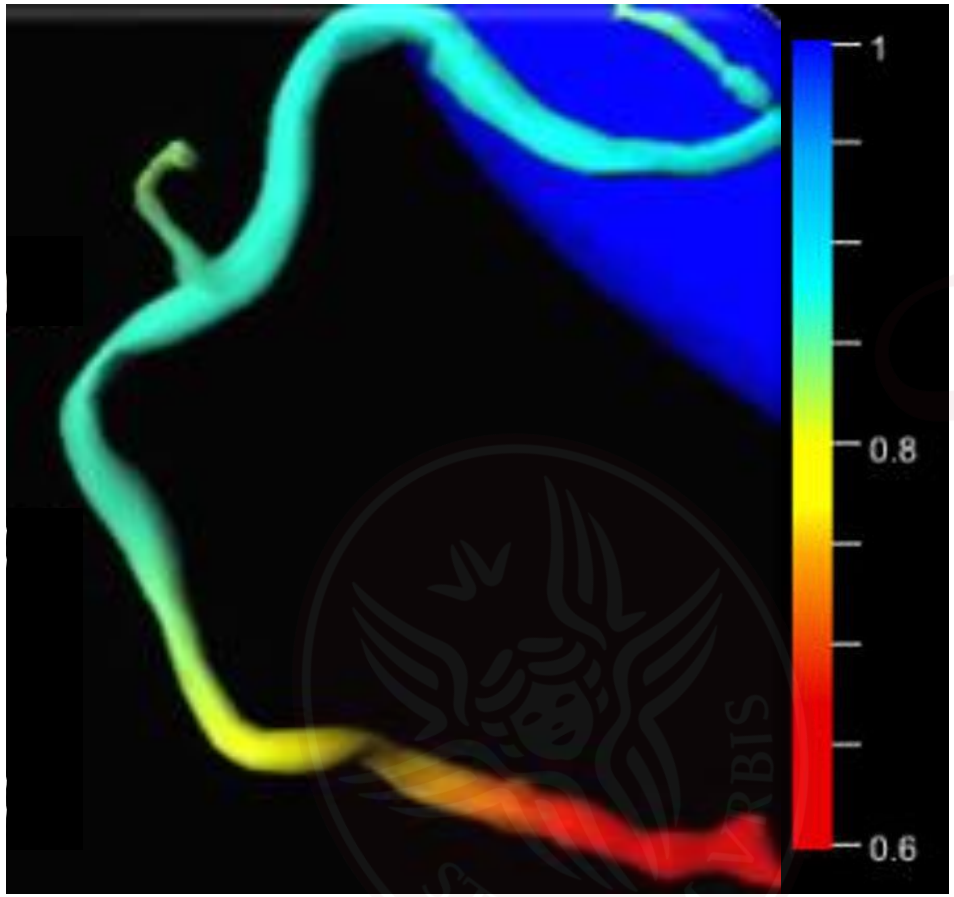
- CT-FFR and Stress CTP may be used in stenosis ranging from 50 to 90% to better define if a stenosis is hemodynamically significant
  - CAD-RADS 3
  - CAD-RADS 4A

- CAD-RADS 2 could be considered if proximal lesion and stenosis ≥ 40%, including HRP features

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

ISCHEMIA

CT-FFR



> 0.80

Normal
(I)

CAD-RADS 3 or 4/I-

Defer invasive angiography and optimize medical therapy

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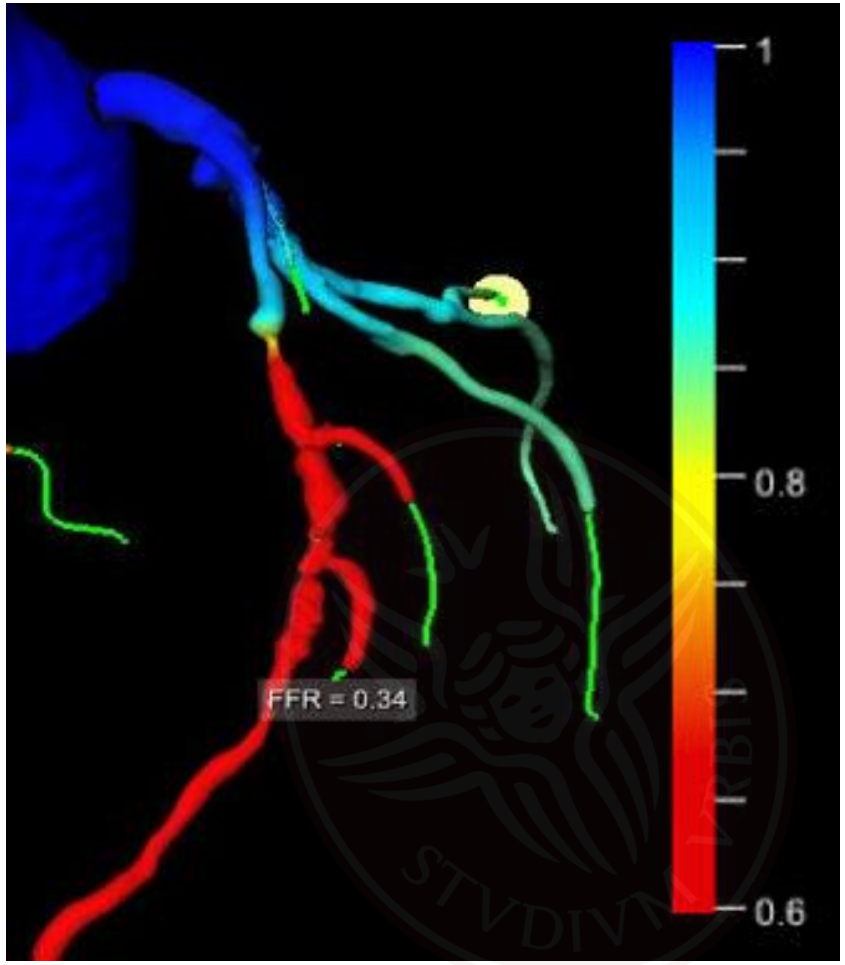
ISCHEMIA

CT-FFR



< 0.75

Abnormal
(I+)

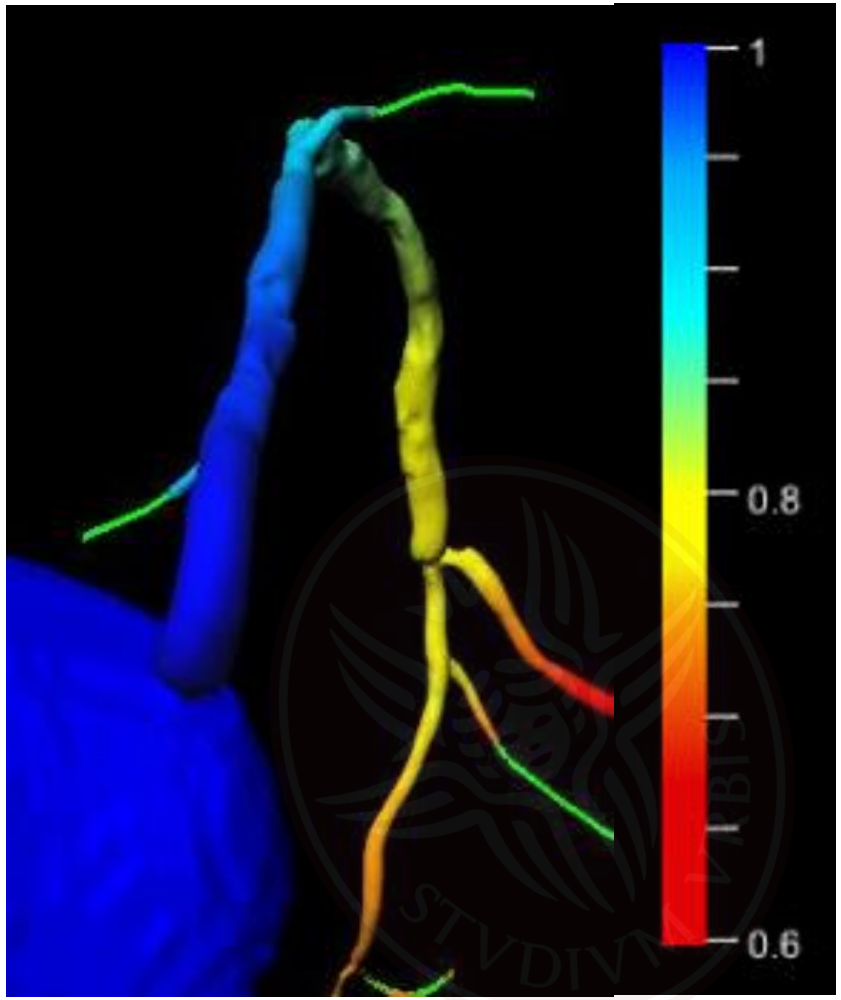
CAD-RADS 3 or 4/I+

Consider ICA for individuals likely to benefit from revascularization

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

ISCHEMIA

CT-FFR



0.76 - 0.80

Borderline
(I±)

CAD-RADS 3 or 4/I±

Consider ICA based on

- Symptoms
- Lesion location
- Trans-lesional pressure loss

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ISCHEMIA

CTP

REST

STRESS

- Myocardial Infarct
- No evidence of ischemia in a defined coronary territory

CAD-RADS 3 or 4/I-

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

ISCHEMIA

CTP

REST

STRESS

- No evidence of ischemia in a defined coronary territory

CAD-RADS 3 or 4/I-

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

ISCHEMIA

CTP

REST

STRESS

- Myocardial ischemia in a defined coronary territory

CAD-RADS 3 or 4/I+

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

ISCHEMIA

CTP

REST

STRESS

- Peri-infarct ischemia in a defined coronary territory

CAD-RADS 3 or 4/I+

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

ISCHEMIA

CTP

REST

STRESS

- Borderline or indeterminate results for myocardial ischemia or discordance between perfusion defect and anatomical finding, with low diagnostic confidence

CAD-RADS 3 or 4/I±

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

EXCEPTIONS

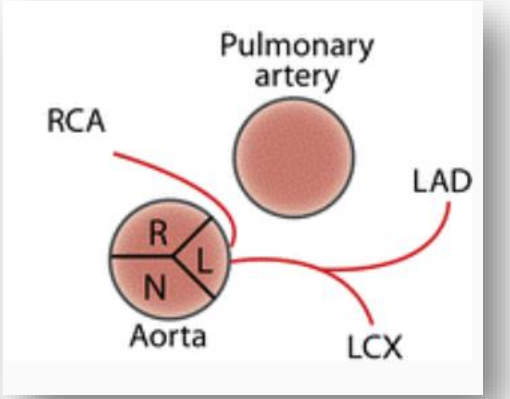
Modifier “E” accounts for any non-atherosclerotic narrowing of the coronary arteries

Table 3: Examples of non-atherosclerotic causes of coronary abnormalities to be included in Modifier “E” = Exceptions. Please note that this is not a comprehensive list.

Coronary dissection
Anomalous origin of the coronary arteries
Coronary artery aneurysm or pseudoaneurysm
Vasculitis
Coronary artery fistula
Extrinsic coronary artery compression
Arterio-venous malformation
Other causes

Category P is not used if there is no plaque

E.g. Anomalous origin of RCA with inter-arterial course and consequent moderate stenosis due to compression, no plaque, and CT-FFR 0.72



CAD-RADS 4A/I+/E

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MORE THAN 1 MODIFIER

Use symbol "/"

Follow this order

e.g.

CAD-RADS 3/P3/HRP/S

- Presence of a stent
- Pt with a moderate stenosis
- Severe amount of plaque burden and high-risk plaque features

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CAD-RADS 2.0

Differences with 1st CAD-RADS version

	2016 CAD-RADS	2022 CAD-RADS
Stenosis grading	CAD-RADS 0, 1, 2, 3, 4A, 4B and 5	No change
Plaque burden grading	No systematic classification	New CAD-RADS category grading scale for Plaque Burden ranging from P1 to P4
Modifiers	Four modifiers were introduced to complement the CAD-RADS classification First: modifier N (non-diagnostic) Second: modifier S (stent) Third: modifier G (graft) Fourth: modifier V (vulnerability)	Addition of two new modifiers: modifier I (ischemia) and modifier E (exceptions) and replacement of modifier V (vulnerable) with HRP (high-risk plaque) First: modifier N (non-diagnostic) Second: modifier HRP (replaces V) Third: modifier I+ (ischemia), I- and I ± Fourth: modifier S (stent) Fifth: modifier G (graft) Sixth: modifier E (exceptions)

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

Suggested Recommendations in Patients with Stable Chest Pain

Stenosis	Plaque	Suggested Recommendation for Report
CAD RADS 0	N/A	Reassurance. Consider non-atherosclerotic causes of symptoms.
CAD RADS 1 or CAD RADS 2	P1	Consider non-atherosclerotic causes of symptoms Consider risk factor modification and preventive pharmacotherapy
	P2	Consider non-atherosclerotic causes of symptoms. Risk factor modification and preventive pharmacotherapy.
	P3 or P4	Consider non-atherosclerotic causes of symptoms. Aggressive risk factor modification and preventive pharmacotherapy.
CAD RADS 3	P1/P2/P3/P4	Consider CT-FFR, CTP or stress testing Aggressive risk factor modification and preventive pharmacotherapy. Other treatments (including anti-anginal therapy) should be considered per guideline directed care
	If I+	Consider ICA, especially if frequent symptoms persist after guideline-directed medical therapy
CAD RADS 4	P1/P2/P3/P4	Consider ICA[a] or functional[b] assessment Aggressive risk factor modification and preventive pharmacotherapy. Other treatments (including anti-anginal therapy and options of revascularization) should be considered per guideline directed care
CAD RADS 5	P1/P2/P3/P4	Consider ICA[a], functional[b], and/or viability assessment Aggressive risk factor modification and preventive pharmacotherapy. Other treatments (including anti-anginal therapy and options of revascularization) should be considered per guideline directed care

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

Suggested Recommendations in Patients with Acute Chest Pain

Stenosis	Plaque	Suggested Recommendation for Report
CAD RADS 0	N/A	Reassurance. No further evaluation of ACS is required. If Tn (+) consider other sources of increased troponin
CAD RADS 1	P1 or P2	No further evaluation of ACS is required. If Tn (+) consider other sources of increased troponin Referral for outpatient follow-up for risk factor modification and preventive pharmacotherapy.
CAD RADS 1	P3 or P4	No further evaluation of ACS is required. If Tn (+) consider other sources of increased troponin Referral for outpatient follow-up for aggressive risk factor modification and preventive pharmaco-therapy.
CAD RADS 2	P1 or P2	If clinical suspicion of ACS is high, Tn (+) or high risk plaque (HRP) features, consider hospital admission with cardiology consultation. If Tn (+) consider other sources of increased troponin Referral for outpatient follow-up for risk factor modification and preventive pharmacotherapy
CAD RADS 2	P3 or P4	If clinical suspicion of ACS is high, Tn (+) or high risk plaque (HRP) features, consider hospital admission with cardiology consultation. If Tn (+) consider other sources of increased troponin. Referral for outpatient follow-up for aggressive risk factor modification and preventive pharmaco-therapy.
CAD RADS 3	P1/P2/P3/P4 If I+	Consider hospital admission with cardiology consultation. Consider CT-FFR, CTP or stress testing Preventive management, including aggressive preventive pharmacotherapy. Other treatments (including anti-anginal therapy) should be considered per guideline directed care. Consider ICA
CAD RADS 4A	P1/P2/P3/P4	Hospital admission with cardiology consultation. Consider ICA[a] or functional assessment[b] Preventive management, including aggressive preventive pharmacotherapy. Other treatments (including anti-anginal therapy and options of revascularization) should be considered per guideline directed care
CAD RADS 4B	P1/P2/P3/P4	Hospital admission with cardiology consultation. ICA is recommended. Preventive management, including aggressive preventive pharmacotherapy. Other treatments (including anti-anginal therapy and options of revascularization) should be considered per guideline directed care
CAD RADS 5	P1/P2/P3/P4	Hospital admission with cardiology consultation. Expedited ICA and revascularization if suspected acute occlusion. Preventive management, including aggressive preventive pharmacotherapy. Other treatments (including anti-anginal therapy and options of revascularization) should be considered per guideline directed care.

Cury RC et al. Radiol Cardiothorac Imaging. 2022 Sep 22;4(5):e220183. doi: 10.1148/ryct.220183

SISTEMA SANITARIO REGIONALE
AZIENDA OSPEDALIERO-UNIVERSITARIA SANT'ANDREA

Cardio-TC/RM WEBINAR FAD

Dal 16 maggio 2024 all'11 Luglio 2024

PROGRAMMA

16 Maggio – ore 17.00/18.00
Introduzione al Corso (A. Laghi)
Saluti Direzione Generale AOUSA (D. Donetti)
Tecnica di acquisizione della Cardio TC/Utilizzo del Mdc e Triple-rule-out (D. Caruso)

23 Maggio – ore 17.00/18.00
Anatomia coronarica (L. Pugliese)

30 Maggio – ore 17.00/18.00
Caratteristiche di placca: calcifica, non calcifica, vulnerabile (D. De Santis)

6 Giugno – ore 17.00/18.00
La definizione della stenosi secondo CAD-RADS v.2 (D. De Santis)

13 Giugno – ore 17.00/18.00
Indicazione alla Cardio RM, protocollo di acquisizione e sequenze principali (D. De Santis)

27 Giugno – ore 17.00/18.00
Patologia infiammatoria (miocarditi, pericarditi) (D. De Santis)

4 Luglio – ore 17.00/18.00
Cardiopatia ischemica (L. Pugliese)

11 Luglio – ore 17.00/18.00
Cardiomiopatie (ipertrofica, dilatativa, aritmogena) e patologie da Accumulo (L. Pugliese)

SAPIENZA UNIVERSITÀ DI ROMA

Il **Corso Webinar CardioTC** e **CardioRM** del Sant'Andrea 2024 è un corso di Cardio TC (Tomografia Computerizzata) e Cardio RM (Risonanza Magnetica) progettato per fornire ai discenti una comprensione approfondita delle due principali tecniche di imaging cardiaco utilizzate nella pratica clinica moderna.
Questo corso mira a fornire una panoramica completa dei principi di base, delle applicazioni cliniche e delle sfide associate all'uso della TC e della RM nel contesto della valutazione cardiaca. Il corso inizia con una discussione delle tecniche di acquisizione della Cardio TC, compreso l'uso dei mezzi di contrasto e i protocolli come il "Triple-rule- out". I discenti impareranno a interpretare le immagini TC per valutare l'anatomia coronarica, identificare caratteristiche delle placche aterosclerotiche e definire stenosi coronariche secondo il sistema CAD-RADS.
Successivamente, il focus si sposta sulla Cardio RM, esplorando le indicazioni per questo tipo di imaging, i protocolli di acquisizione e le sequenze principali utilizzate per valutare la struttura e la funzione cardiaca per diagnosticare patologie cardiache, tra cui infiammazioni miocardiche, cardiomiopatie e malattie da accumulo.

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Segreteria Scientifica
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U.O.C. di Radiologia
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GE HealthCare

SISTEMA SANITARIO REGIONALE
AZIENDA OSPEDALIERO-UNIVERSITARIA SANT'ANDREA

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