SISTEMA SANITARIO REGIONALE
AZIENDA OSPEDALIERO-UNIVERSITARIA SANT'ANDREA

Cardio-TC/RM WEBINAR FAD

Dal 16 maggio 2024 all'11 Luglio 2024

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.

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)

PROVIDER: StudioProgress ID: 652
N° IDENTIFICATIVO AGENAS: ID 412471

Segreteria Organizzativa e Provider 652
StudioProgress snc Via Cattaneo 51
25121 Brescia Tel: 030/290326 – Fax: 030/2809839
info@studioprogress.it – www.studioprogress.it
fad.studioprogress.it

Segreteria Scientifica
Prof. Andrea Laghi – Dott. Damiano Caruso
U.O.C. di Radiologia
AOU Sant'Andrea Sapienza Università di Roma

GE HealthCare

SISTEMA SANITARIO REGIONALE
AZIENDA OSPEDALIERO-UNIVERSITARIA SANT'ANDREA

Caratteristiche di Placca:

calcifica, non calcifica, vulnerabile

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

DOVE ERAVAMO RIMASTI…

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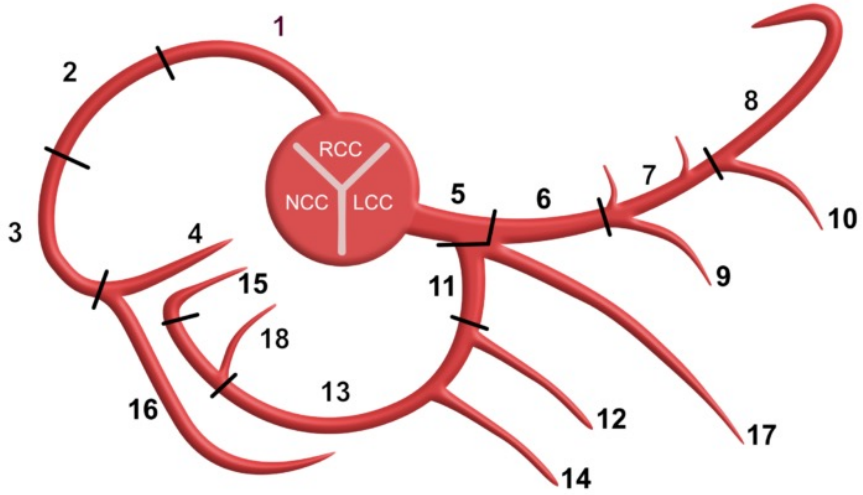
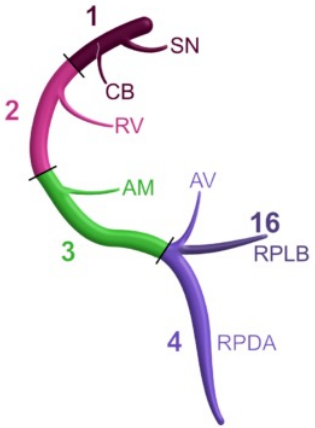
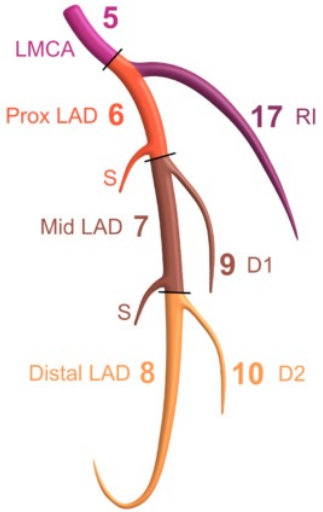
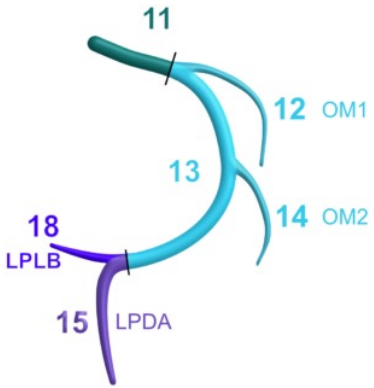
CORONARY ARTERIES ANATOMY

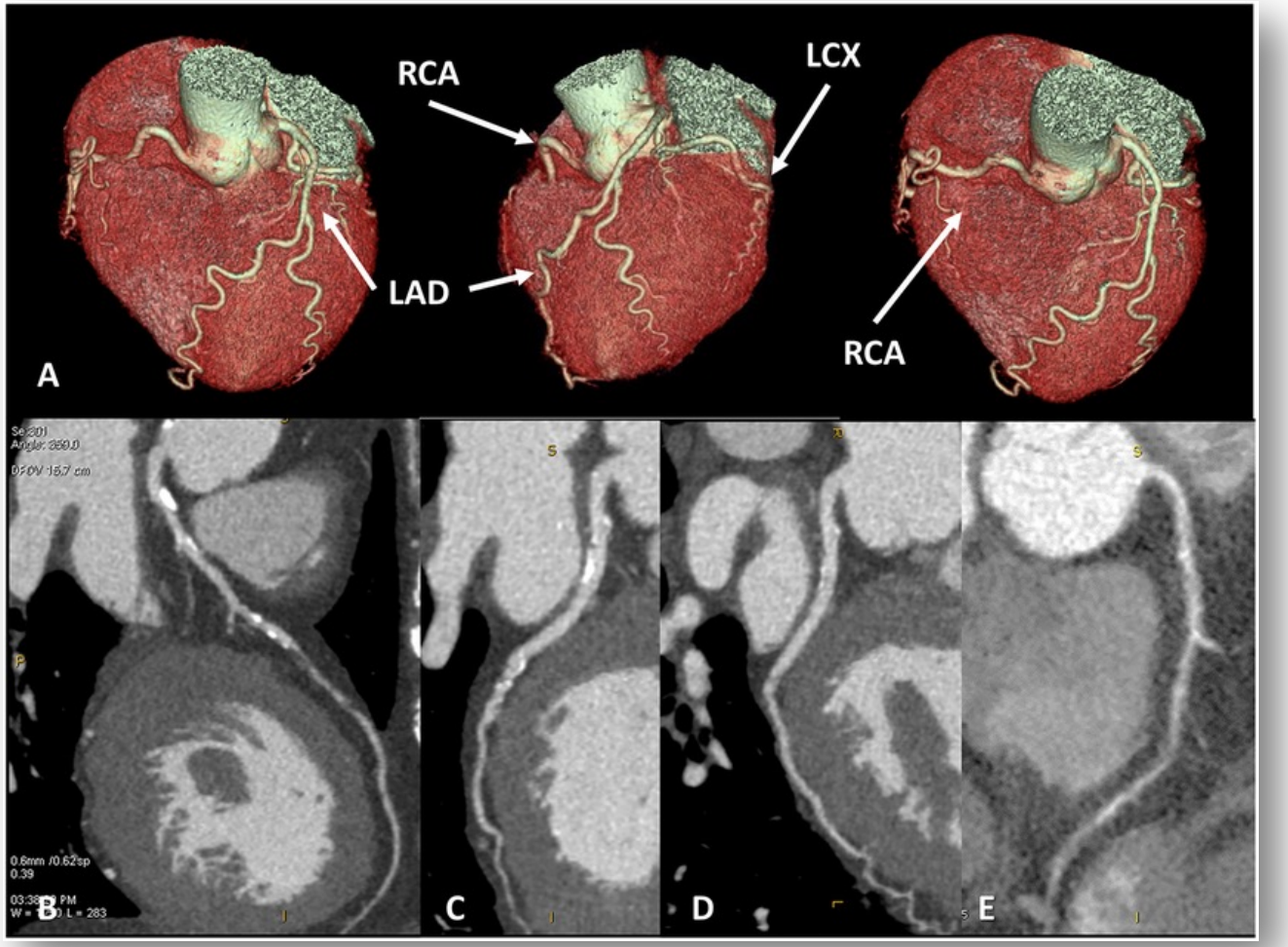
SISTEMA SANITARIO REGIONALE
AZIENDA OSPEDALIERO-UNIVERSITARIA
SANT'ANDREA





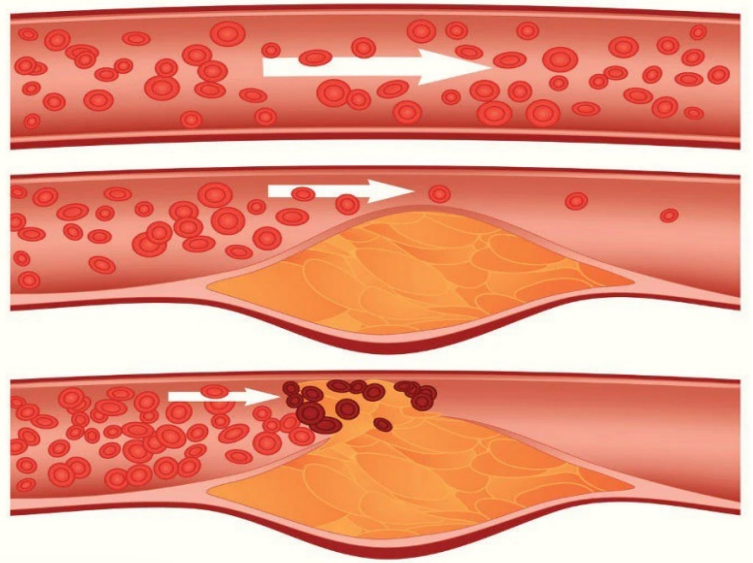


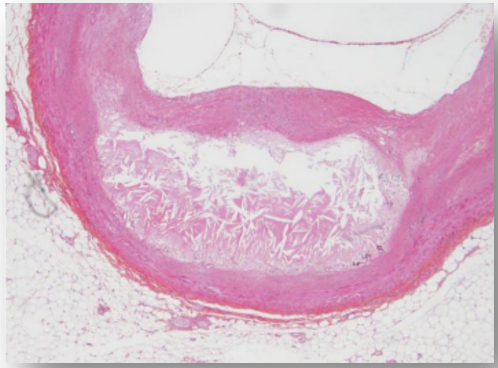




ATHEROSCLEROSIS

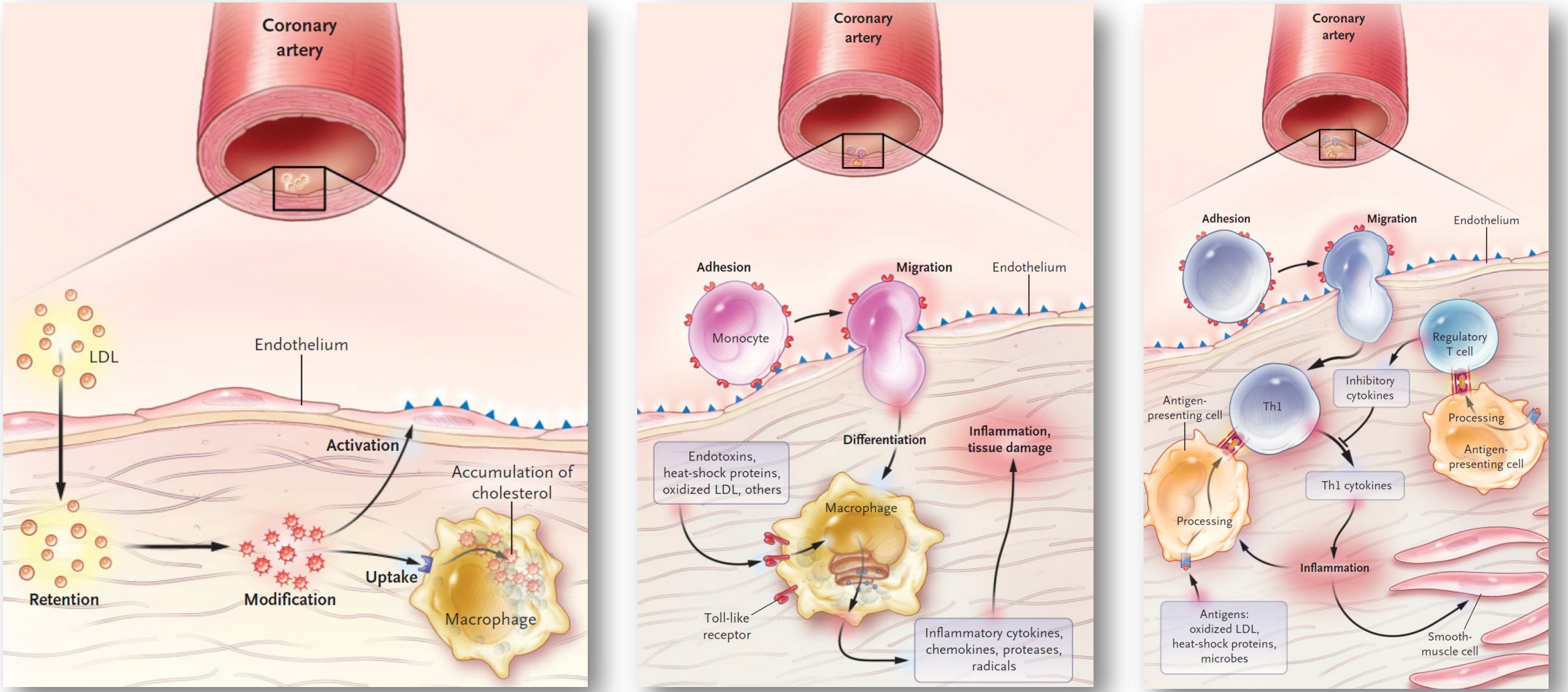
- Chronic inflammatory disease of the arteries
- 17.9 million people are estimated to die of CVD (32% of all deaths)
- multifactorial etiology:
  - HLD, HTN, DM, smoke, age, male gender, strong family history
  - sedentary lifestyle, obesity, diets high in saturated and trans-fatty acids
  - certain genetic mutations contribute to risk.





- Pahwa R, Jialal I. Atherosclerosis. [Updated 2023 Aug 8]. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK507799/
- Fan J, Watanabe T. Atherosclerosis: Known and unknown. Pathol Int. 2022 Mar;72(3):151-160. doi: 10.1111/pin.13202
- ttps://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1

ROLE OF INFLAMMATION



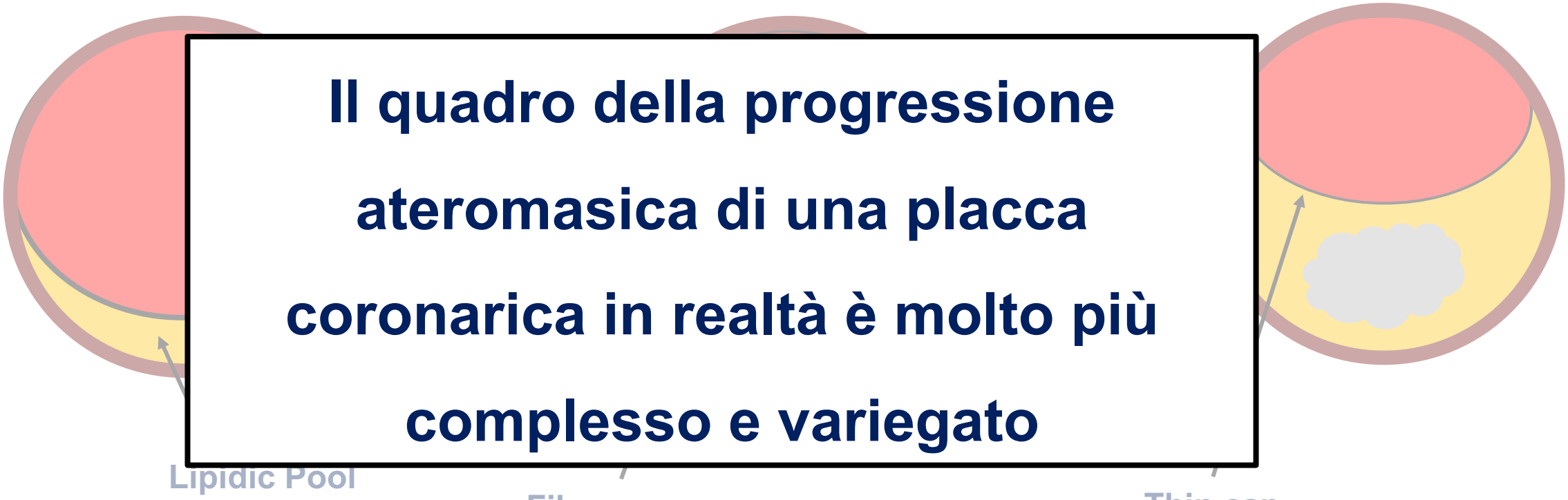
Hansson GK. Inflammation, atherosclerosis, and coronary artery disease. N Engl J Med. 2005 Apr 21;352(16):1685-95. doi: 10.1056/NEJMra043430

CORONARY PLAQUE ANATOMY

Intimal thinckening

Fibrous cap ateroma

Thin cap ateroma

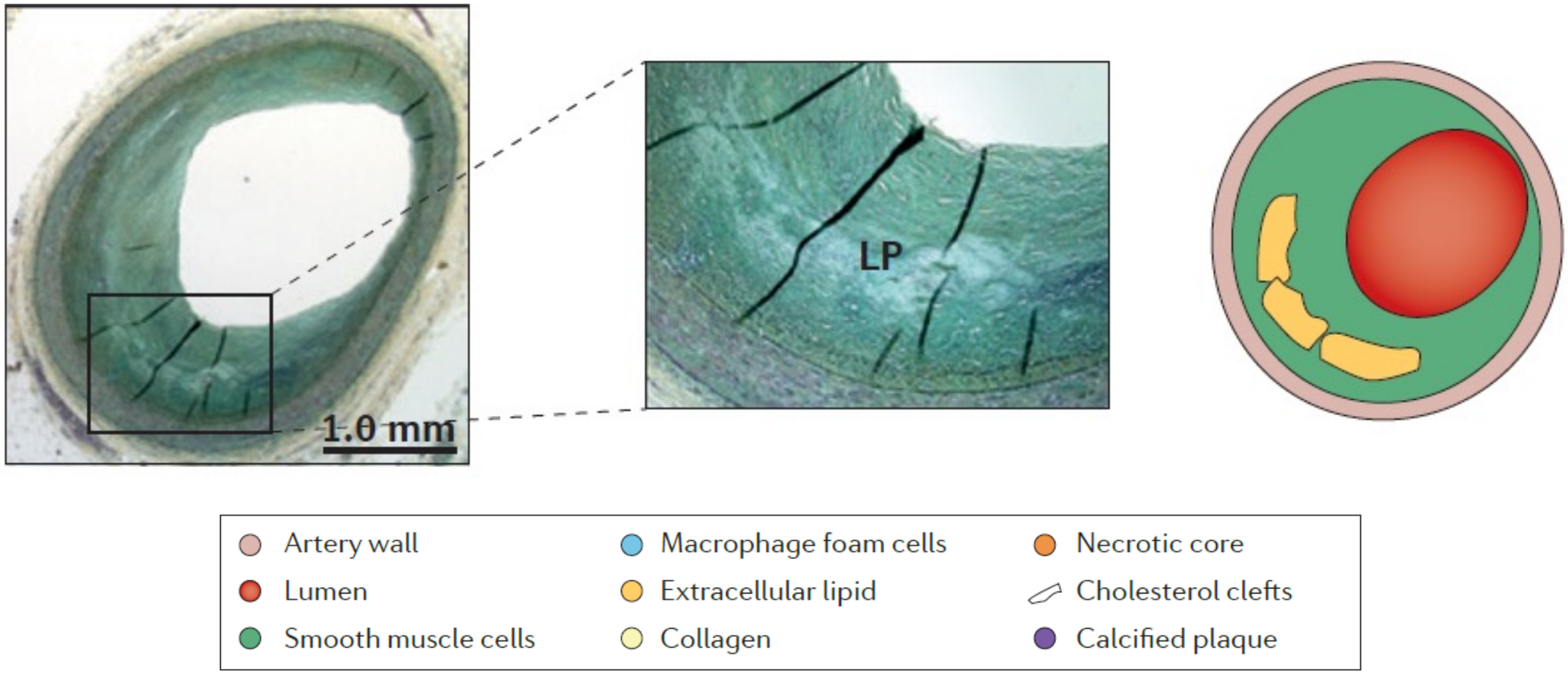


Il quadro della progressione ateromasica di una placca coronarica in realtà è molto più complesso e variegato

Elevato rischio di rottura

PROGRESSION OF ATHEROSCLEROSIS

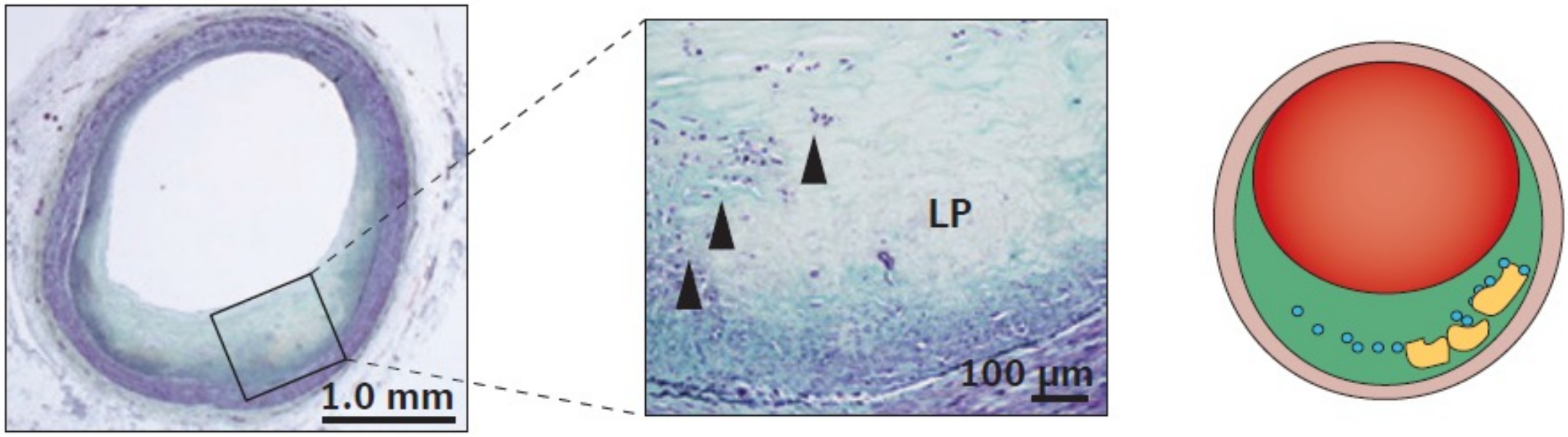
Pathological Intimal Thickening Without Macrophage Infiltration



Yahagi K et al. Nat Rev Cardiol. 2016 Feb;13(2):79-98. doi: 10.1038/nrcardio.2015.164

PROGRESSION OF ATHEROSCLEROSIS

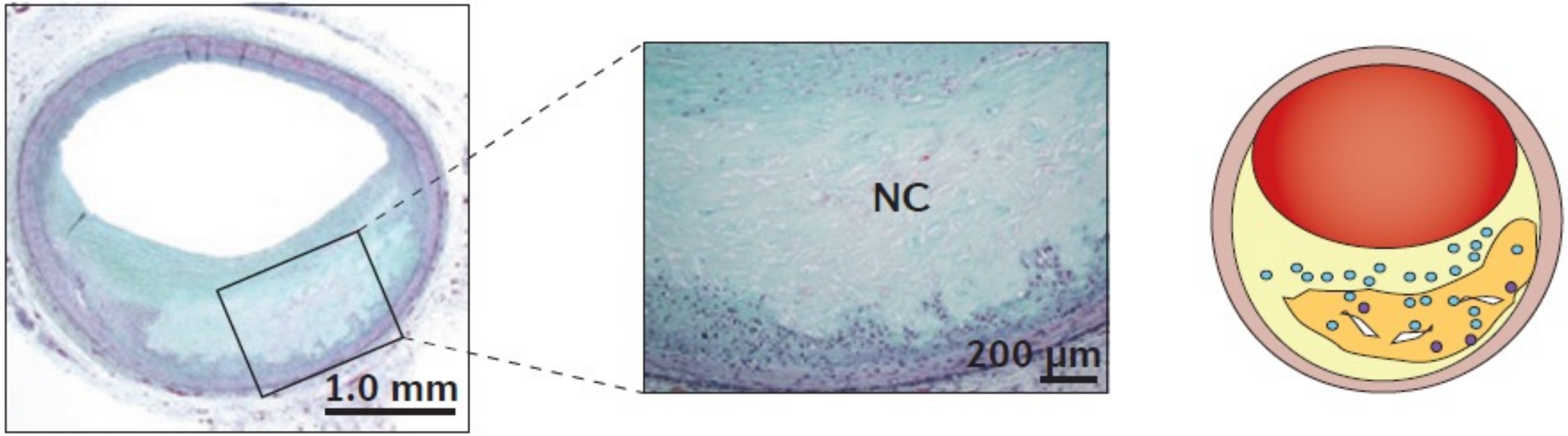
Pathological Intimal Thickening With Macrophage Infiltration



Yahagi K et al. Nat Rev Cardiol. 2016 Feb;13(2):79-98. doi: 10.1038/nrcardio.2015.164

PROGRESSION OF ATHEROSCLEROSIS

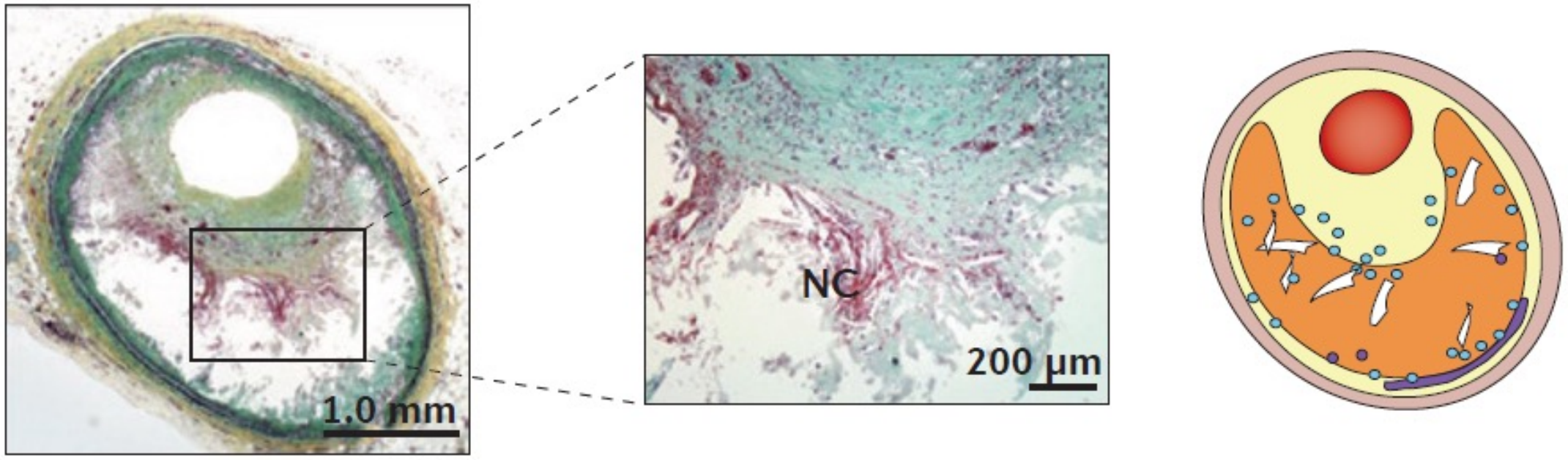
Early Fibroatheroma



Yahagi K et al. Nat Rev Cardiol. 2016 Feb;13(2):79-98. doi: 10.1038/nrcardio.2015.164

PROGRESSION OF ATHEROSCLEROSIS

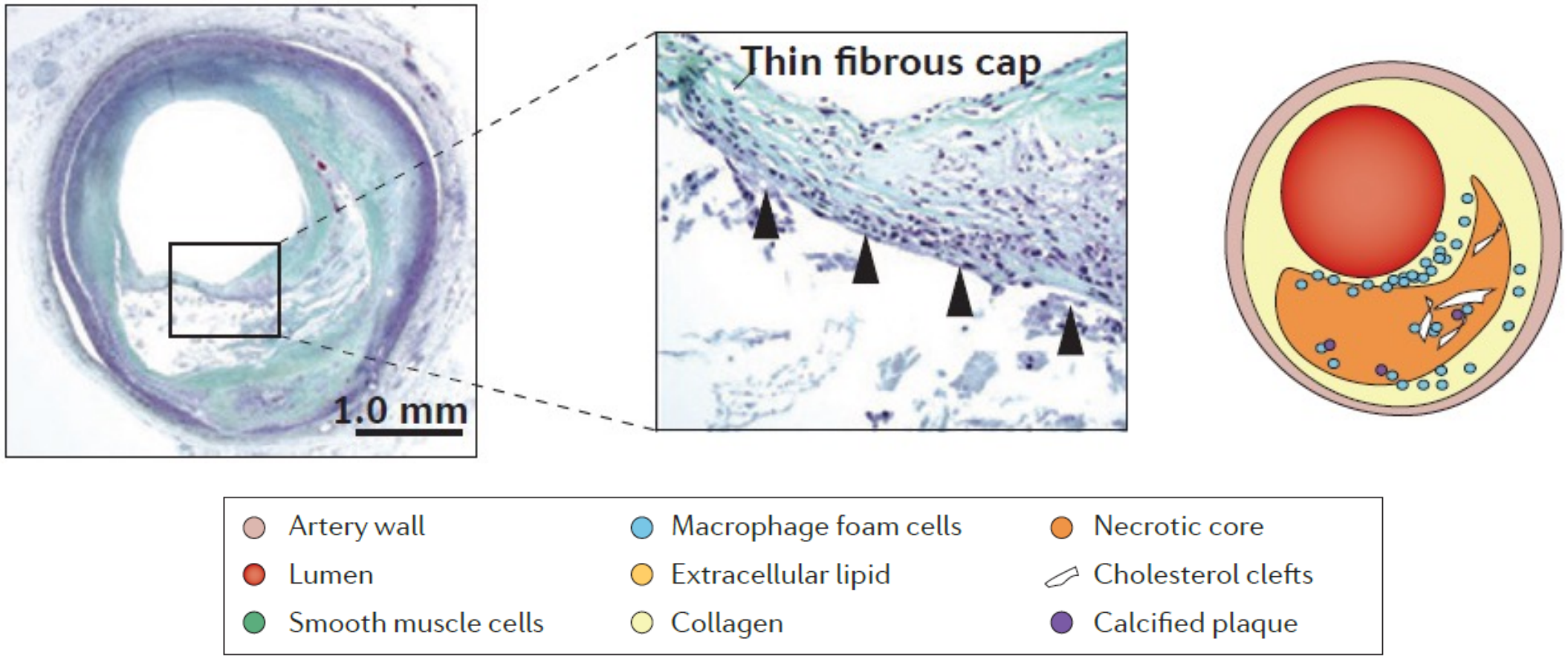
Late Fibroatheroma



Yahagi K et al. Nat Rev Cardiol. 2016 Feb;13(2):79-98. doi: 10.1038/nrcardio.2015.164

PROGRESSION OF ATHEROSCLEROSIS

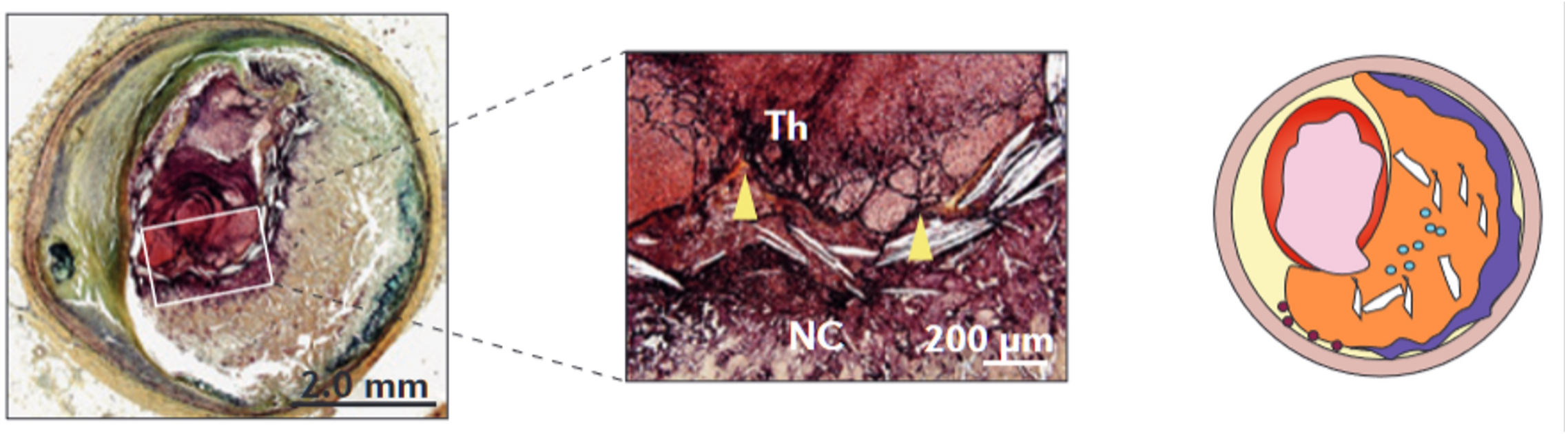
Thin Cap Fibroatheroma



Yahagi K et al. Nat Rev Cardiol. 2016 Feb;13(2):79-98. doi: 10.1038/nrcardio.2015.164

LESIONS WITH ACUTE THROMBI

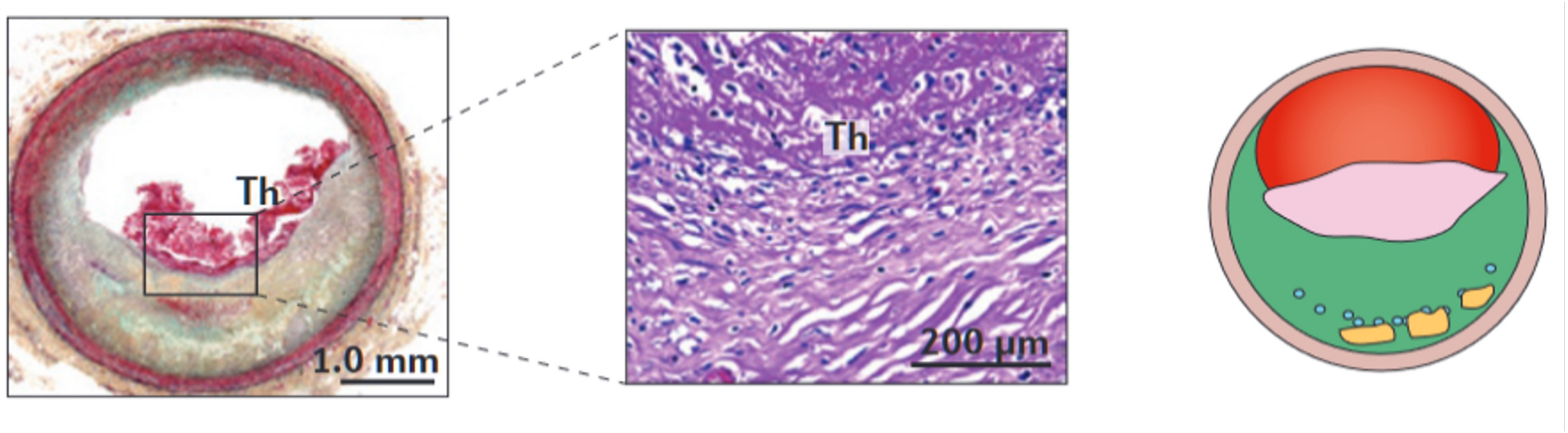
Plaque Rupture



Yahagi K et al. Nat Rev Cardiol. 2016 Feb;13(2):79-98. doi: 10.1038/nrcardio.2015.164

LESIONS WITH ACUTE THROMBI

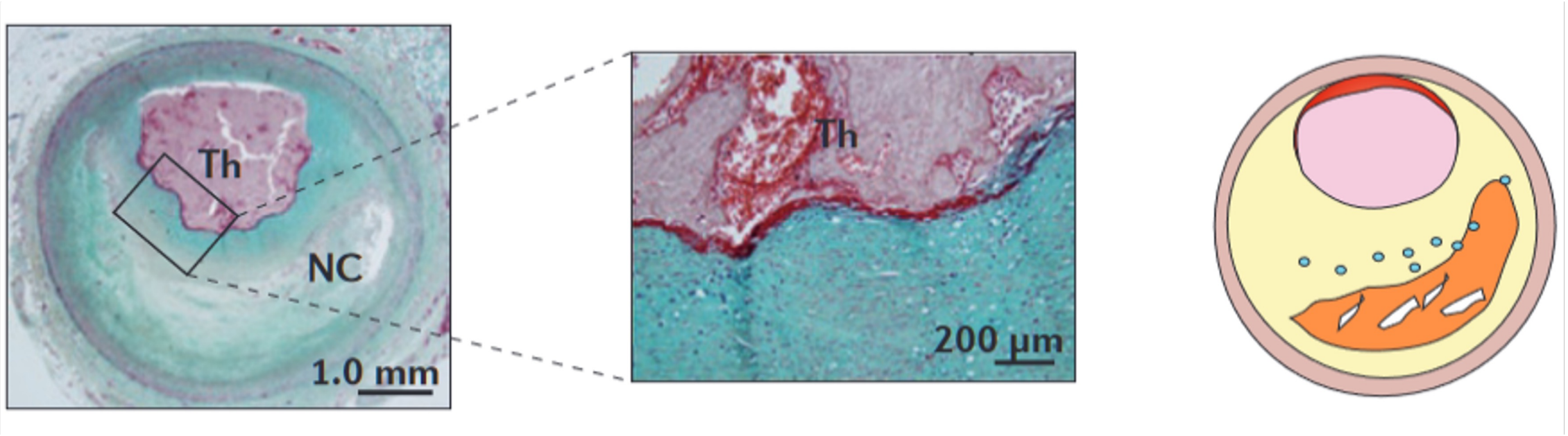
Plaque Erosion With Underlying Pathological Intimal Thickening



Yahagi K et al. Nat Rev Cardiol. 2016 Feb;13(2):79-98. doi: 10.1038/nrcardio.2015.164

LESIONS WITH ACUTE THROMBI

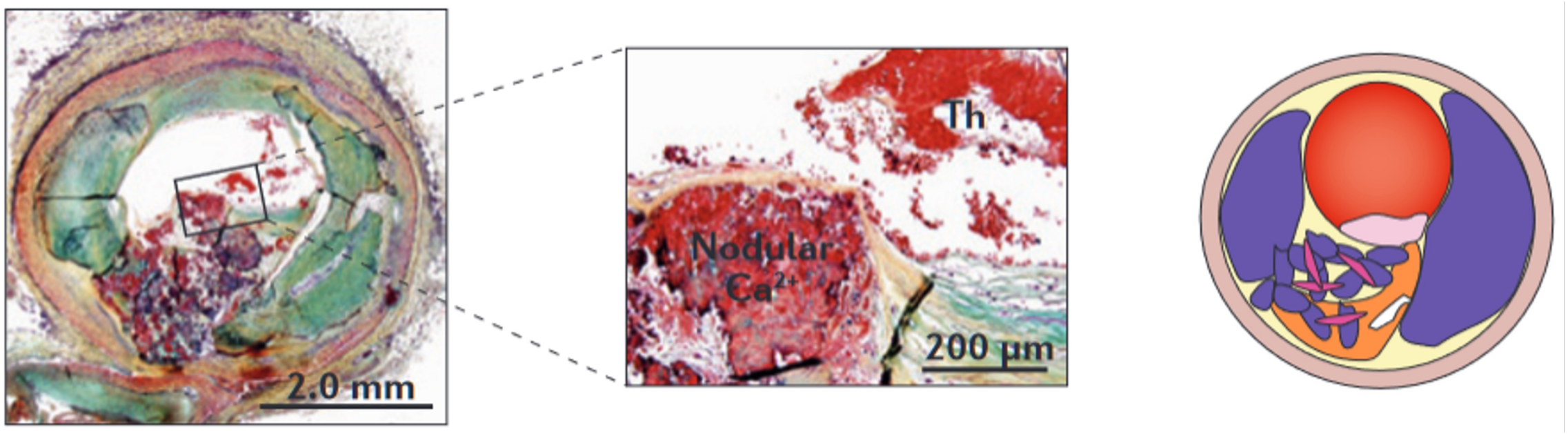
Plaque Erosion With Underlying Fibroatheroma



Yahagi K et al. Nat Rev Cardiol. 2016 Feb;13(2):79-98. doi: 10.1038/nrcardio.2015.164

LESIONS WITH ACUTE THROMBI

Calcified Nodule



Yahagi K et al. Nat Rev Cardiol. 2016 Feb;13(2):79-98. doi: 10.1038/nrcardio.2015.164

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TYPES OF PLAQUES

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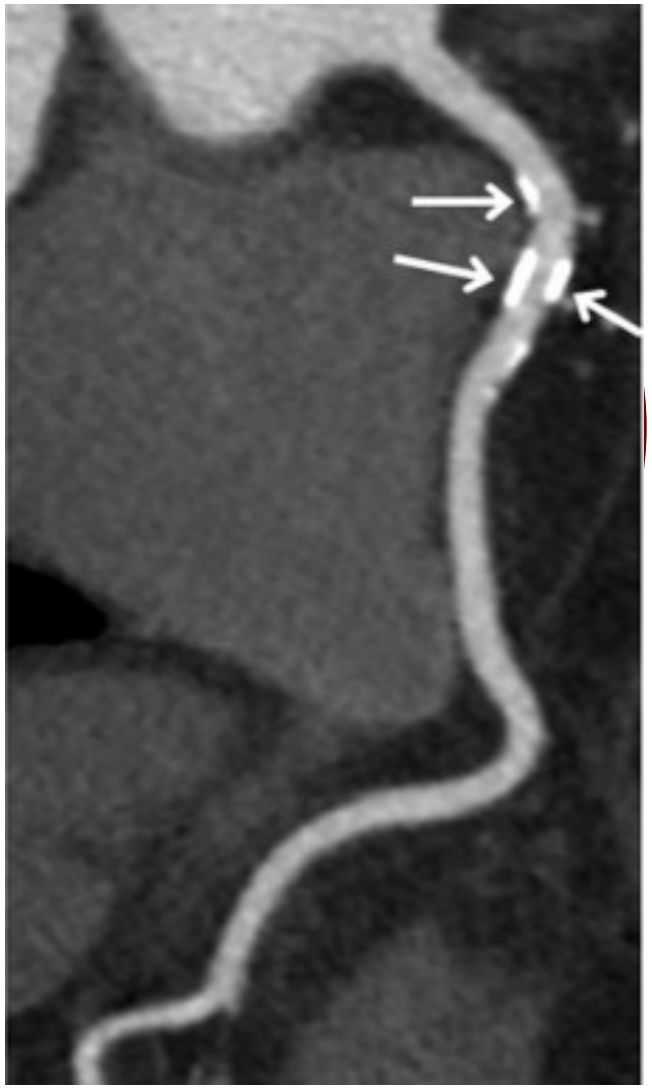
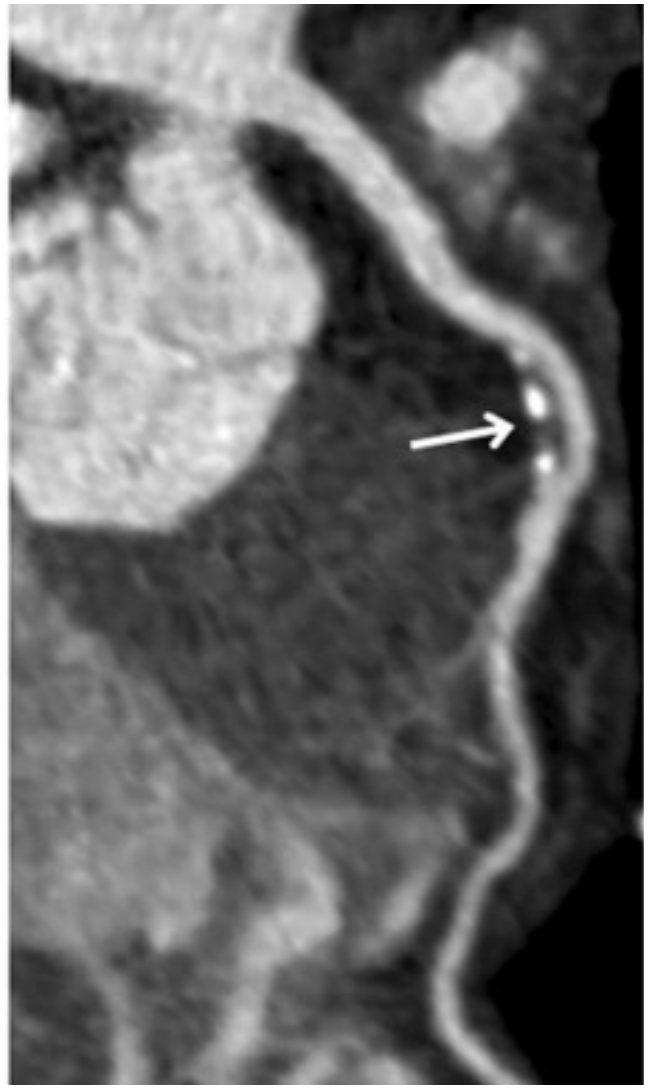
SANT'ANDREA

CALCIFIED

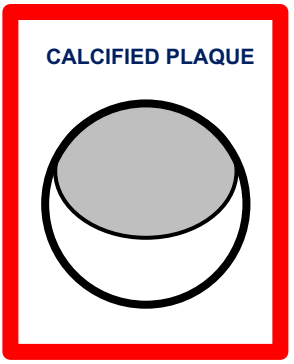


SOFT

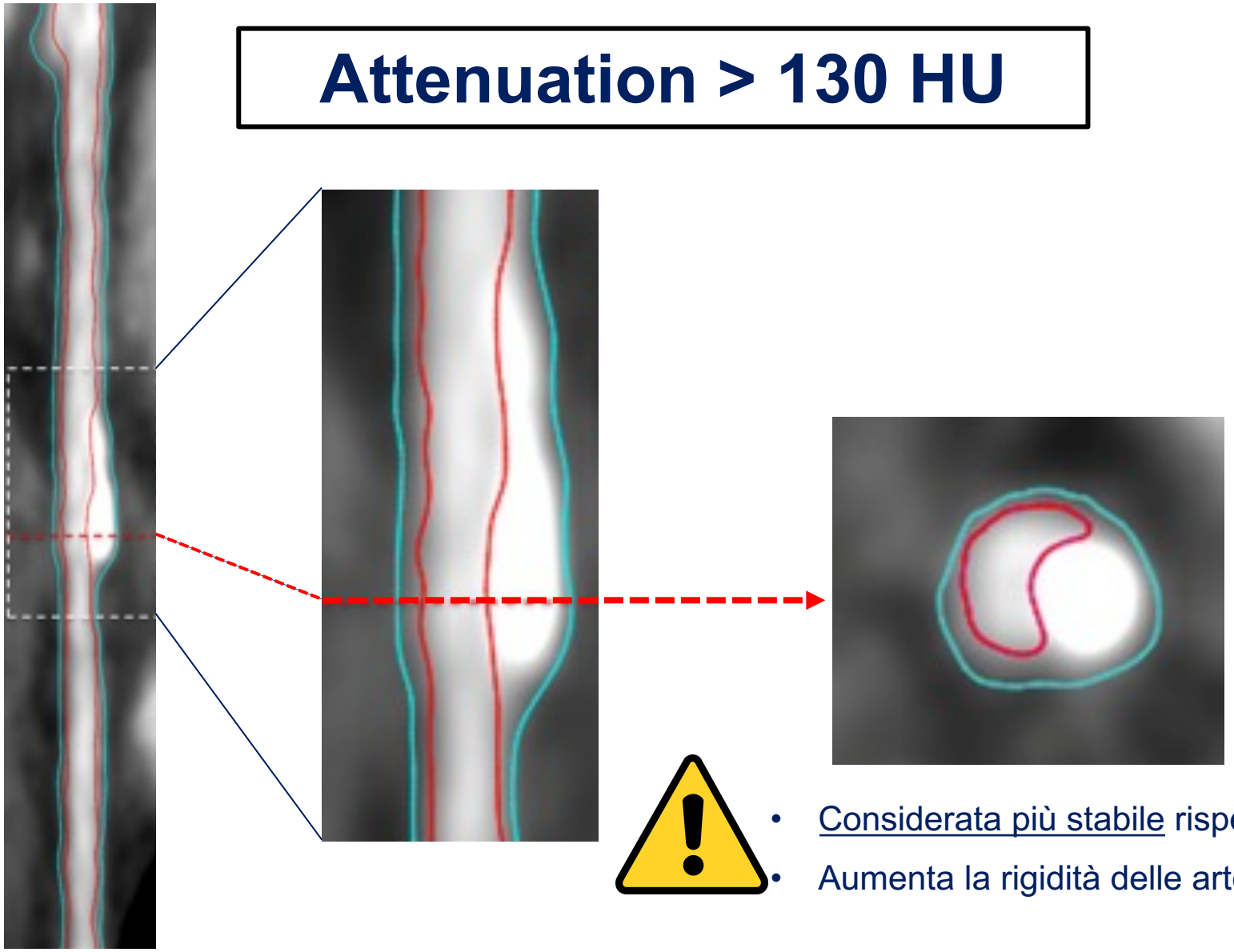
MIXED



CALCIFIED PLAQUE



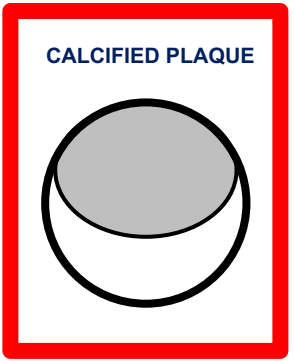
Attenuation > 130 HU



- Considerata più stabile rispetto alle placche non calcifiche
- Aumenta la rigidità delle arterie

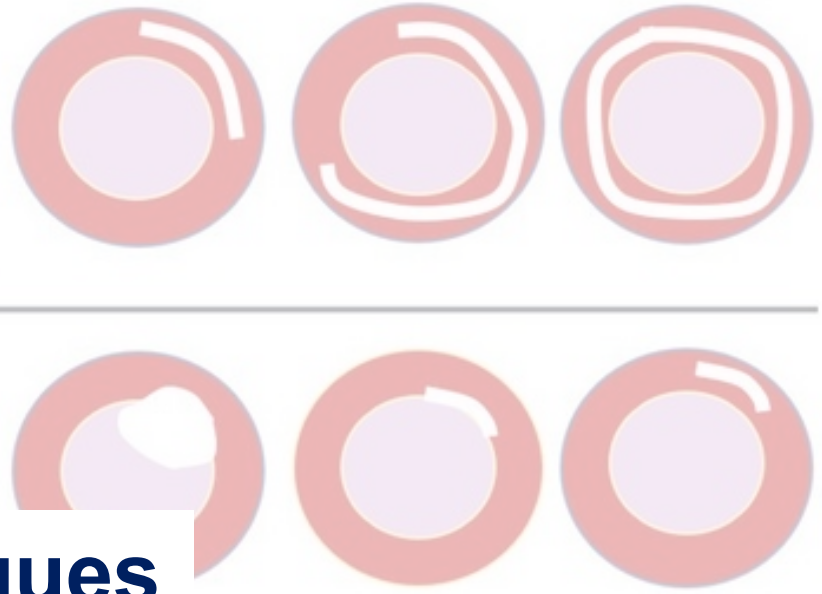
van Popele NM et al. Stroke. 2001 Feb;32(2):454-60. doi: 10.1161/01.str.32.2.454

CALCIFIED PLAQUE



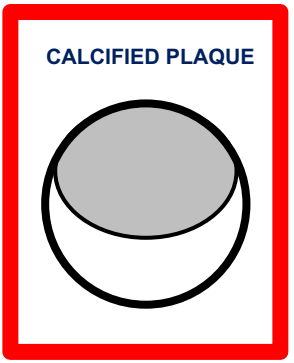
Characteristics of Calcified Plaques

Eccentricity	Calcific Arc (degrees or quadrants)	Eccentric Calcium Concentric Calcium Calcium Ring (360°)
Depth	Distance from Lumen Profile	Protruding (“nodule”) Superficial
Thickness	Max Calcium Thickness	Thin Thick
Length	Longitudinal Extension	Focal Long

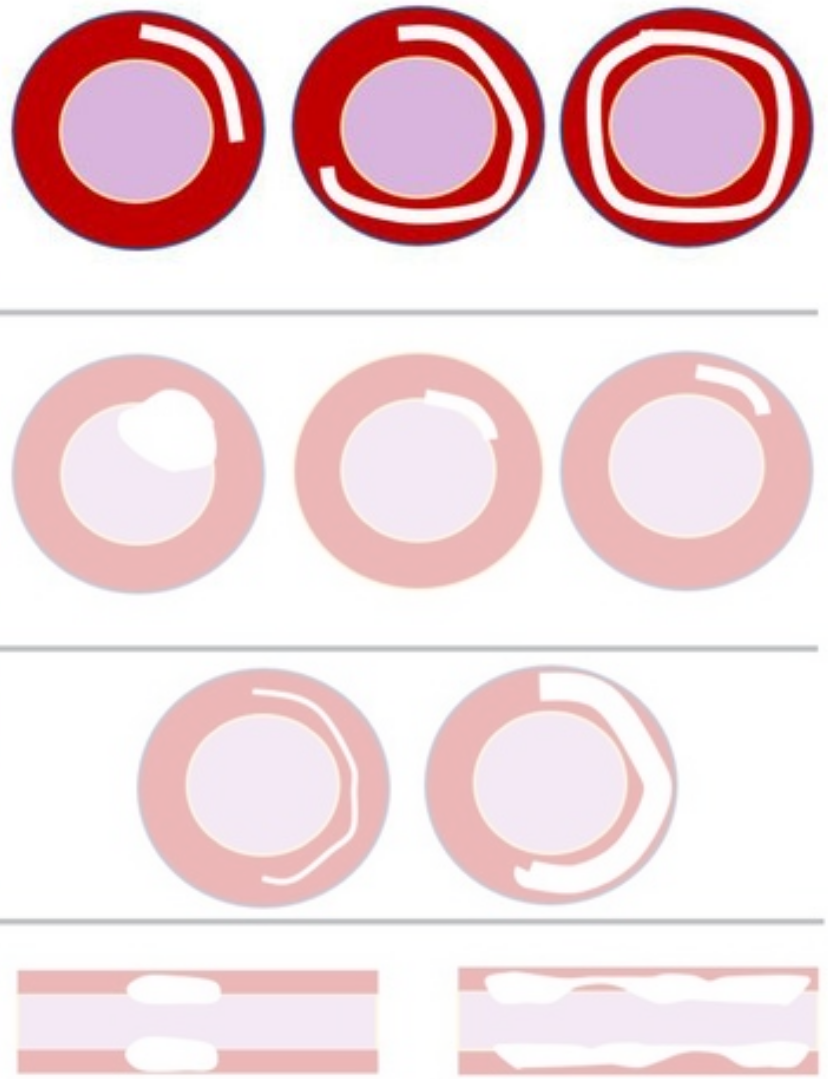


Wopperer SB et al. Front Cardiovasc Med. 2023 Apr 6;10:1133510. doi: 10.3389/fcvm.2023.1133510

CALCIFIED PLAQUE



Eccentricity	Calcific Arc (degrees or quadrants)	Eccentric Calcium Concentric Calcium Calcium Ring (360°)
Depth	Distance from Lumen Profile	Protruding (“nodule”) Superficial Deep
Thickness	Max Calcium Thickness	Thin Thick
Length	Longitudinal Extension	Focal Long



Wopperer SB et al. Front Cardiovasc Med. 2023 Apr 6;10:1133510. doi: 10.3389/fcvm.2023.1133510

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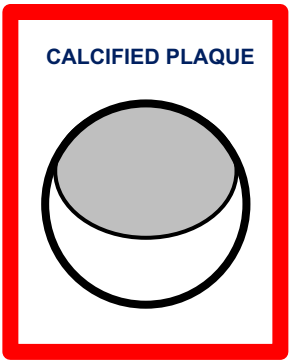
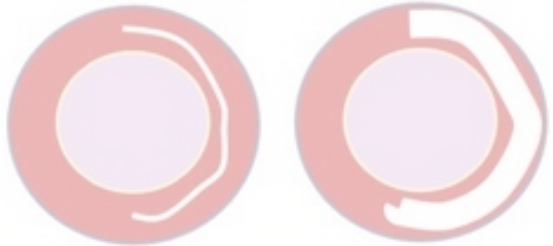
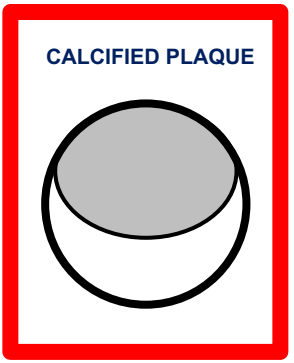


Eccentricity	Calcific Arc (degrees or quadrants)	Eccentric Calcium Concentric Calcium Calcium Ring (360°)	
Depth	**Distance from Lumen Profile**	**Protruding** *("nodule")* **Superficial** **Deep**	
Thickness	Max Calcium Thickness	Thin Thick	
Length	Longitudinal Extension	Focal Long	

Wopperer SB et al. Front Cardiovasc Med. 2023 Apr 6;10:1133510. doi: 10.3389/fcvm.2023.1133510

CALCIFIED PLAQUE



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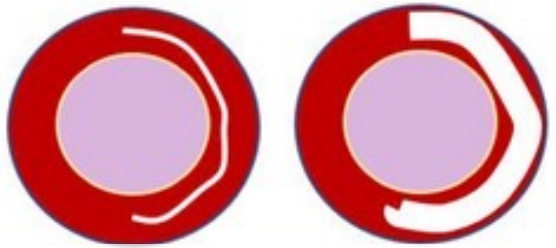
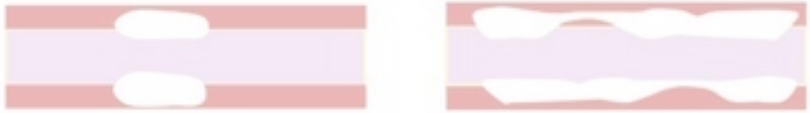
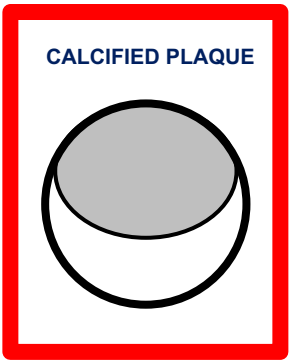
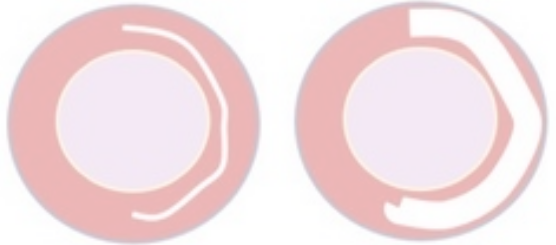
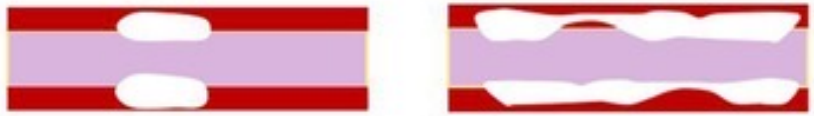
Depth	Distance from Lumen Profile	Protruding (“nodule”) Superficial Deep	
Thickness	Max Calcium Thickness	Thin Thick	
Length	Longitudinal Extension	Focal Long	

Wopperer SB et al. Front Cardiovasc Med. 2023 Apr 6;10:1133510. doi: 10.3389/fcvm.2023.1133510

CALCIFIED PLAQUE



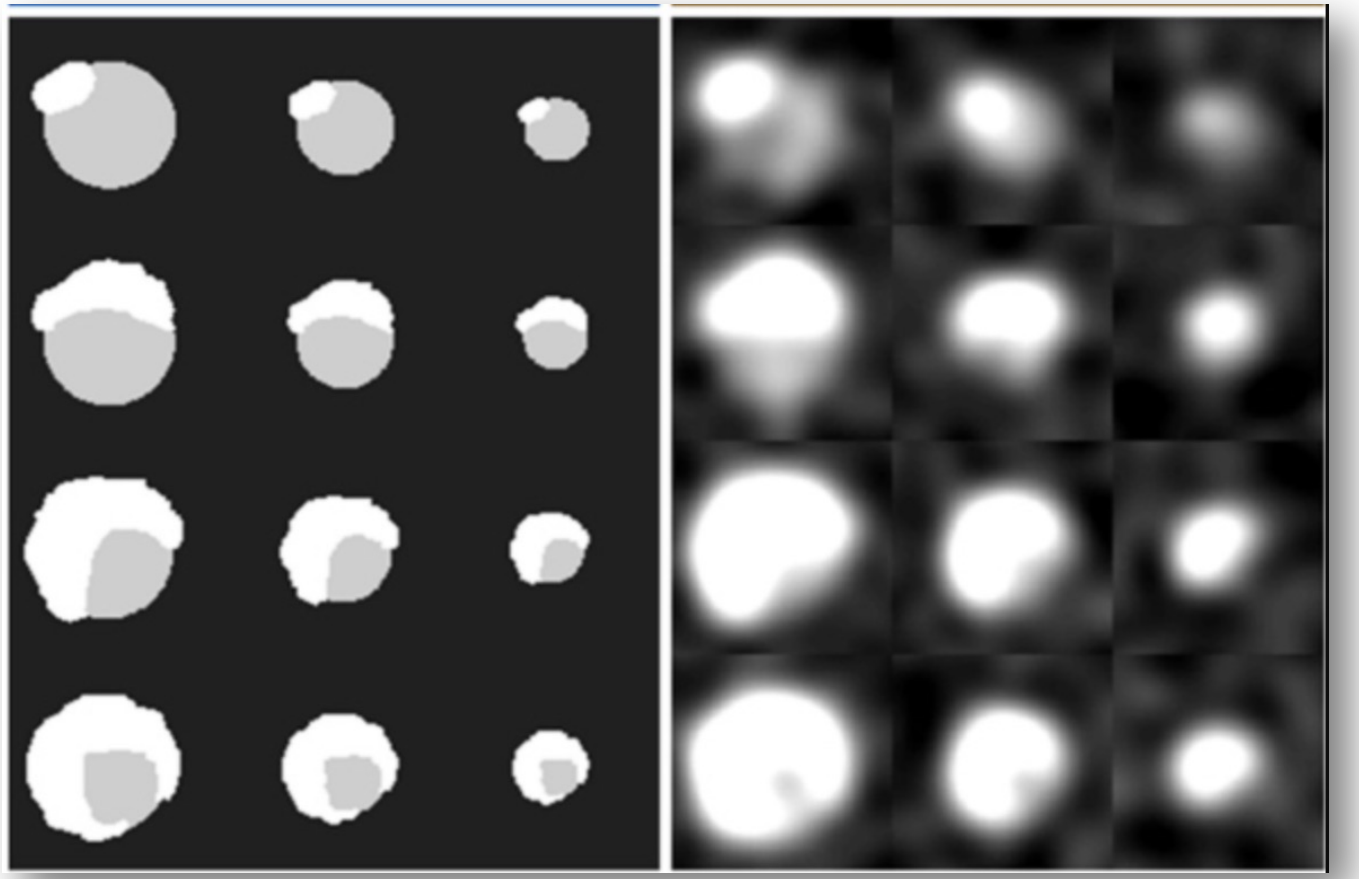
Eccentricity	Calcific Arc (degrees or quadrants)	Eccentric Calcium Concentric Calcium Calcium Ring (360°)	
Depth	Distance from Lumen Profile	Protruding (“nodule”) Superficial Deep	
Thickness	Max Calcium Thickness	Thin Thick	
Length	Longitudinal Extension	Focal Long	

Wopperer SB et al. Front Cardiovasc Med. 2023 Apr 6;10:1133510. doi: 10.3389/fcvm.2023.1133510

BLOOMING ARTIFACT

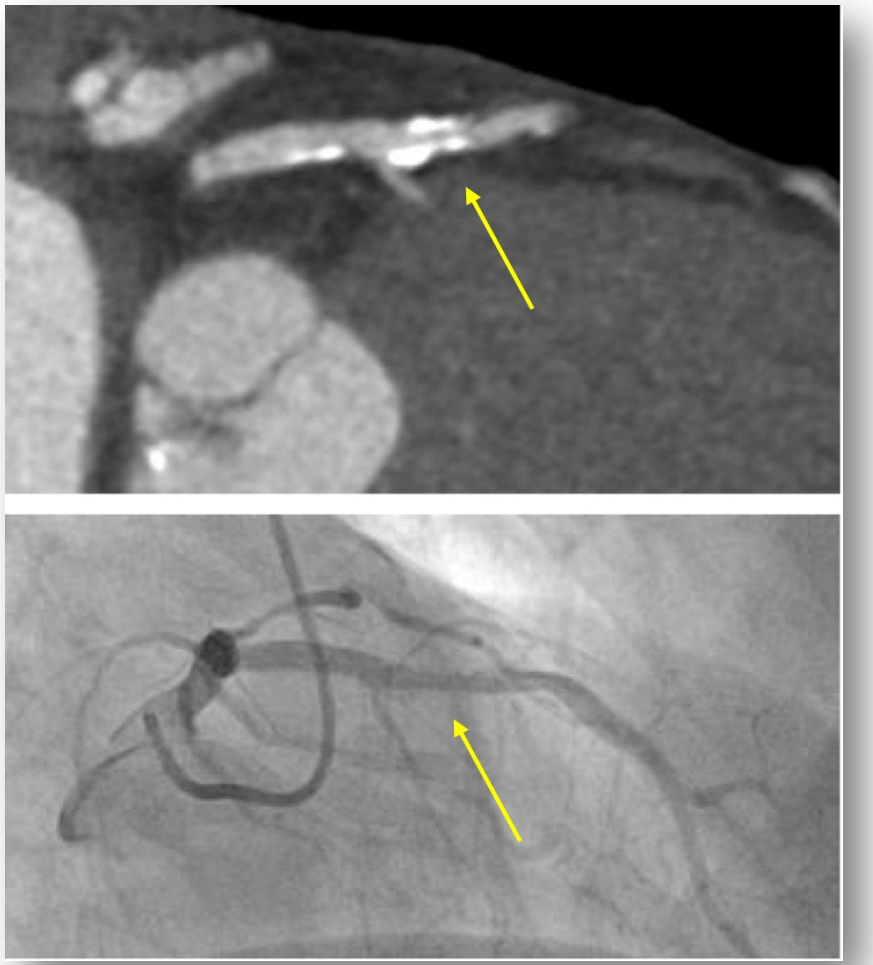
- Due to partial volume averaging: the CT value assigned to each voxel is the average o the linear attenuation coefficients.

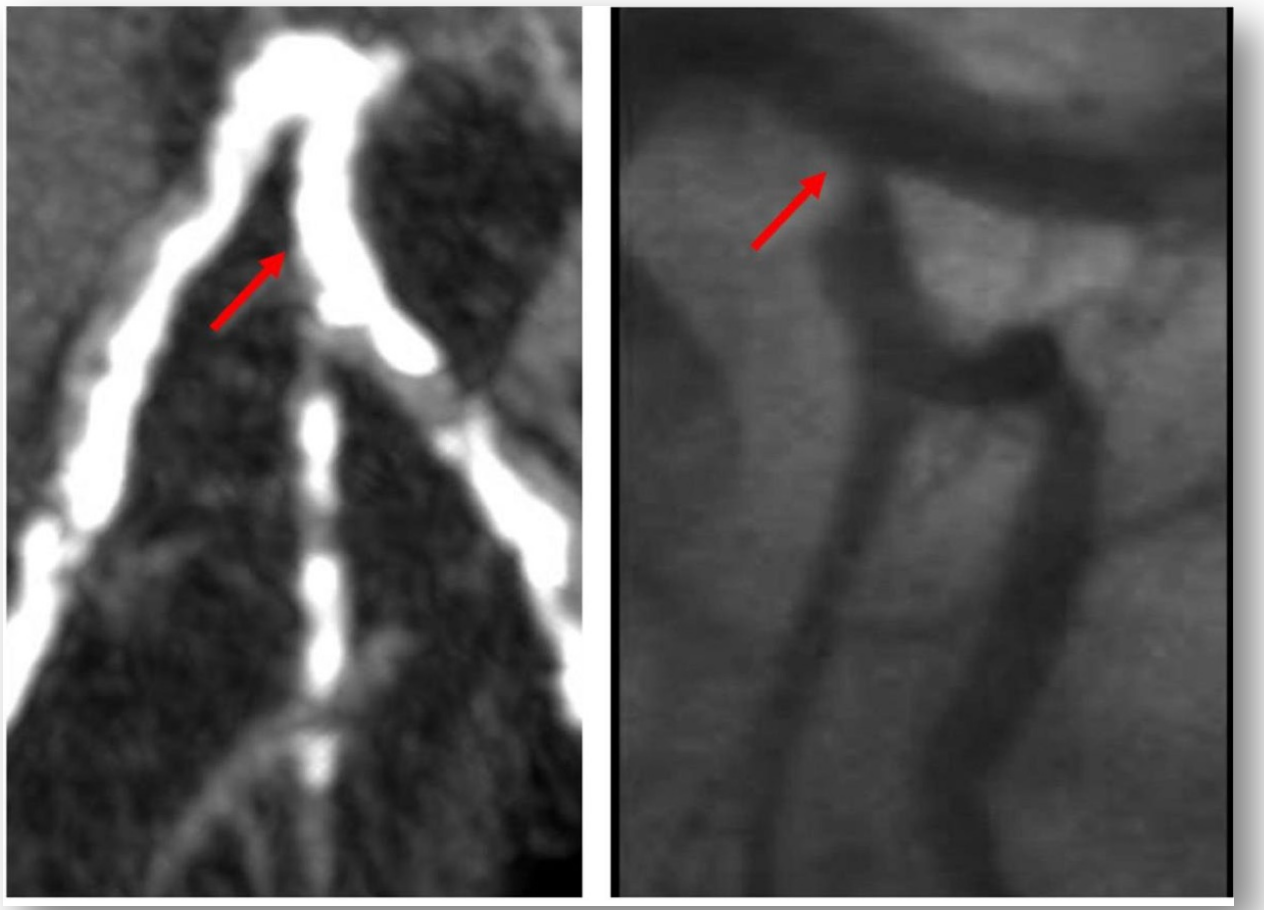
- Overestimation of high-density voxels.



- Pack JD et al. Vis Comput Ind Biomed Art. 2022 Dec 9;5(1):29. doi: 10.1186/s42492-022-00125-0
- Raff GL et al. J Cardiovasc Comput Tomogr. 2009 Mar-Apr;3(2):122-36. doi: 10.1016/j.jcct.2009.01.001

BLOOMING ARTIFACT

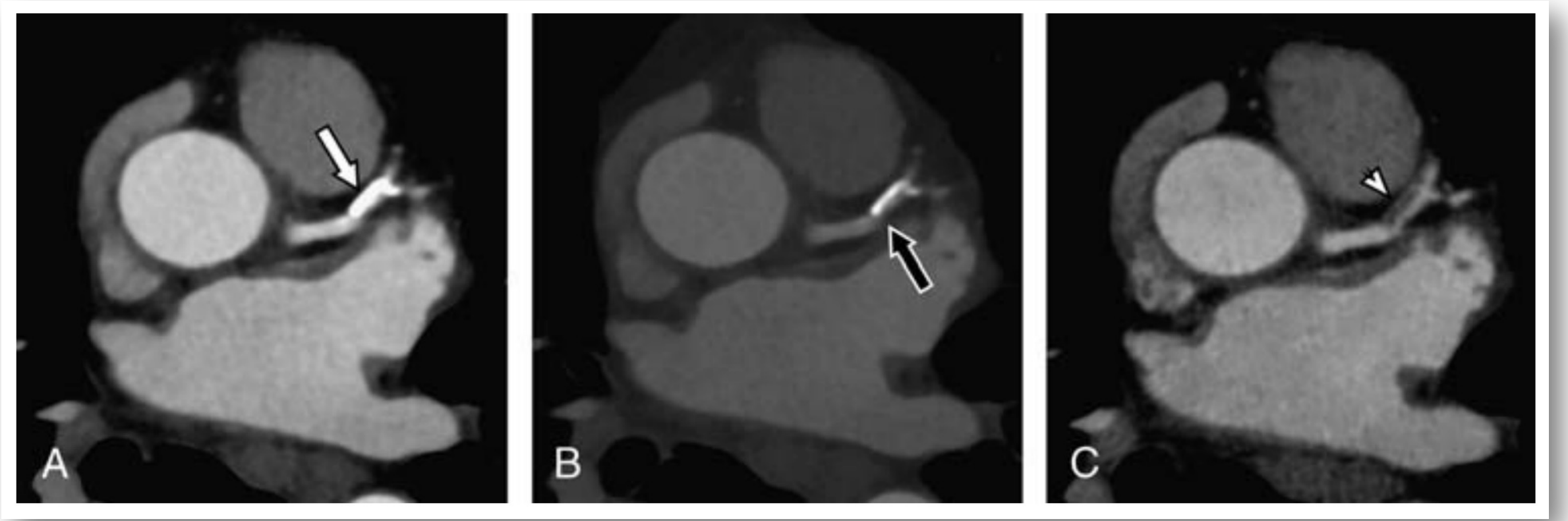




Pack JD et al. Vis Comput Ind Biomed Art. 2022 Dec 9;5(1):29. doi: 10.1186/s42492-022-00125-0

VIRTUAL CALCIUM SUBTRACTION

- Le nuove tecnologie (DECT/PCCT), consentono l'utilizzo di algoritmi per la sottrazione del calcio della immagini TC senza la necessità di un'acquisizione di immagini aggiuntive.

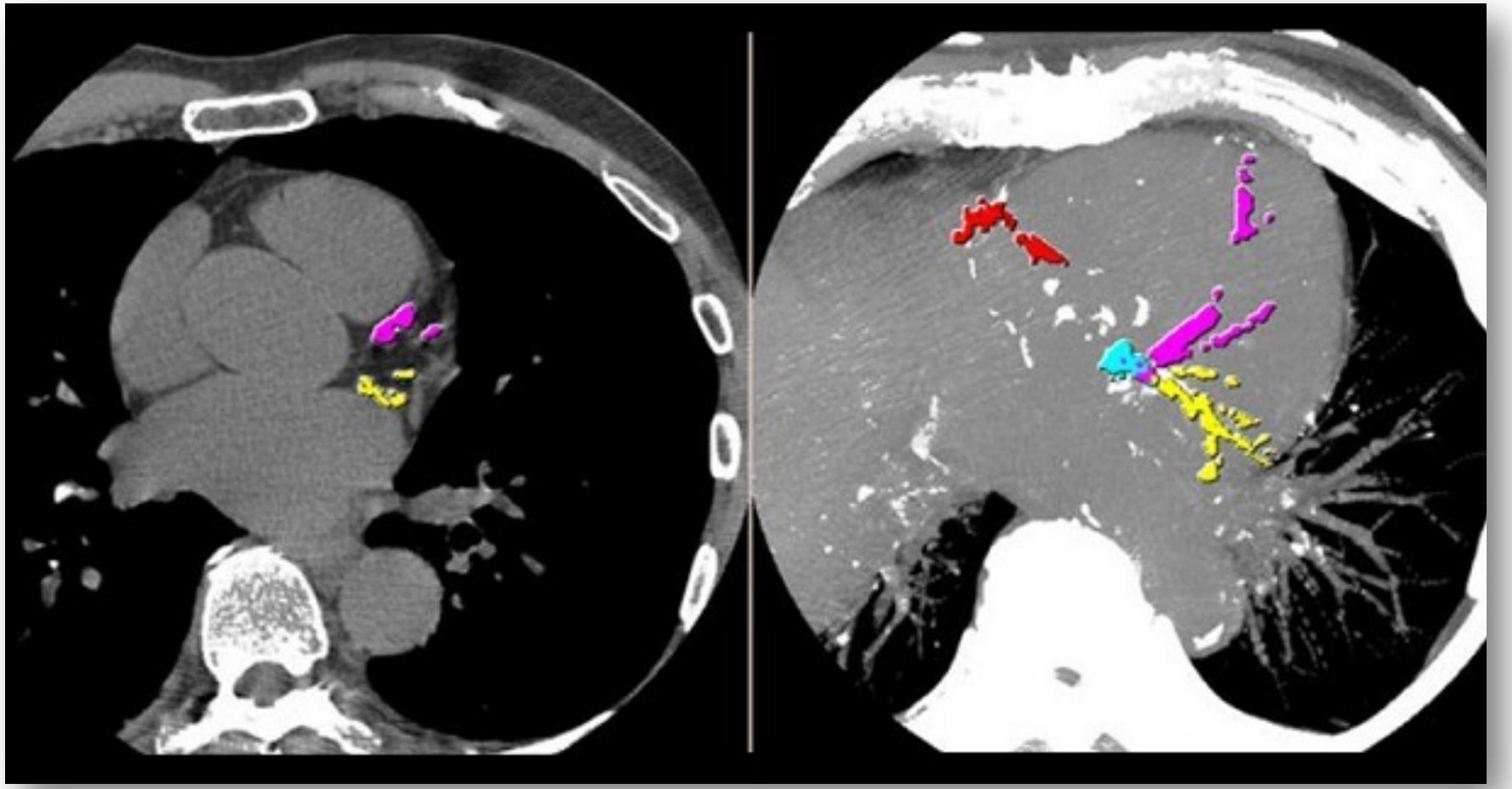


De Santis D et al. Invest Radiol. 2018 Feb;53(2):103-109. doi: 10.1097/RLI.0000000000000416

CALCIFIED PLAQUE

Can we quantify the amount of calcified coronary plaques?

Coronary Artery Calcium Score (CaCs)



Misura quantitativa del contenuto di calcio nelle coronarie e rappresenta un indicatore importante del rischio di malattia coronarica.

Il punteggio viene calcolato utilizzando un software dedicato e viene generalmente espresso in unità di Agatston.

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Coronary Artery Calcium Score (CaCs)

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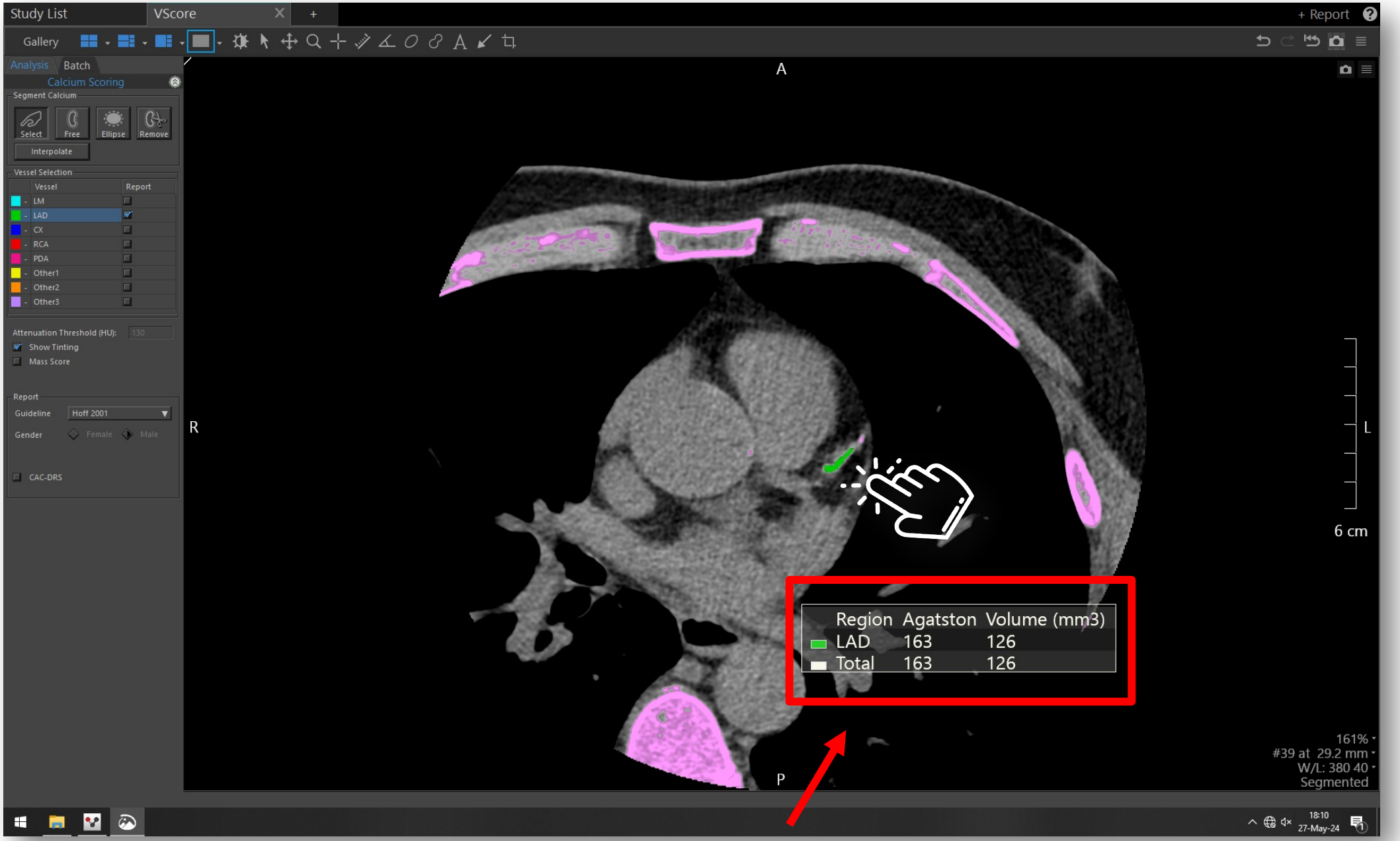
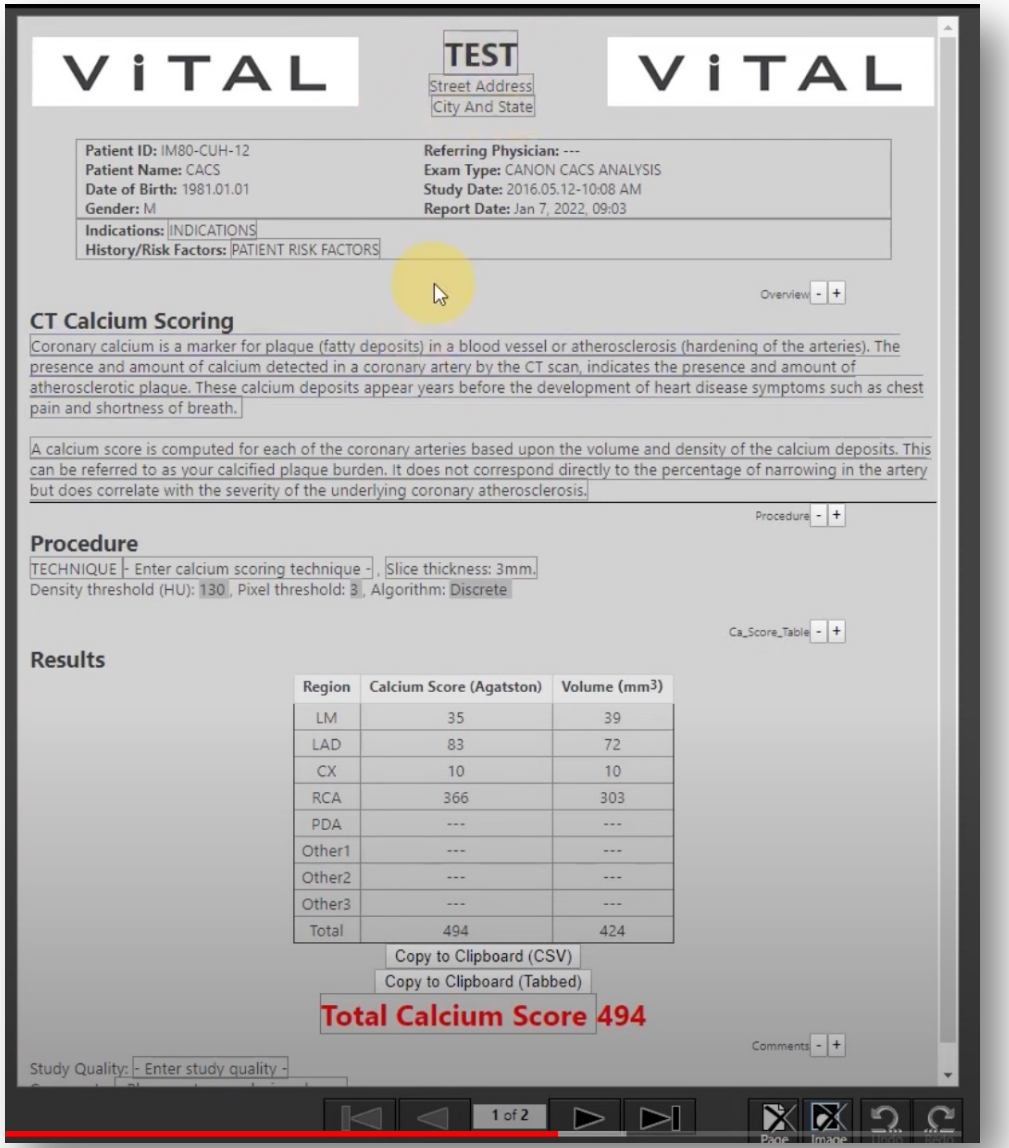


Coronary Artery Calcium Score (CaCs)



VITAL TEST VITAL
Street Address
City And State

Patient ID: IM80-CUH-12
Patient Name: CACS
Date of Birth: 1981.01.01
Gender: M
Referring Physician: ---
Exam Type: CANON CACS ANALYSIS
Study Date: 2016.05.12-10:08 AM
Report Date: Jan 7, 2022, 09:03
Indications: INDICATIONS
History/Risk Factors: PATIENT RISK FACTORS

Overview - +

CT Calcium Scoring

Coronary calcium is a marker for plaque (fatty deposits) in a blood vessel or atherosclerosis (hardening of the arteries). The presence and amount of calcium detected in a coronary artery by the CT scan, indicates the presence and amount of atherosclerotic plaque. These calcium deposits appear years before the development of heart disease symptoms such as chest pain and shortness of breath.

A calcium score is computed for each of the coronary arteries based upon the volume and density of the calcium deposits. This can be referred to as your calcified plaque burden. It does not correspond directly to the percentage of narrowing in the artery but does correlate with the severity of the underlying coronary atherosclerosis.

Procedure - +

Procedure

TECHNIQUE - Enter calcium scoring technique - , Slice thickness: 3mm.
Density threshold (HU): 130 , Pixel threshold: 3 , Algorithm: Discrete

Ca_Score_Table - +

Results

Region	Calcium Score (Agatston)	Volume (mm3)
LM	35	39
LAD	83	72
CX	10	10
RCA	366	303
PDA	---	---
Other1	---	---
Other2	---	---
Other3	---	---
Total	494	424

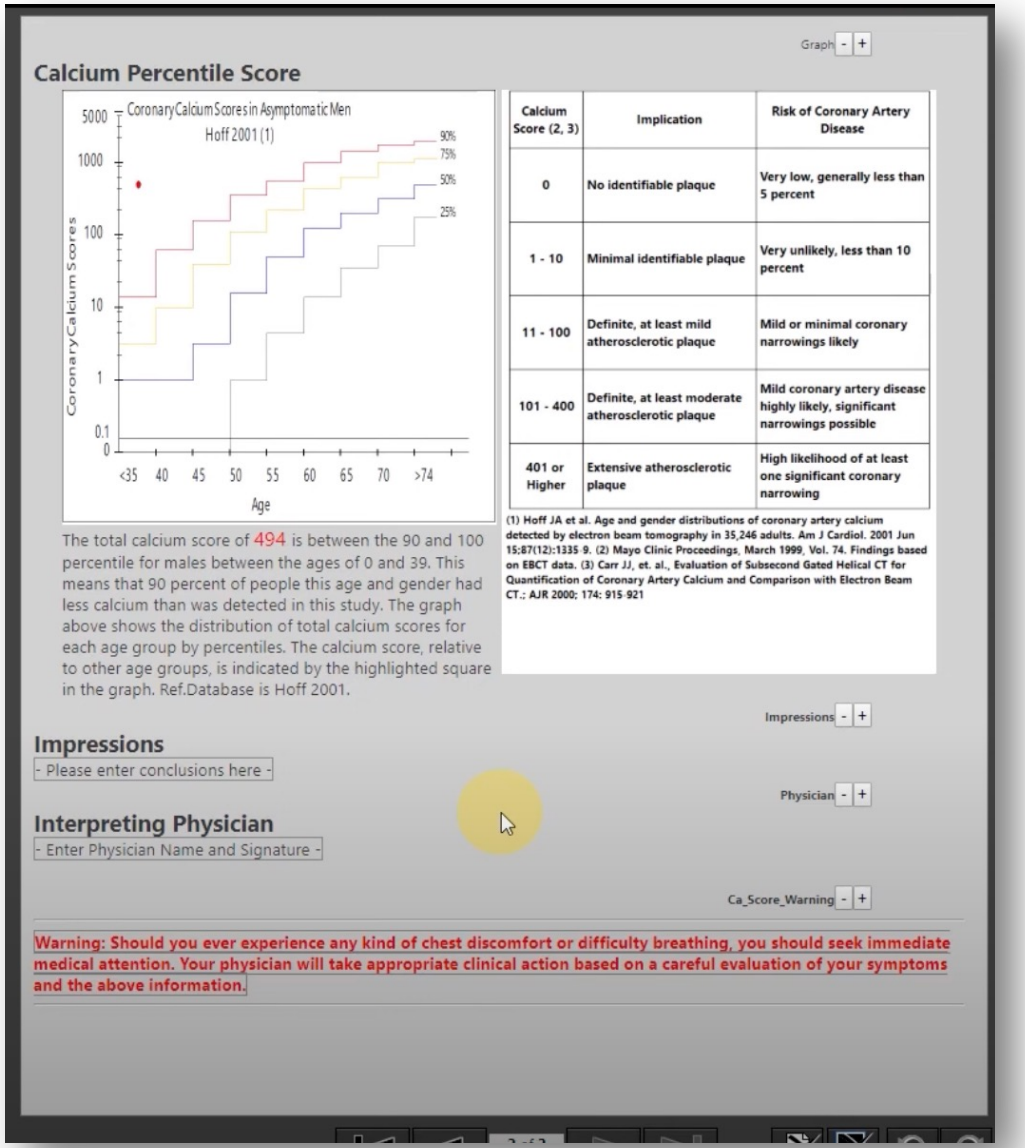
Copy to Clipboard (CSV)
Copy to Clipboard (Tabbed)

Total Calcium Score 494

Comments - +

Study Quality: - Enter study quality -

1 of 2



Graph - +

Calcium Percentile Score

Calcium Score (2, 3)	Implication	Risk of Coronary Artery Disease
0	No identifiable plaque	Very low, generally less than 5 percent
1 - 10	Minimal identifiable plaque	Very unlikely, less than 10 percent
11 - 100	Definite, at least mild atherosclerotic plaque	Mild or minimal coronary narrowings likely
101 - 400	Definite, at least moderate atherosclerotic plaque	Mild coronary artery disease highly likely, significant narrowings possible
401 or Higher	Extensive atherosclerotic plaque	High likelihood of at least one significant coronary narrowing

(1) Hoff JA et al. Age and gender distributions of coronary artery calcium detected by electron beam tomography in 35,246 adults. Am J Cardiol. 2001 Jun 15;87(12):1335-9. (2) Mayo Clinic Proceedings, March 1999, Vol. 74. Findings based on EBCT data. (3) Carr JJ, et. al., Evaluation of Subsecond Gated Helical CT for Quantification of Coronary Artery Calcium and Comparison with Electron Beam CT.; AJR 2000; 174: 915-921

The total calcium score of 494 is between the 90 and 100 percentile for males between the ages of 0 and 39. This means that 90 percent of people this age and gender had less calcium than was detected in this study. The graph above shows the distribution of total calcium scores for each age group by percentiles. The calcium score, relative to other age groups, is indicated by the highlighted square in the graph. Ref.Database is Hoff 2001.

Impressions - +

Impressions

- Please enter conclusions here -

Physician - +

Interpreting Physician

- Enter Physician Name and Signature -

Ca_Score_Warning - +

Warning: Should you ever experience any kind of chest discomfort or difficulty breathing, you should seek immediate medical attention. Your physician will take appropriate clinical action based on a careful evaluation of your symptoms and the above information.

Coronary Artery Calcium Score (CaCs)

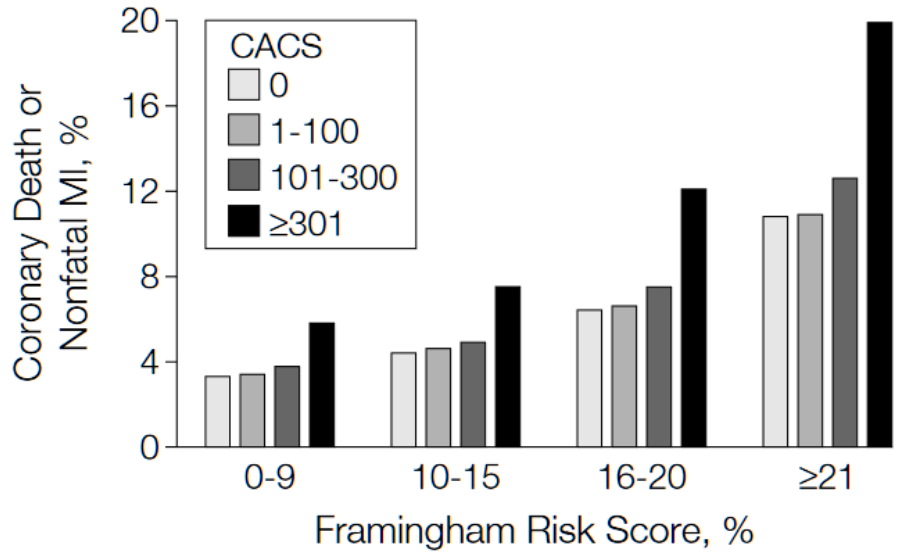
Definisce il rischio di evento cardiovascolare maggiore negli anni successivi.

Table I Classification of coronary calcium score

Absolute value (Agatston units)	Ranking
0	Absent
>0<10	Minimal
≥10<100	Mild
≥100<400	Moderate
≥400<1000	Severe
≥1000	Extensive

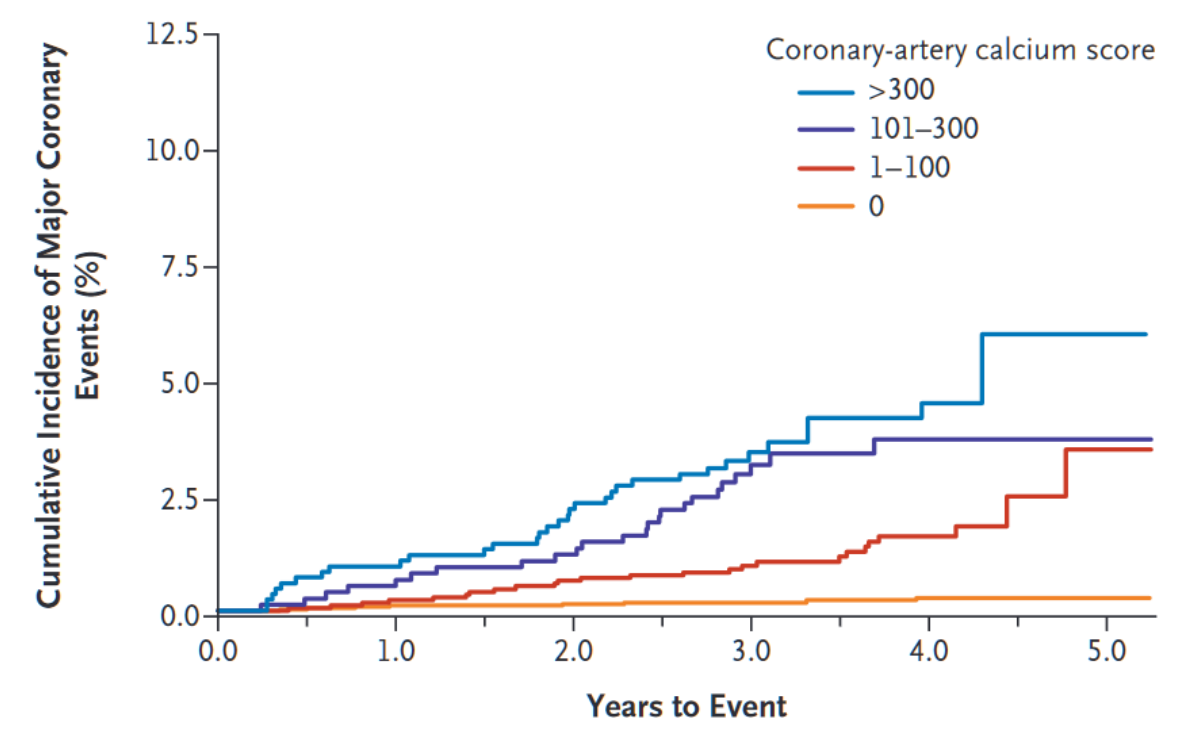
Classification of coronary calcium absolute content evaluated by cardiac CT and quantified by Agatston units.

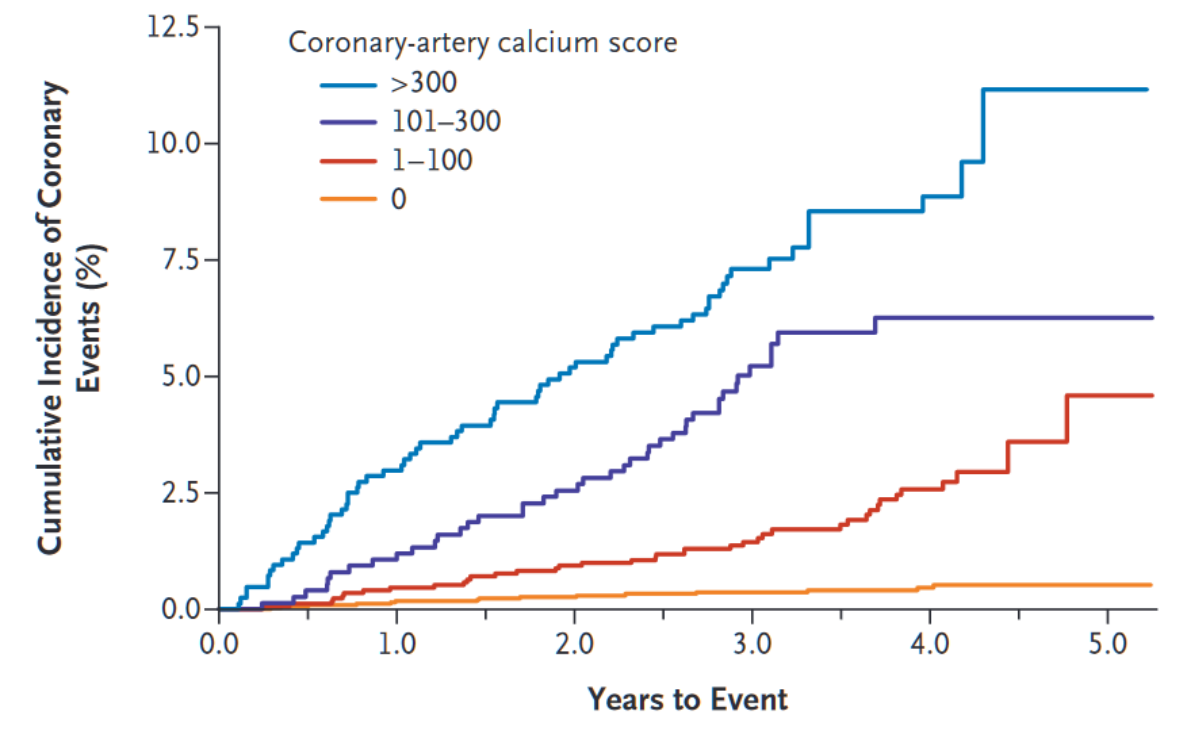
Figure 1. Predicted 7-Year Event Rates From COX Regression Model for CHD Death or Nonfatal Myocardial Infarction for Categories of FRS or CACS



- Perrone-Filardi P et al. Eur Heart J. 2011 Aug;32(16):1986-93, 1993a, 1993b. doi: 10.1093/eurheartj/ehq235
- Greenland P et al JAMA. 2004 Jan 14;291(2):210-5. doi: 10.1001/jama.291.2.210

Coronary Artery Calcium Score (CaCs)





Detrano R et al. N Engl J Med. 2008 Mar 27;358(13):1336-45. doi: 10.1056/NEJMoa072100

Coronary Artery Calcium Score (CaCs)

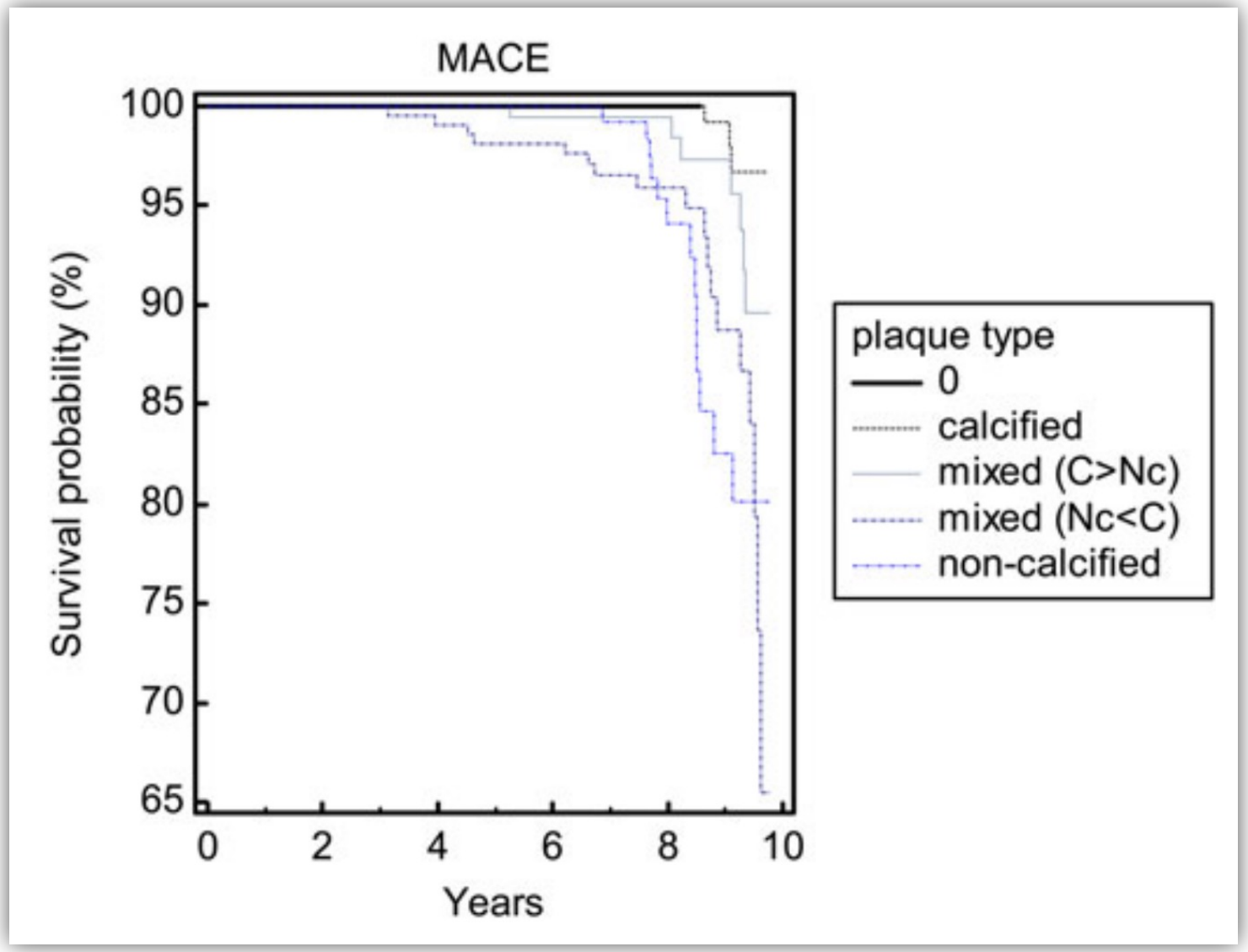
PROs

- Non-invasive
- Fast
- No CM needed
- Predictive of cardiovascular events

CONs

- Underestimates mixed plaques
- Misses soft plaques
- Can't be the sole criterion for CAD (CCTA needed)
- Statins: paradoxical increase of CaSc

CaSC IS NOT ENOUGH



Feuchtner G. et al. Eur Heart J Cardiovasc Imaging. 2017 Jul 1;18(7):772-779. doi: 10.1093/ehjci/jew167

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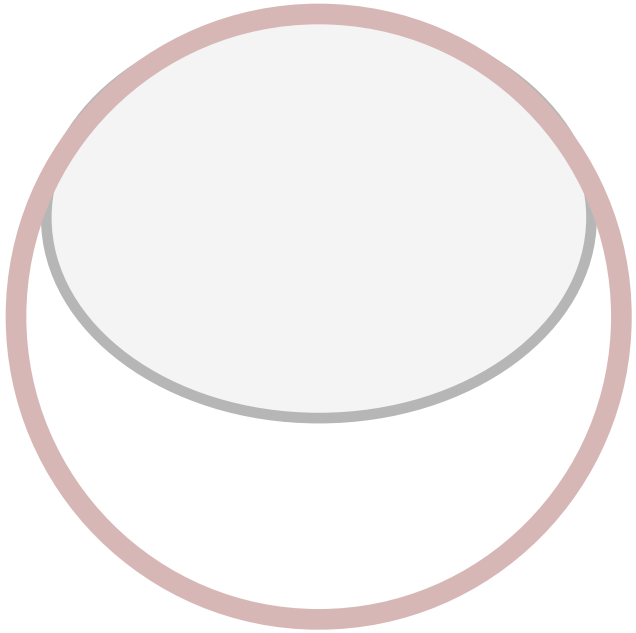
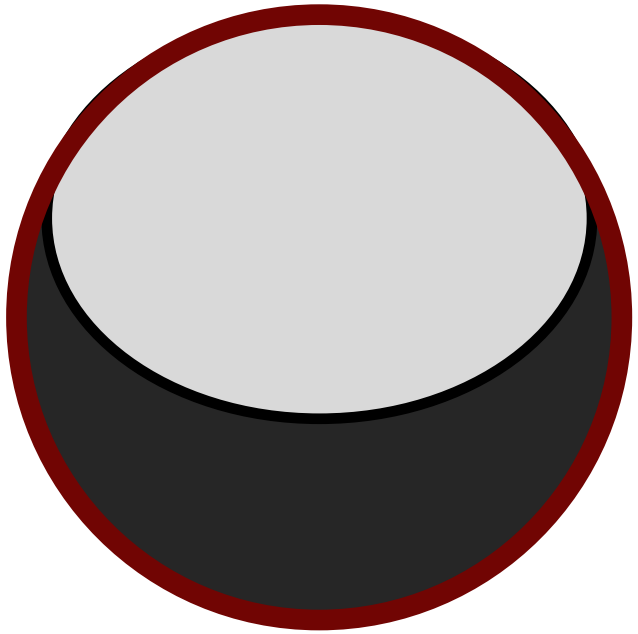
TYPES OF PLAQUES

CALCIFIED

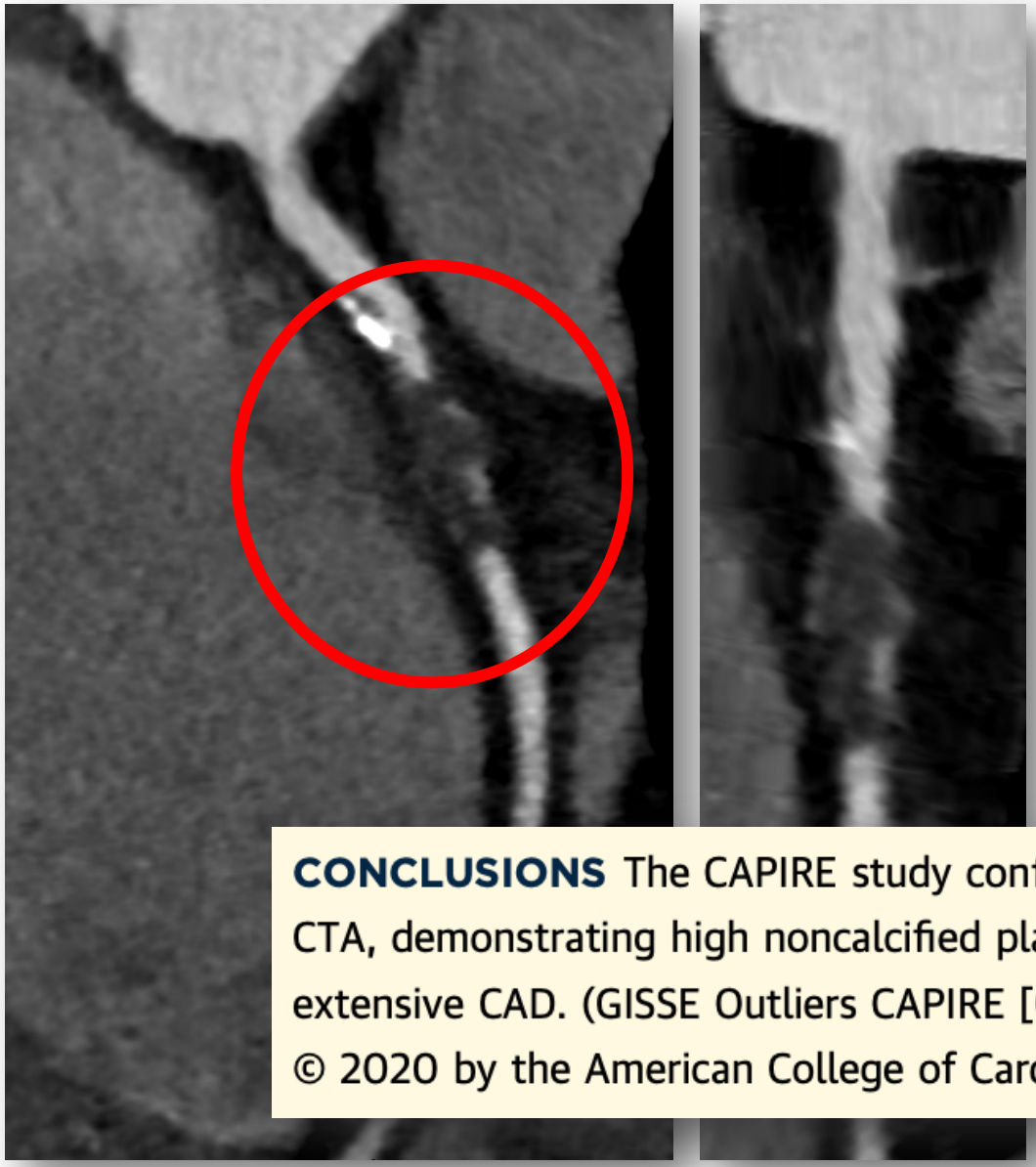


SOFT (NON-CALCIFIED)



MIXED

SOFT (NON-CALCIFIED) PLAQUE



JACC: CARDIOVASCULAR IMAGING VOL. 13, NO. 8, 2020

PUBLISHED BY ELSEVIER

ORIGINAL RESEARCH

Coronary Plaque Features on CTA Can Identify Patients at Increased Risk of Cardiovascular Events

Daniele Andreini, MD, PhD,[a,b,*] Marco Magnoni, MD,[c,*] Edoardo Conte, MD,[a] Serge Masson, PhD,[d] Saima Mushtaq, MD,[a] Sergio Berti, MD,[e] Mauro Canestrari, MD,[f] Giancarlo Casolo, MD,[g] Domenico Gabrielli, MD,[h] Roberto Latini, MD,[d] Paolo Marraccini, MD,[i] Tiziano Moccetti, MD,[j] Maria Grazia Modena, MD,[k] Gianluca Pontone, MD, PhD,[a] Marco Gorini, MS,[l] Aldo P. Maggioni, MD,[l] Attilio Maseri, MD,[c] on behalf of the CAPIRE Investigators

- La mancanza di un cappuccio fibroso spesso e l'assenza di

CONCLUSIONS The CAPIRE study confirmed the prognostic value of atherosclerosis assessment by coronary CTA, demonstrating high noncalcified plaque volume as the most ACS-predictive parameter in patients with extensive CAD. (GISSE Outliers CAPIRE [CAPIRE]; NCT02157662) (J Am Coll Cardiol Img 2020;13:1704–17)

Motoyama S et al. J Am Coll Cardiol. 2009 Jun 30;54(1):49-57. doi: 10.1016/j.jacc.2009.02.068

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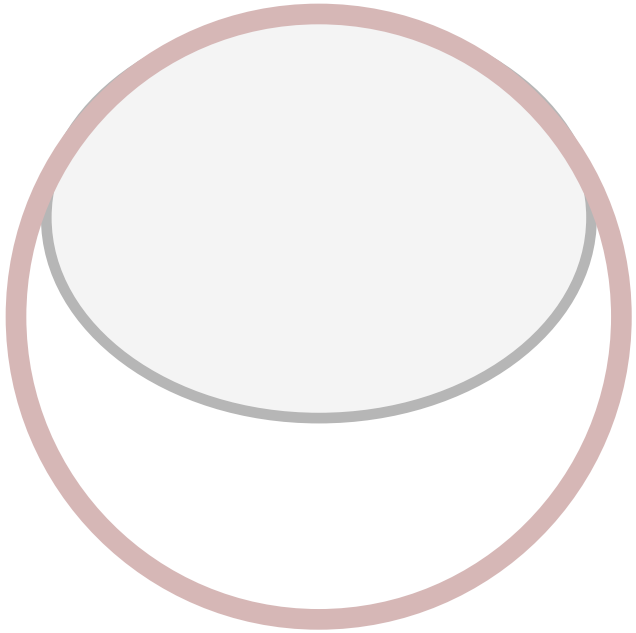
TYPES OF PLAQUES

CALCIFIED



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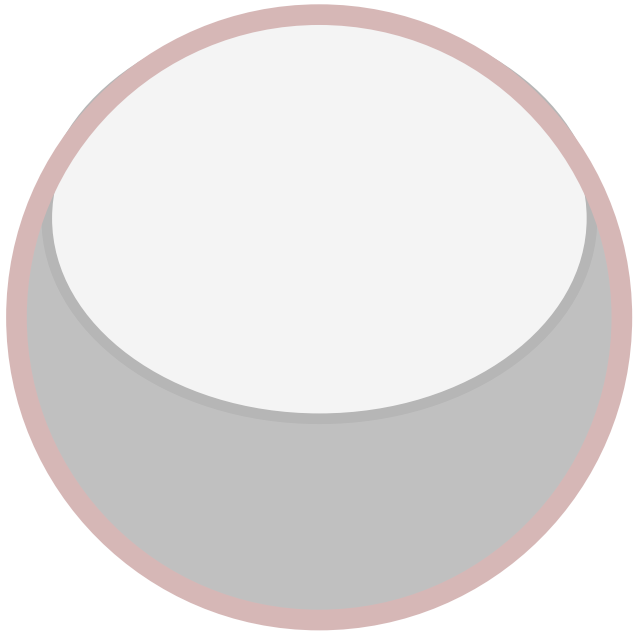
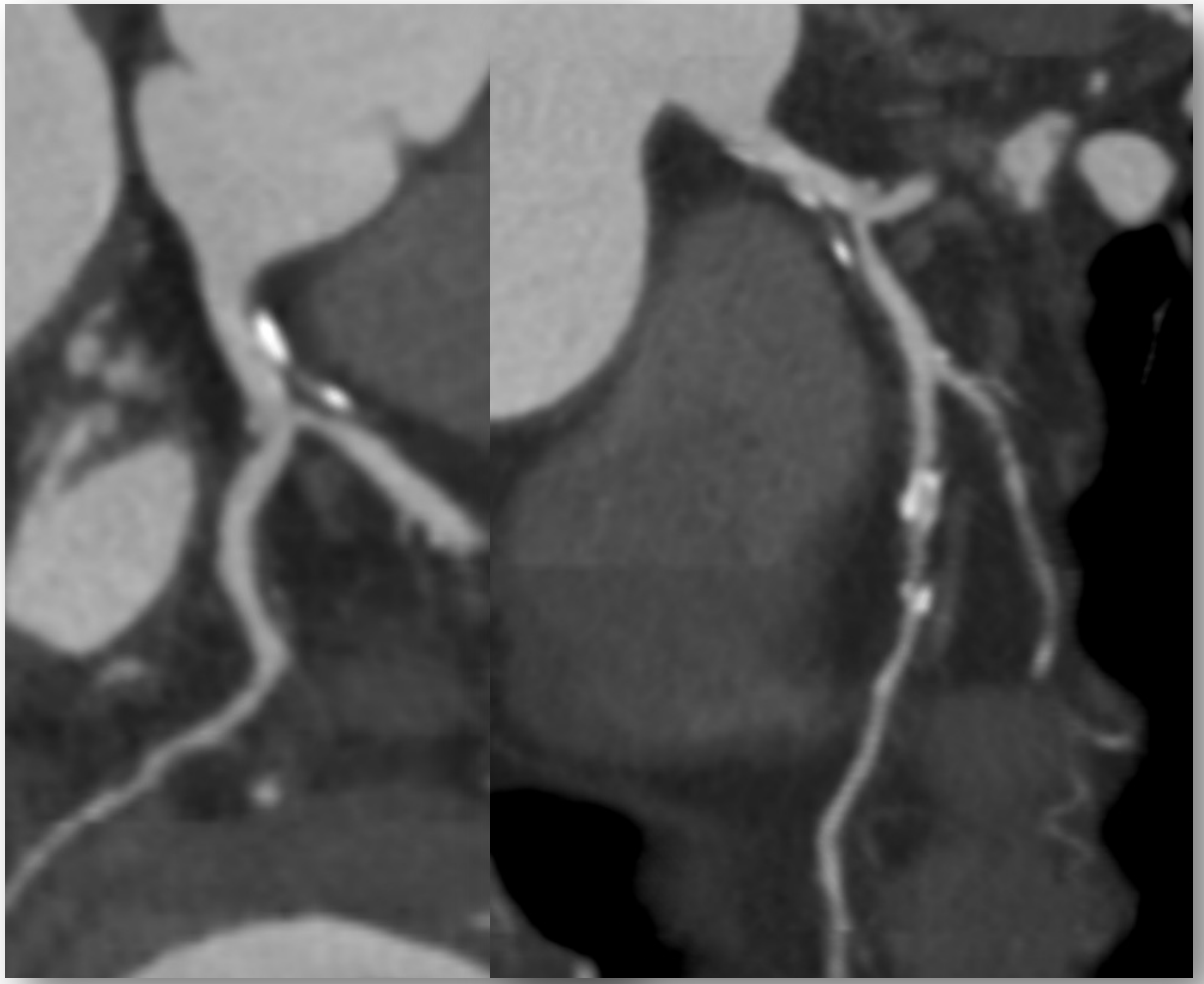


MIXED

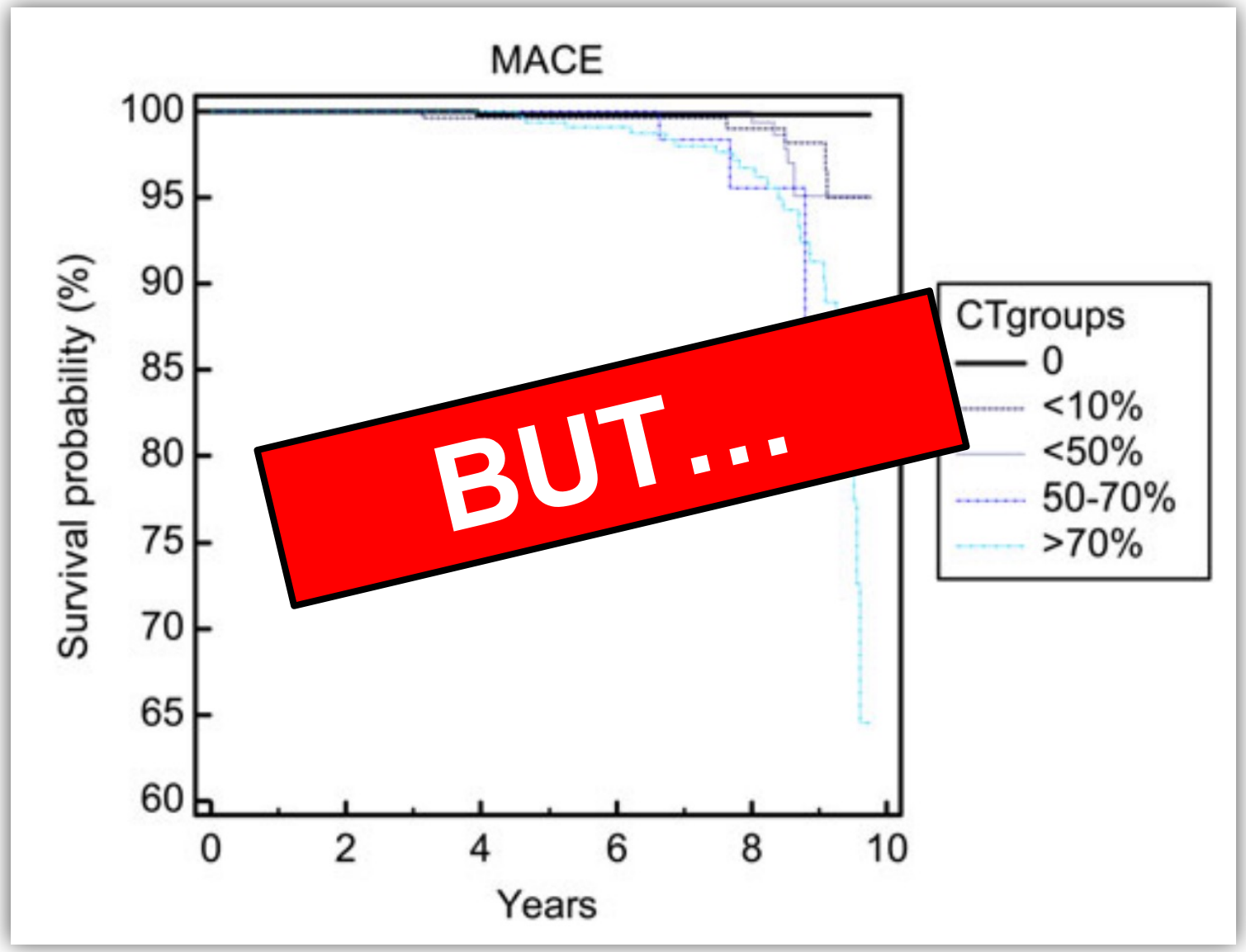
MIXED PLAQUE



- Contiene sia componenti calcifiche che non calcifiche (lipidiche e fibrose)
- La presenza di componenti lipidiche aumenta il rischio di rottura della placca.
- Considerata meno stabile rispetto alle placche calcifiche.

Motoyama S et al. J Am Coll Cardiol. 2009 Jun 30;54(1):49-57. doi: 10.1016/j.jacc.2009.02.068

% OF STENOSIS CORRELATES WITH MACE

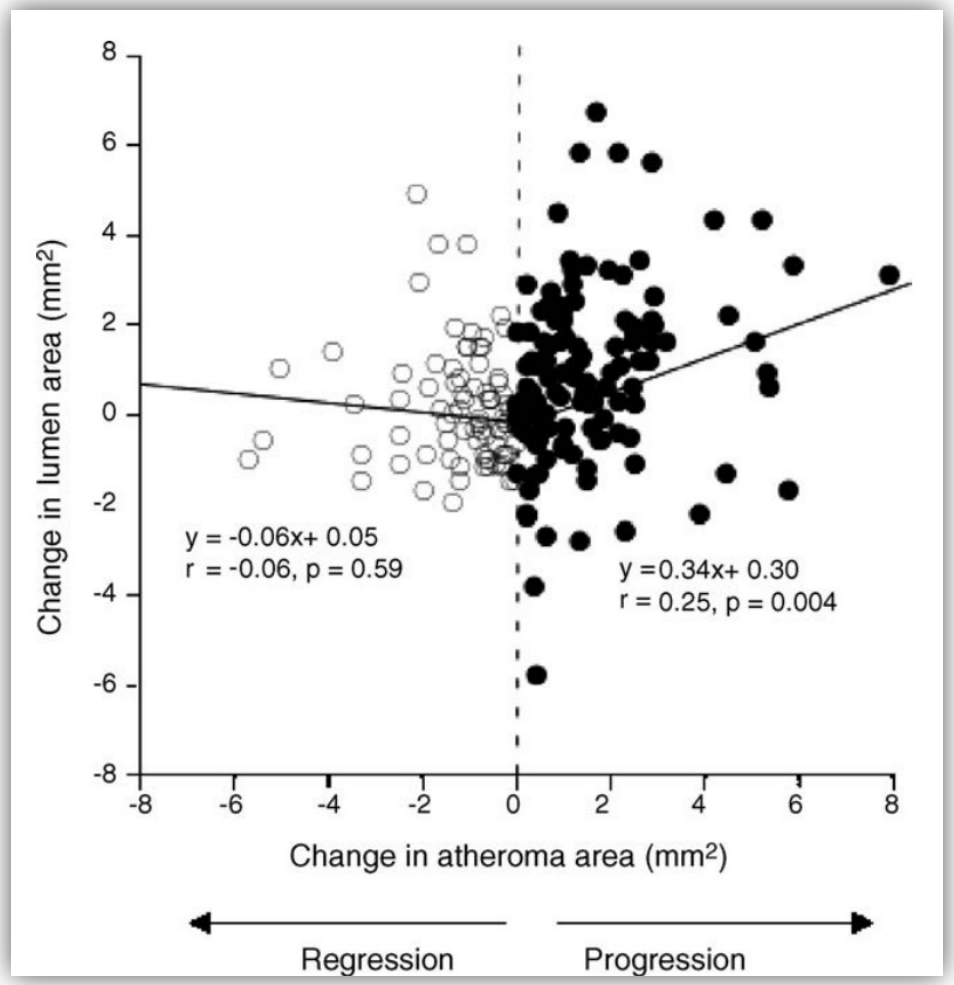


Feuchtner G. et al. Eur Heart J Cardiovasc Imaging. 2017 Jul 1;18(7):772-779. doi: 10.1093/ehjci/jew167

LUMEN SIZE IS NOT ENOUGH

- In patients under statin treatment, disease **progression** of disease is associated with over-compensatory vessel enlargement
  - **paradoxical luminal expansion**

- **Regression** is associated with a compensatory constriction of the vessel area
  - **no net change in luminal area**

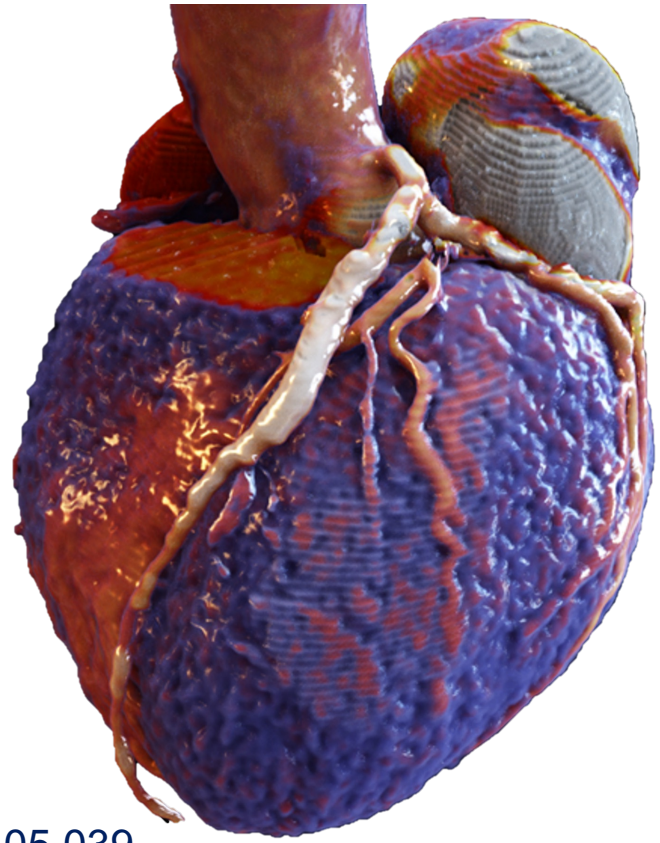


Sipahi I. et al. Atherosclerosis 189 (2006) 229–235 doi: 10.1016/j.atherosclerosis.2005.12.006

VULNERABLE PLAQUE

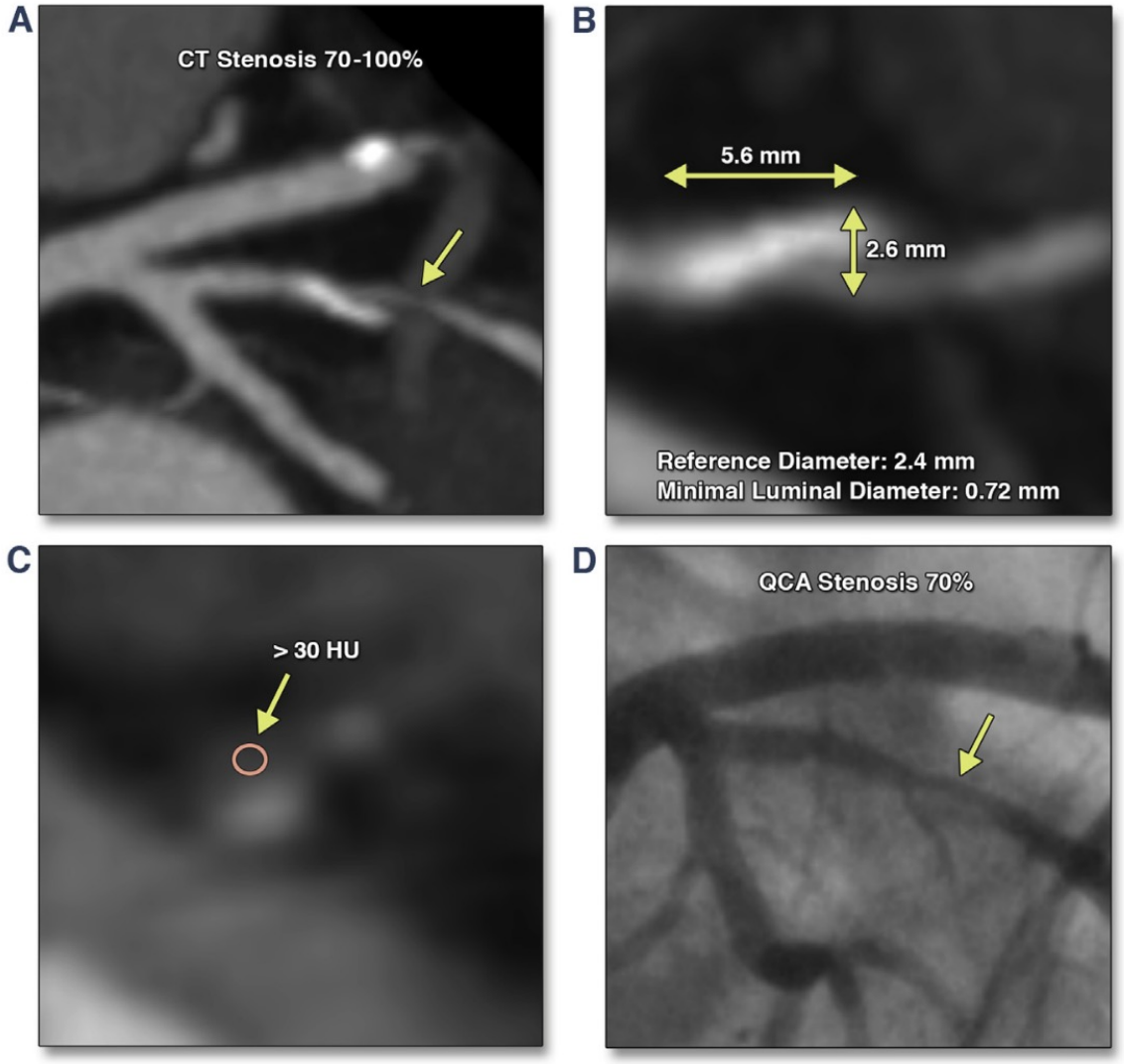
Sebbene esista una stretta correlazione tra le dimensioni della placca, l'evento ischemico e la prognosi, questa correlazione non rappresenta un continuum. Alcune caratteristiche della placca sono legate alla progressione e alla vulnerabilità della placca stessa e possono predire l'evento ischemico di una placca indipendentemente dal grado di stenosi:

1) **Low Attenuation**
2) **Positive Remodeling**
3) **Napkin-Ring Sign**
4) **Spotty Calcification**



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

OBSTRUCTIVE CORONARY STENOSIS DOESN'T ALWAYS EQUAL ISCHEMIA

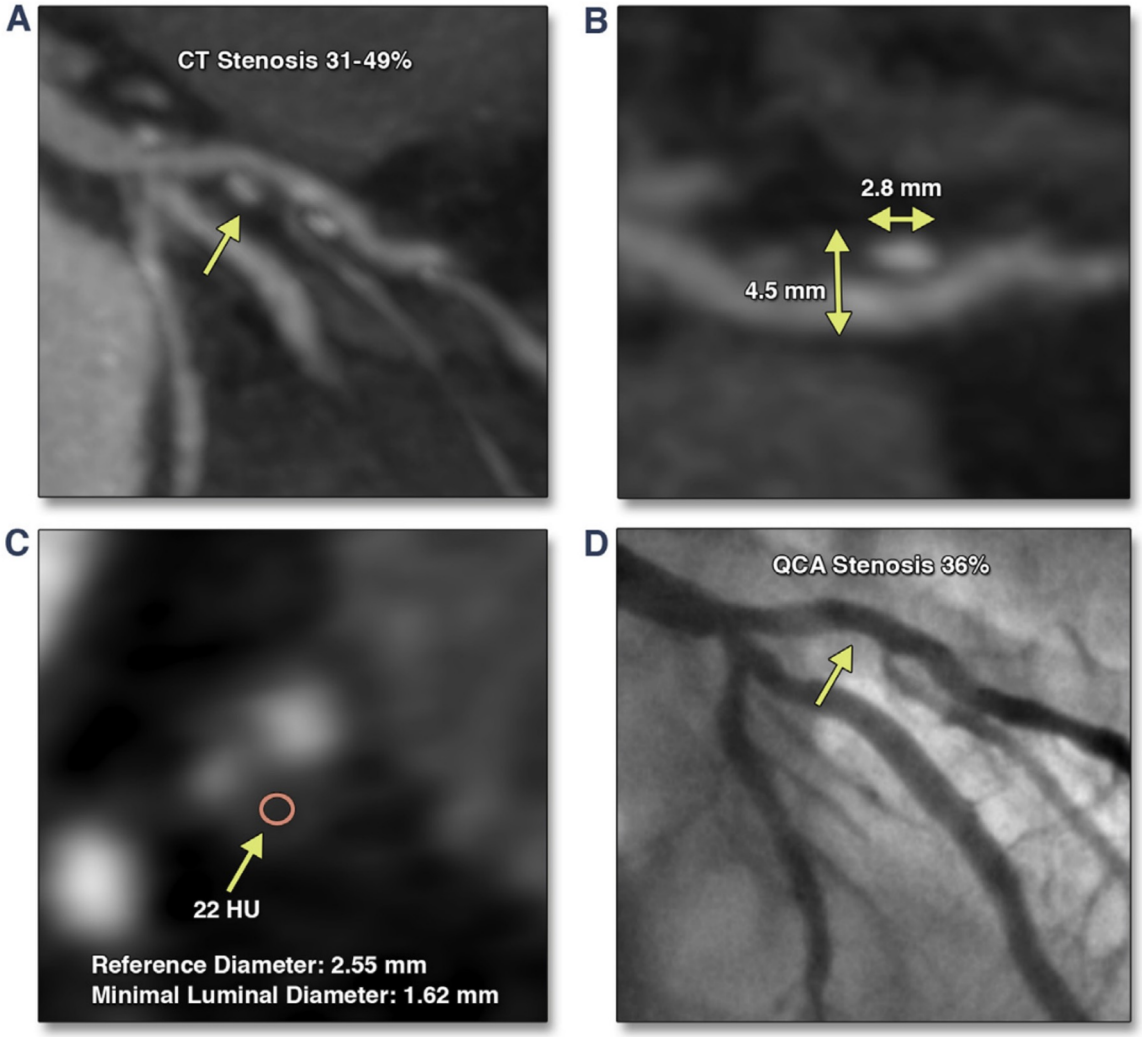


- CCTA: stenosis > 70%
- No positive remodeling (RI: 1.08)
- No spotty calcification
- No Low attenuation (>30 HU)
- ICA: 70% stenosis

FFR: 0.89

Park HB. et al. JACC Cardiovasc Imaging European Heart Journal (2015), doi: 10.1016/ j.jcmg.2014.11.002

OBSTRUCTIVE CORONARY STENOSIS DOESN'T ALWAYS EQUAL ISCHEMIA



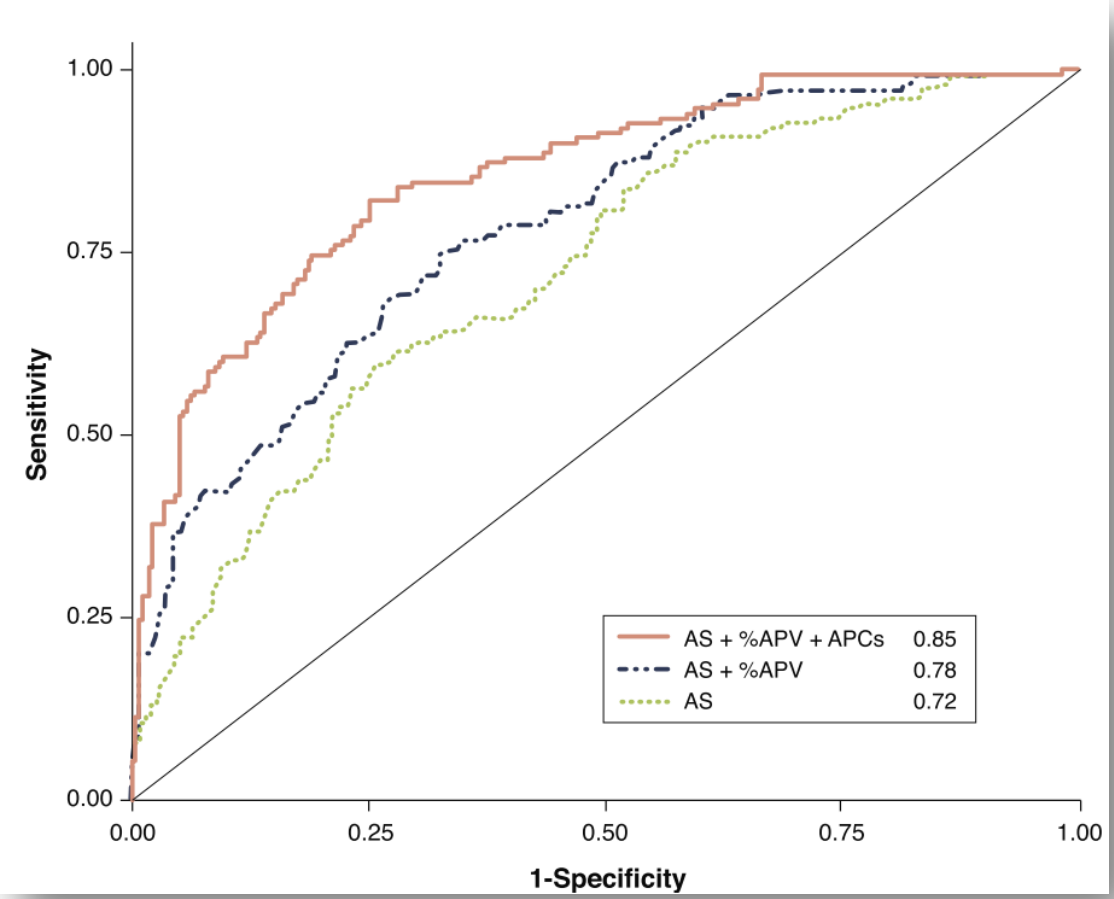
- CCTA: stenosis 25-50%
- Positive remodeling (RI: > 1.1)
- Spotty calcification
- Low attenuation (22 HU)
- ICA: 36% stenosis

FFR: 0.76

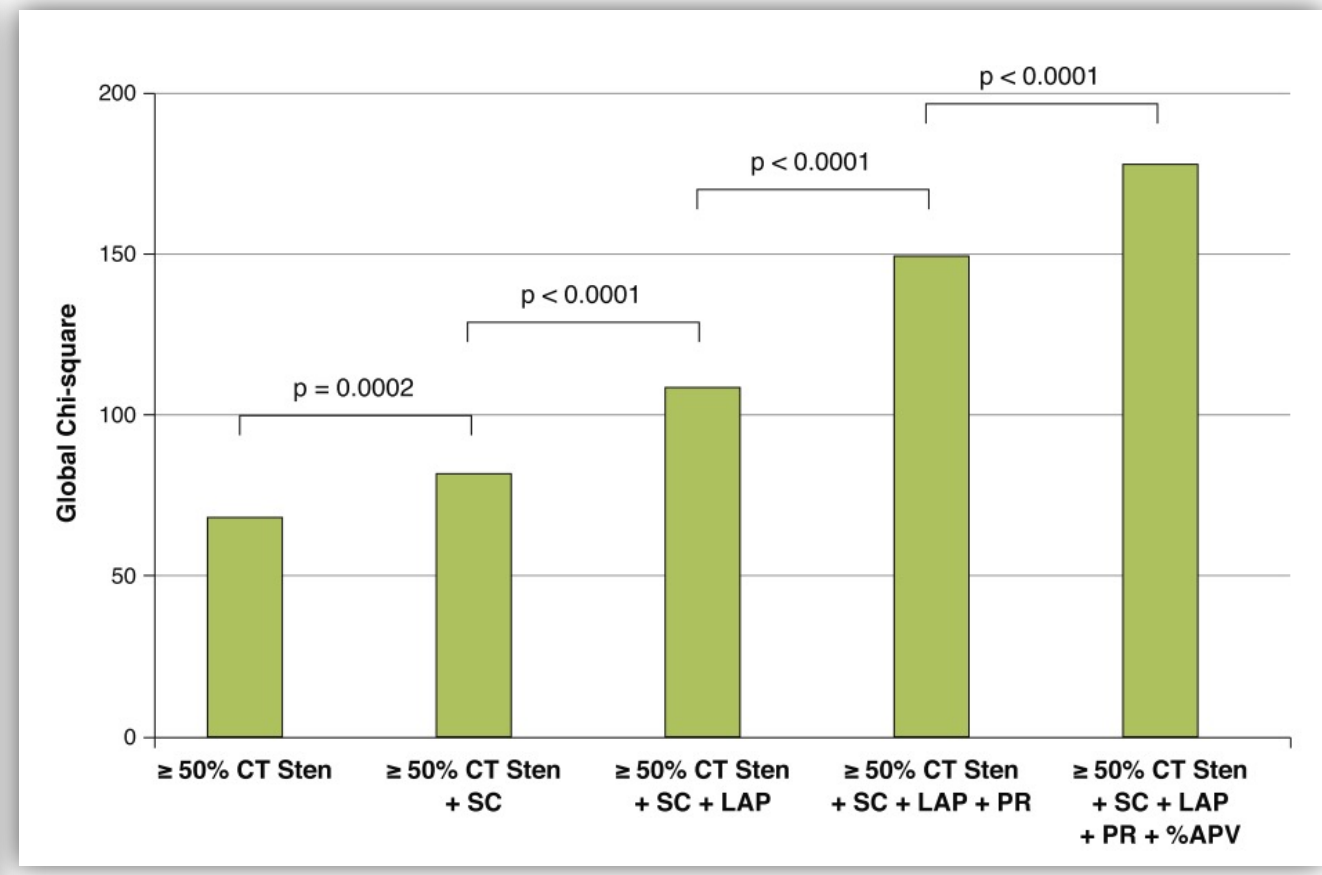
Park HB. et al. JACC Cardiovasc Imaging European Heart Journal (2015), doi: 10.1016/ j.jcmg.2014.11.002

ADDED VALUE OF PLAQUE CHARACTERISTICS

AUC for Stenosis Detection (FFR)

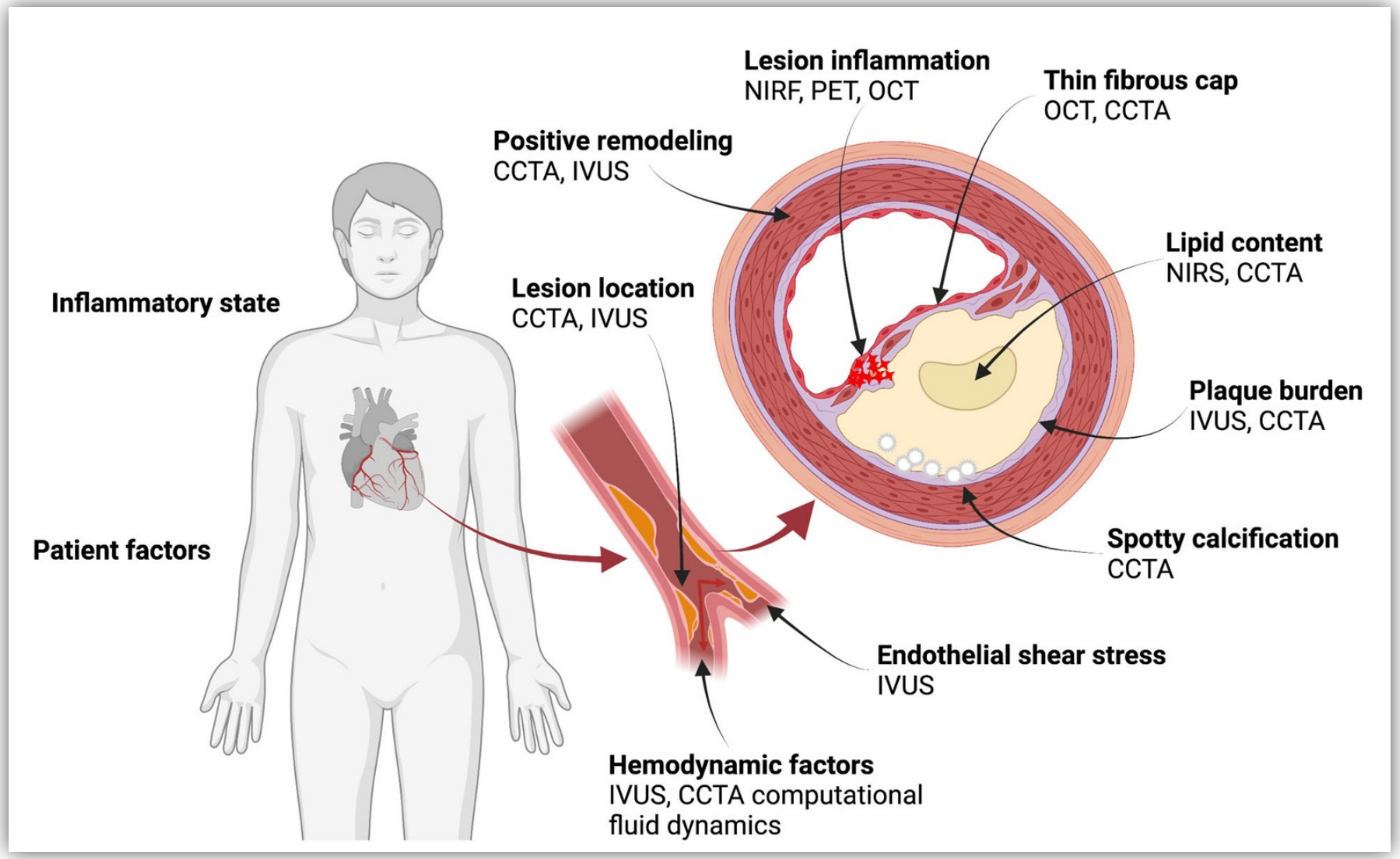


Incremental Risk Prediction Beyond Coronary Stenosis



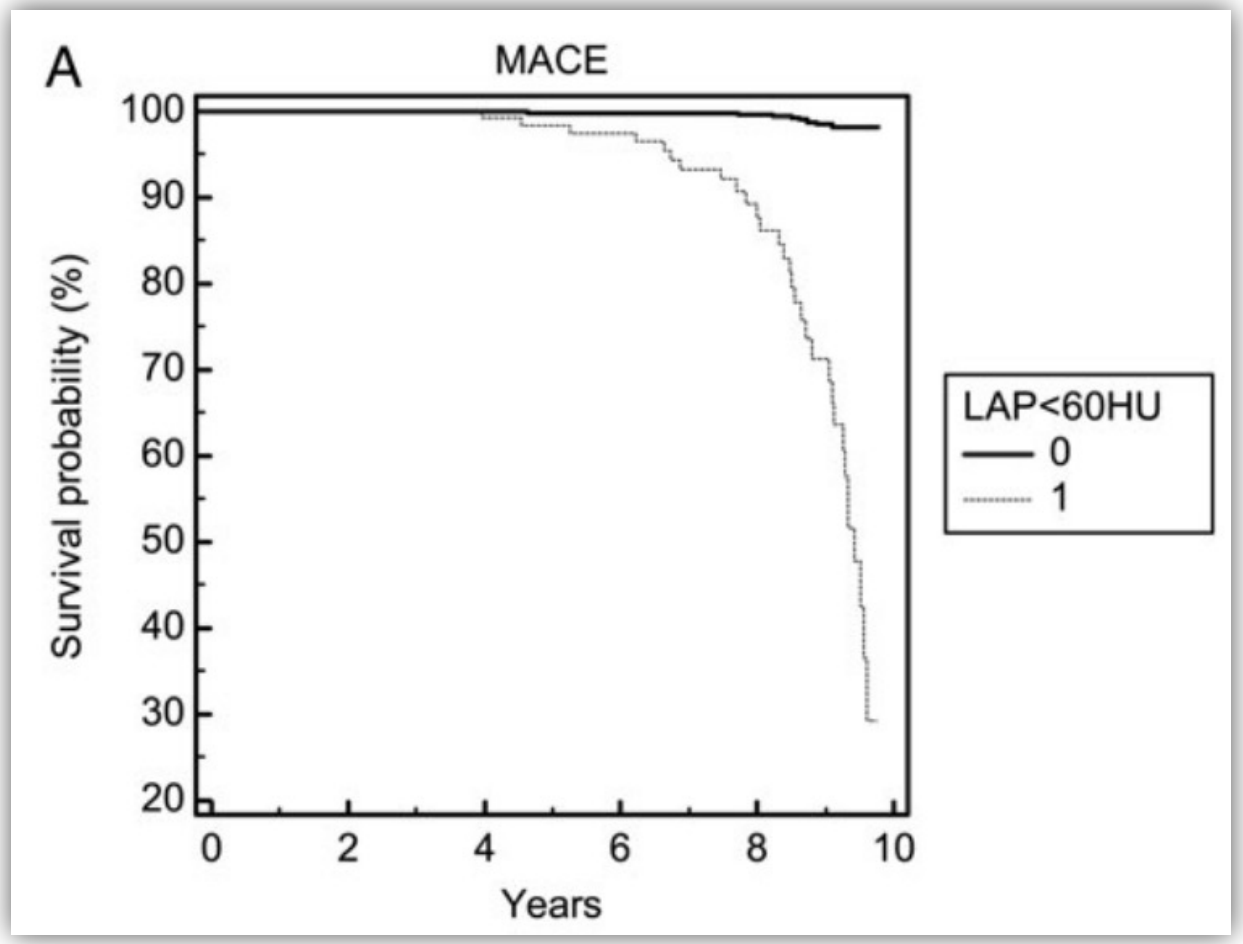
Park HB. et al. JACC Cardiovasc Imaging European Heart Journal (2015), doi: 10.1016/ j.jcmg.2014.11.002

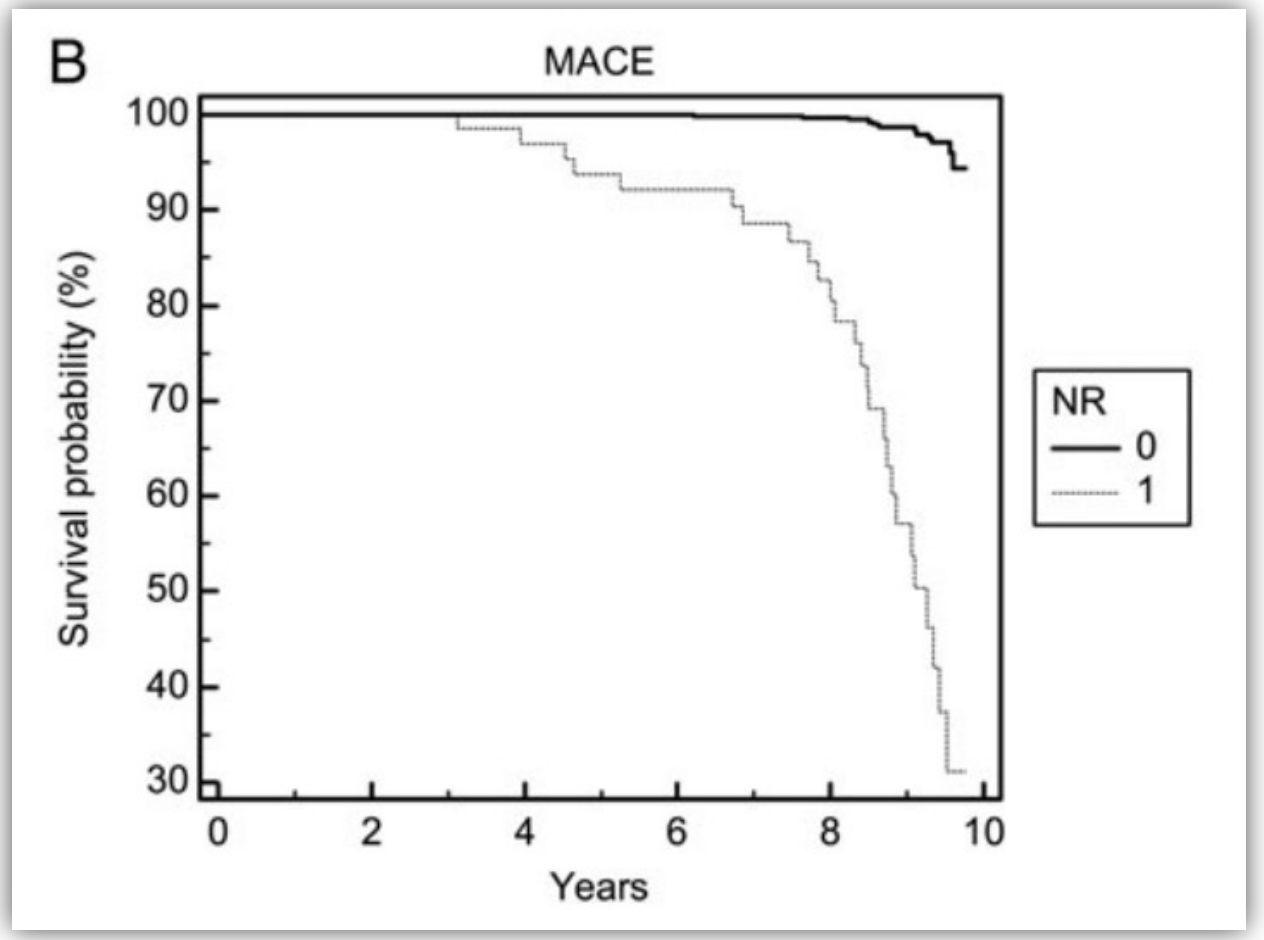
HIGH-RISK PLAQUE FEATURES
ROLE OF CCTA



Dawson LP, Layland J. Cardiol Ther. 2022 Sep;11(3):319-335. doi: 10.1007/s40119-022-00271-9

HIGH-RISK CRITERIA AND MACE





1469 pts

Feuchtner G. et al. Eur Heart J Cardiovasc Imaging. 2017 Jul 1;18(7):772-779. doi: 10.1093/ehjci/jew167

HIGH-RISK CRITERIA AND MACE

Table 5 HRP criteria in patients with MACE

	MACE ($n = 41$)	Non-MACE ($n = 1428$)	*P*-value
CT density (HU)			
Pixel lens	23.8 ± 22.7	48.6 ± 48	<0.001[a]
Area ROI	35.2 ± 32	108.8 ± 53	<0.001[a]
LAP <30 HU (pixel lens), *n* (%)	19 (46.3)	36 (2.5)	<0.001[b]
LAP <30 HU (ROI), *n* (%)	22 (53.6)	34 (2.4)	<0.0001[b]
LAP <60 HU (ROI), *n* (%)	31 (75.6)	91 (6.4)	<0.0001[b]
LAP <90 HU (ROI), *n* (%)	32 (78.0)	100 (7.0)	<0.0001[b]

LAP, low-attenuation plaque; ROI, region of interest; MACE, major adverse cardiac events; HU, Hounsfield Units.
[a]*t*-test.
[b]χ^2 test.

Table 6 HRP criteria vs. MACE

	MACE ($n = 41$)	Non-MACE ($n = 1428$)	*P*-value[a]
Napkin ring	26 (63.4%)	40 (2.8%)	<0.001
Spotty calcification	25 (61%)	206 (14.4%)	<0.001
RI	1.51 ± 0.37	1.3 ± 0.25	0.002
Calcium score (AU)	195.2 ± 335	140.1 ± 352	0.335

RI, remodelling index; AU, Agatston units.
[a]χ^2 test.

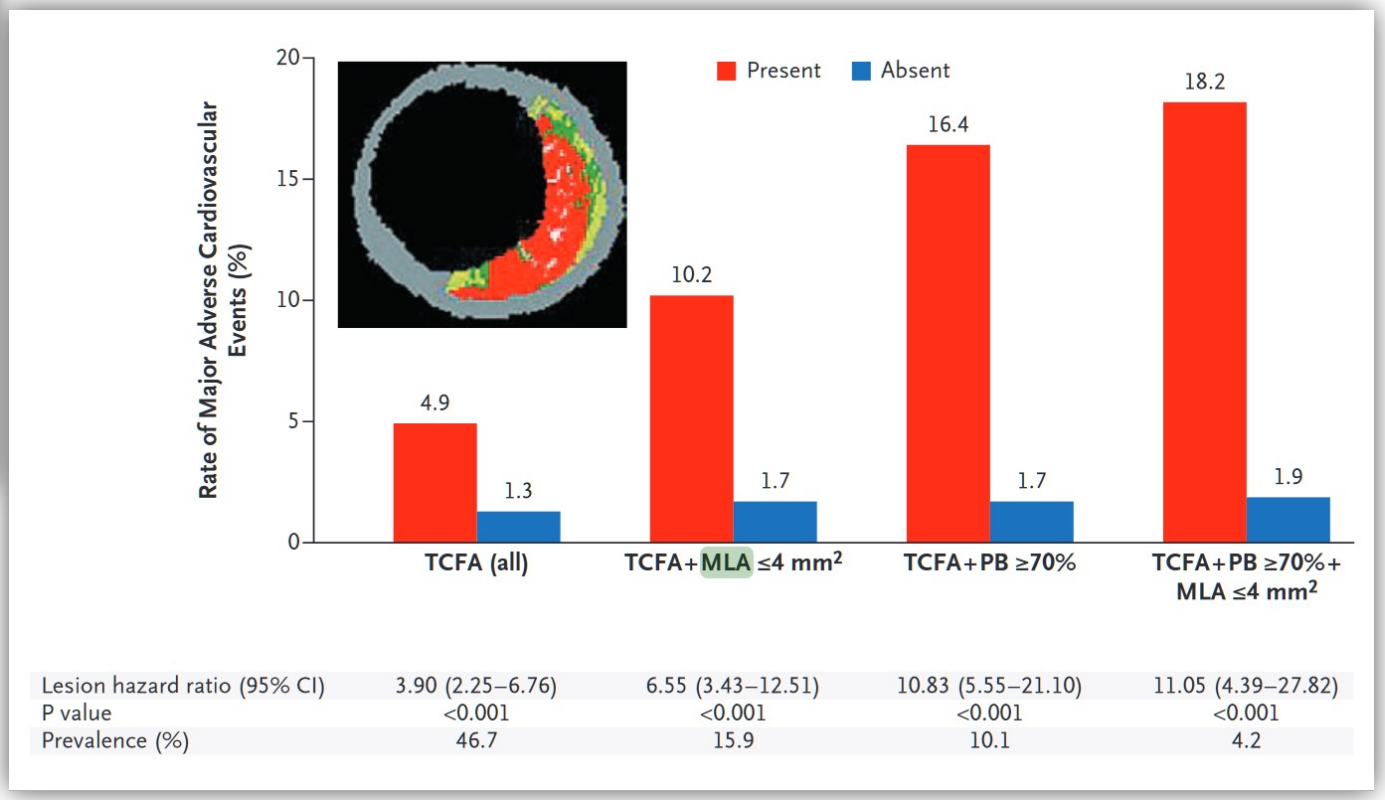
1469 pts

Feuchtner G. et al. Eur Heart J Cardiovasc Imaging. 2017 Jul 1;18(7):772-779. doi: 10.1093/ehjci/jew167

PROSPECT TRIAL

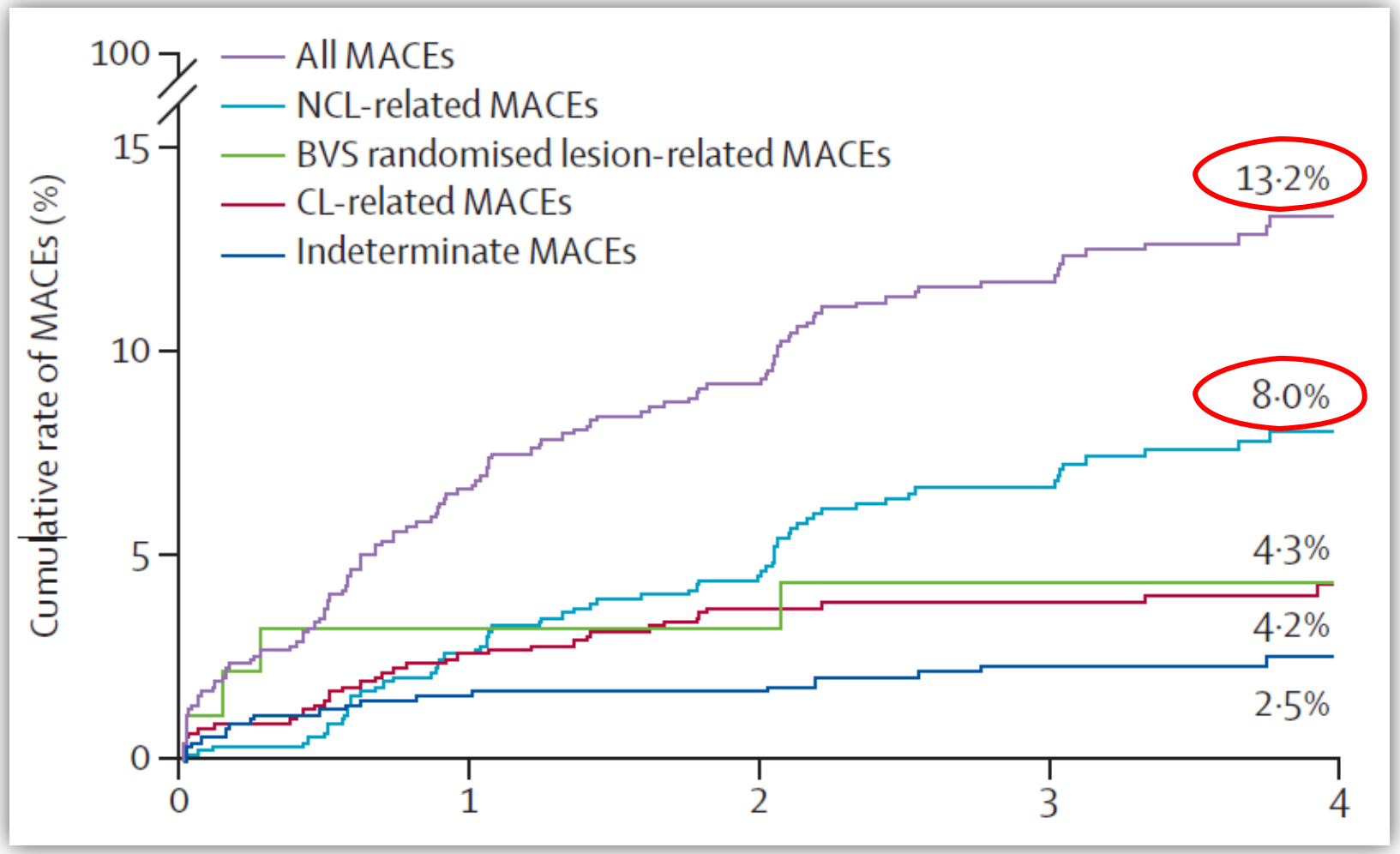
Table 3. Independent Correlates of Major Adverse Cardiovascular Events Related to Nonculprit Lesions during Follow-up.*

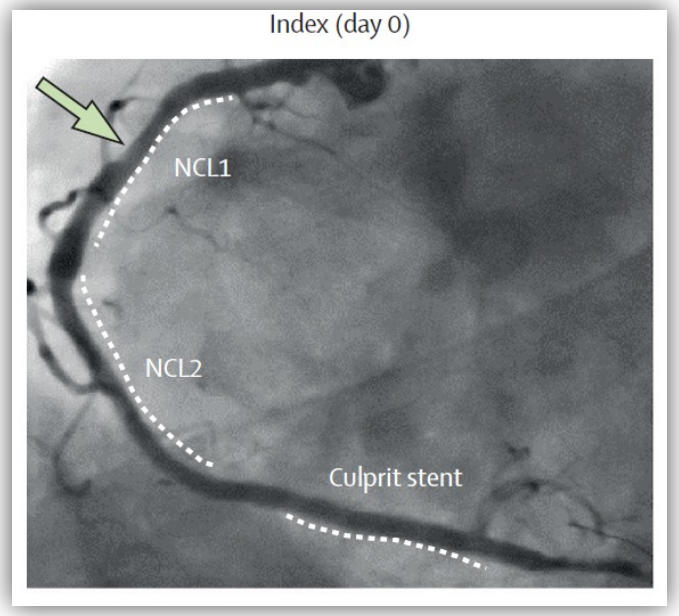
Correlates	Hazard Ratio (95% CI)	P Value
Predictors of patient-level events†		
Insulin-requiring diabetes	3.32 (1.43–7.72)	0.005
Previous percutaneous coronary intervention	2.03 (1.15–3.59)	0.02
Predictors of events at individual lesion sites‡		
Plaque burden ≥70%	5.03 (2.51–10.11)	<0.001
Thin-cap fibroatheroma	3.35 (1.77–6.36)	<0.001
MLA ≤4.0 mm²	3.21 (1.61–6.42)	0.001

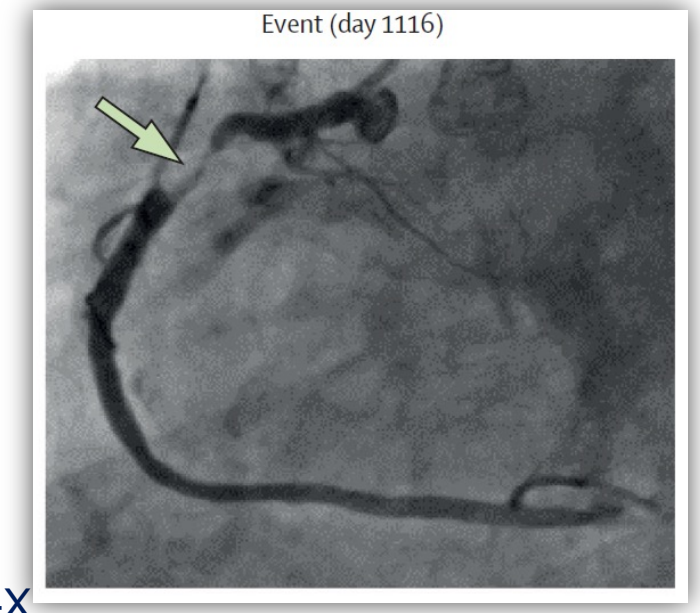


Stone GW et al. N Engl J Med. 2011 Jan 20;364(3):226-35. doi: 10.1056/NEJMoa1002358

PROSPECT II TRIAL

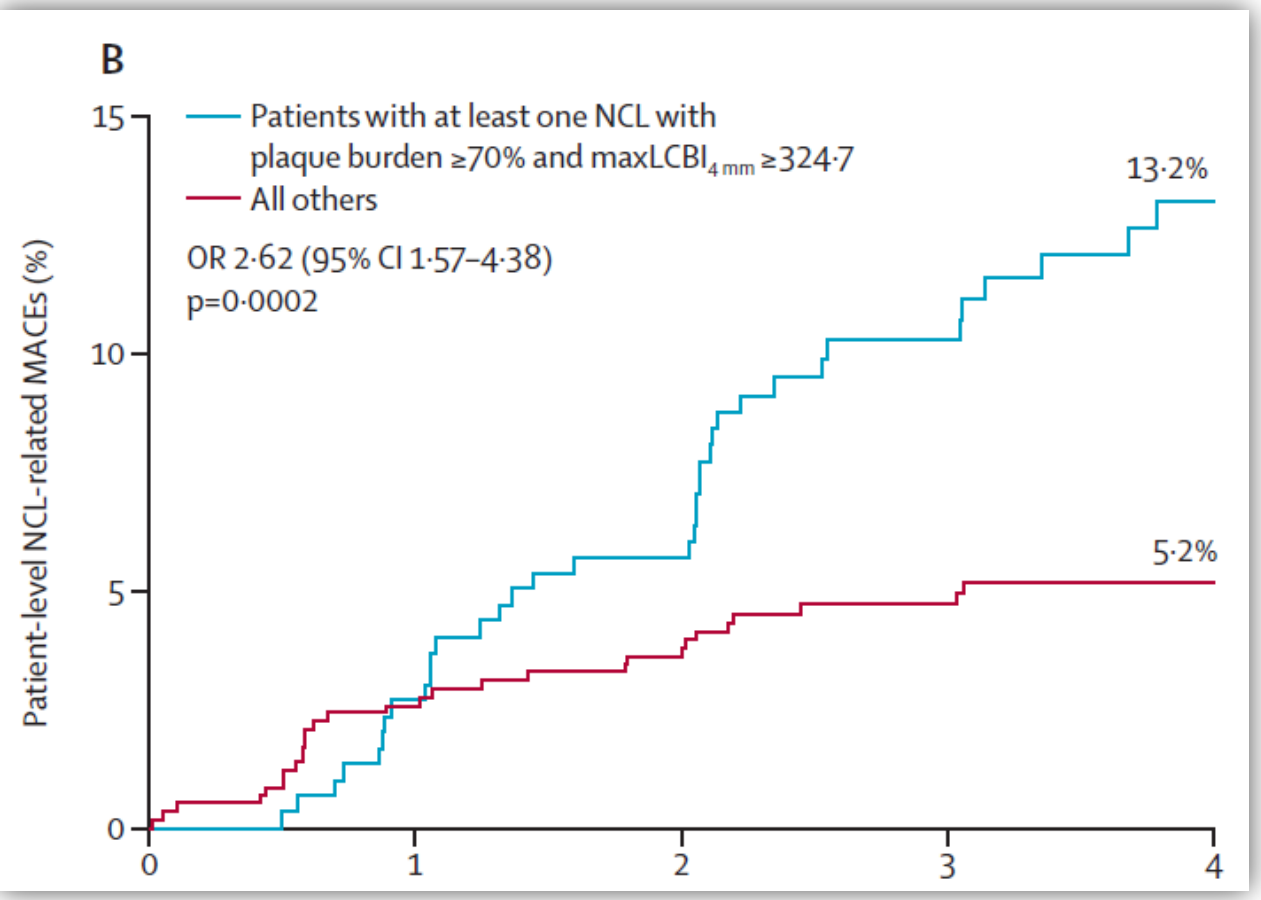


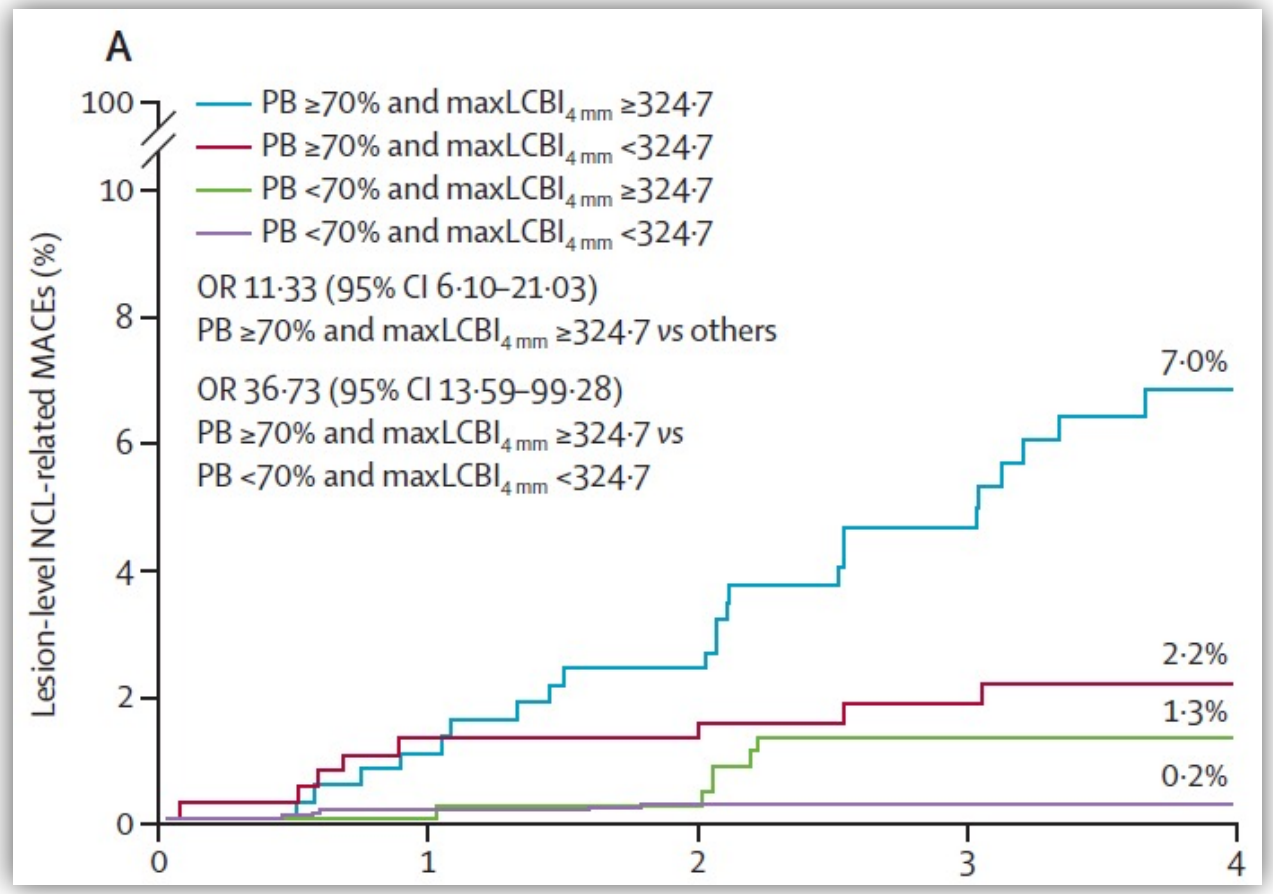




Erlinge D et al. Lancet. 2021 Mar 13;397(10278):985-995. doi: 10.1016/S0140-6736(21)00249-X.

PROSPECT II TRIAL



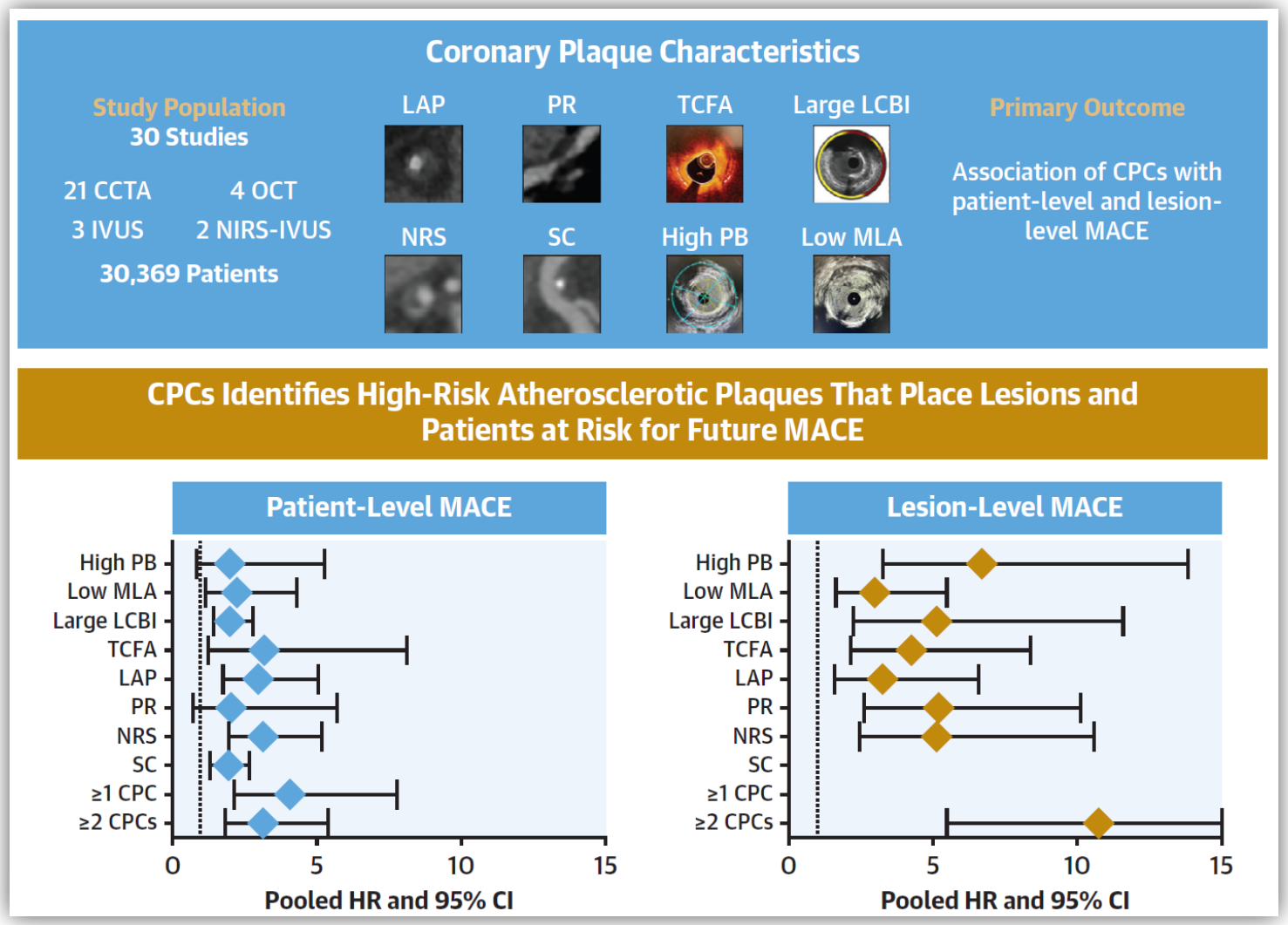


Per lesion

Per patient

Erlinge D et al. Lancet. 2021 Mar 13;397(10278):985-995. doi: 10.1016/S0140-6736(21)00249-X.

PLAQUE FEATURES ASSOCIATED WITH MACEs



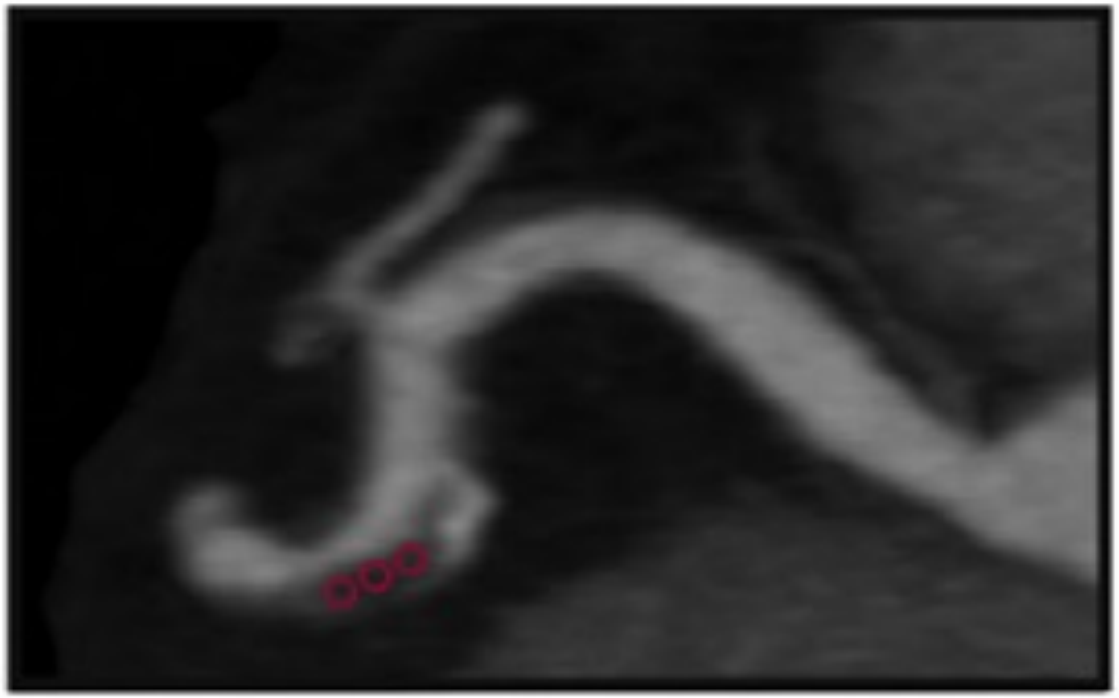
COMPETENCY IN MEDICAL KNOWLEDGE: Coronary plaque characteristics assessed with coronary computed tomography angiography or invasive intravascular imaging modalities consistently predict major adverse cardiovascular events among atherosclerotic patients and lesions. However, because the rate of major adverse cardiovascular events is low, the estimated positive predictive values for lesion-level major adverse cardiovascular events are modest.

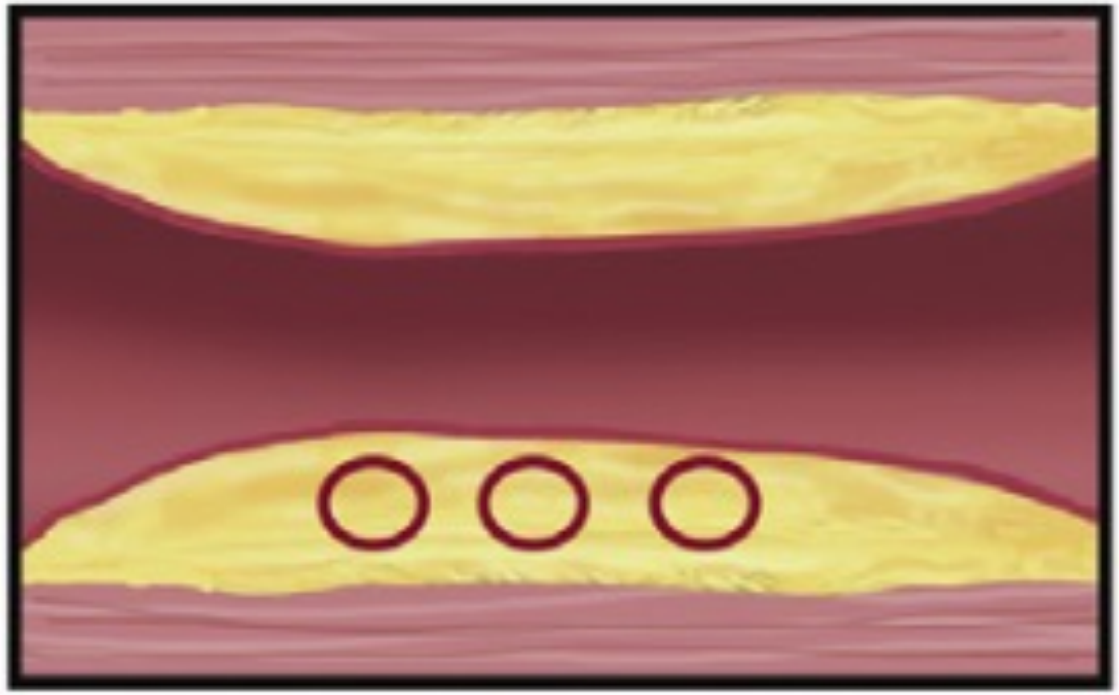
TRANSLATIONAL OUTLOOK: Given the modest sensitivity and positive predictive values observed across all coronary plaque characteristics, the utility of advanced plaque imaging to categorize high-risk patients requires further investigation. For the same reason, the utility of novel pharmacologic intensification and intervention-based plaque passivation approaches guided by coronary plaque characteristics remains to be established.

Gallone G. et al. JACC Cardiovasc Imaging. 2023 Dec;16(12):1584-1604. doi: 10.1016/j.jcmg.2023.08.006.

LOW-ATTENUATION PLAQUE

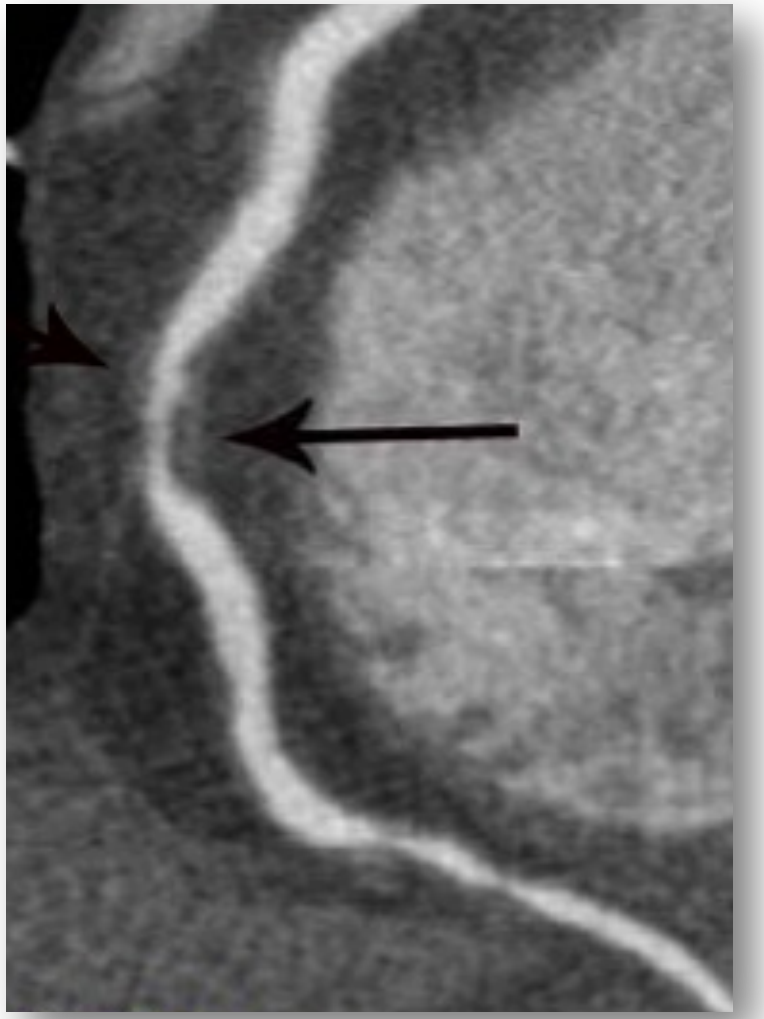
Attenuation: < 30 HU

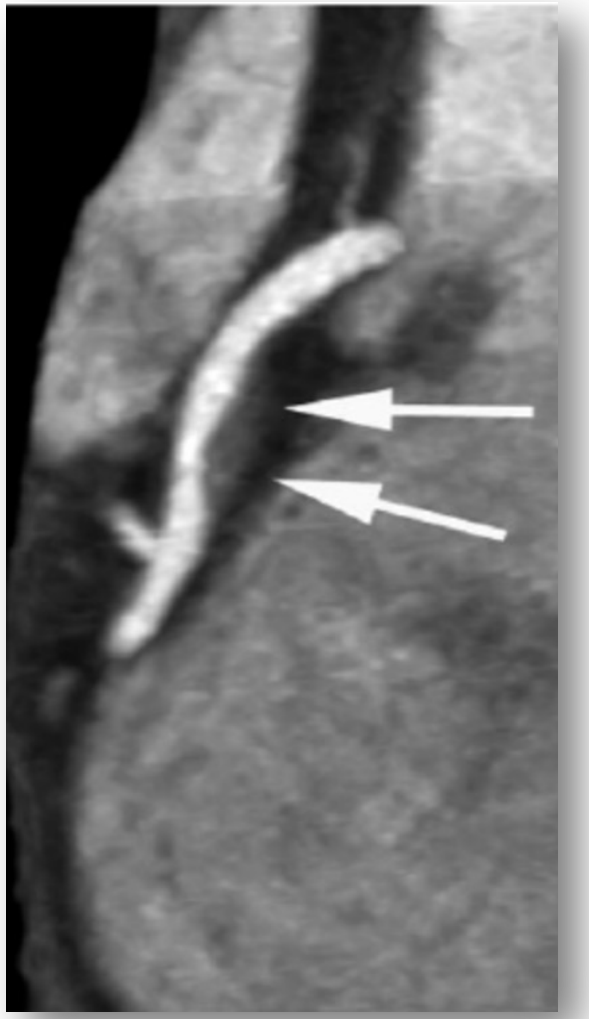




Motoyama S et al. J Am Coll Cardiol. 2007 Jul 24;50(4):319-26. doi: 10.1016/j.jacc.2007.03.044
Motoyama S et al. J Am Coll Cardiol. 2009 Jun 30;54(1):49-57. doi: 10.1016/j.jacc.2009.02.068
Puchner SB et al. J Am Coll Cardiol. 2014 Aug 19;64(7):684-92. doi: 10.1016/j.jacc.2014.05.039

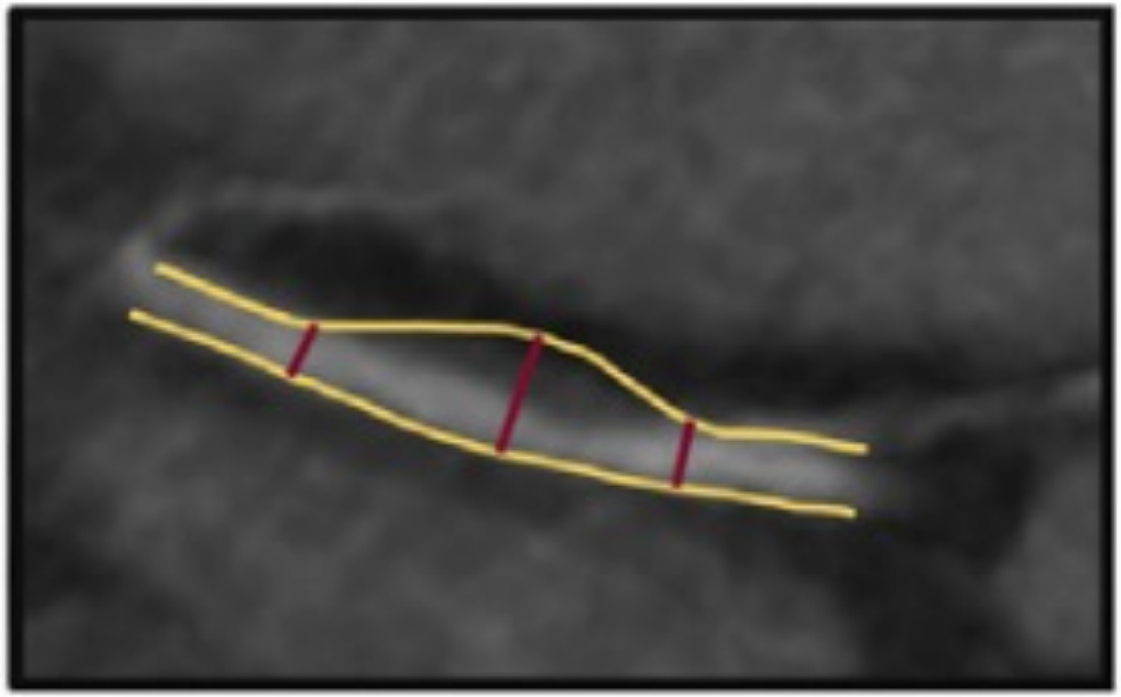
LOW-ATTENUATION PLAQUE

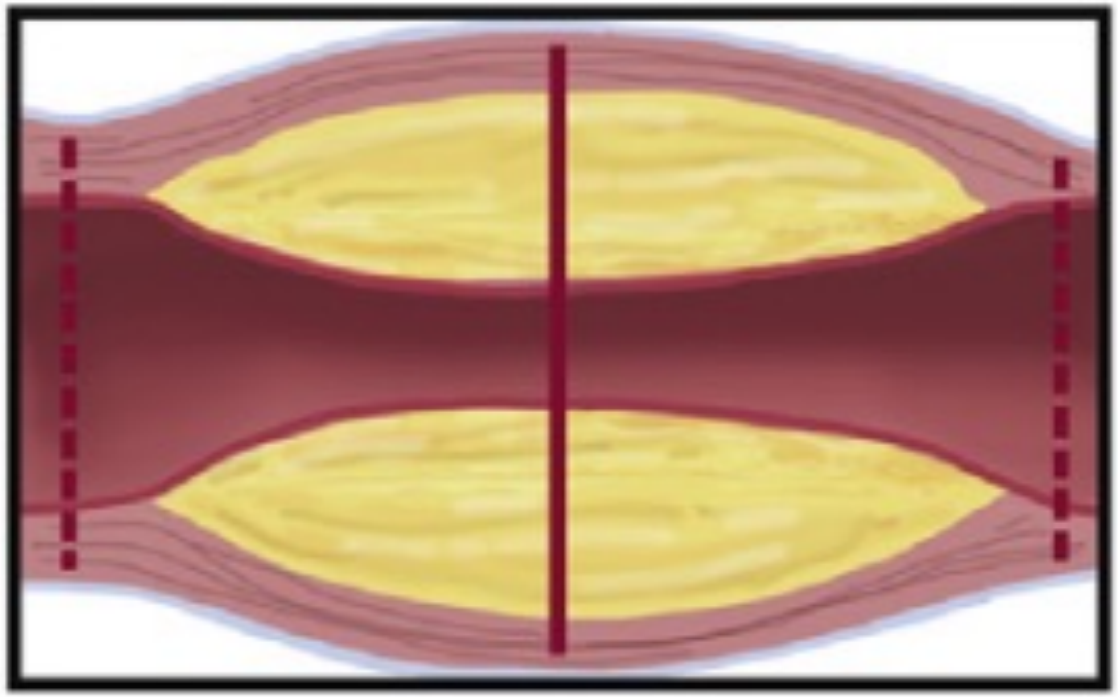




POSITIVE REMODELING

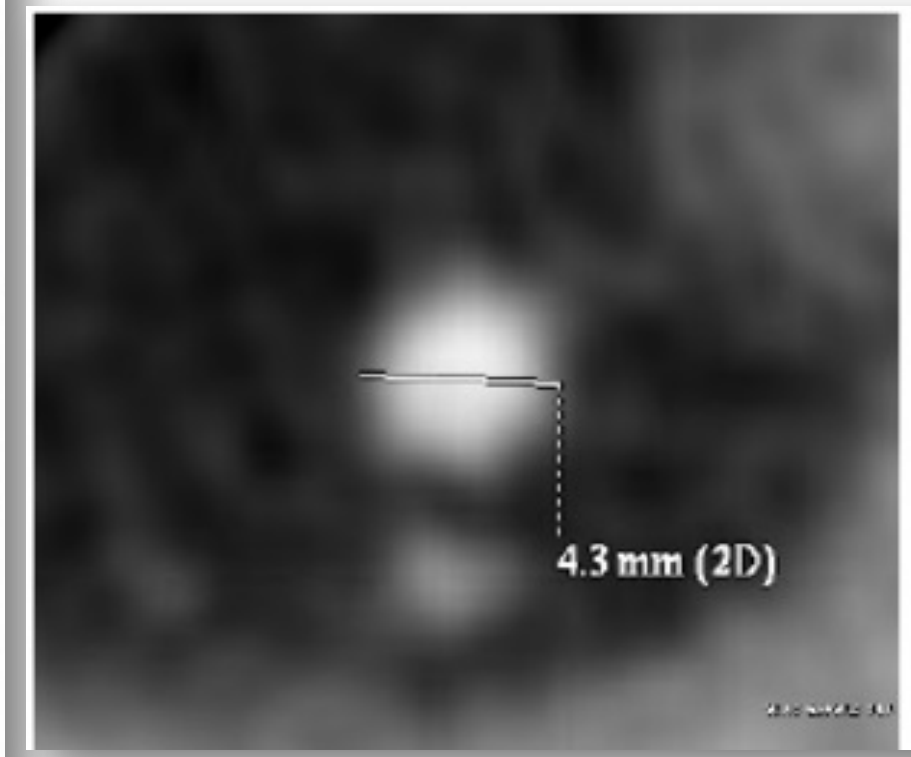
Remodeling Index: ≥ 1.1

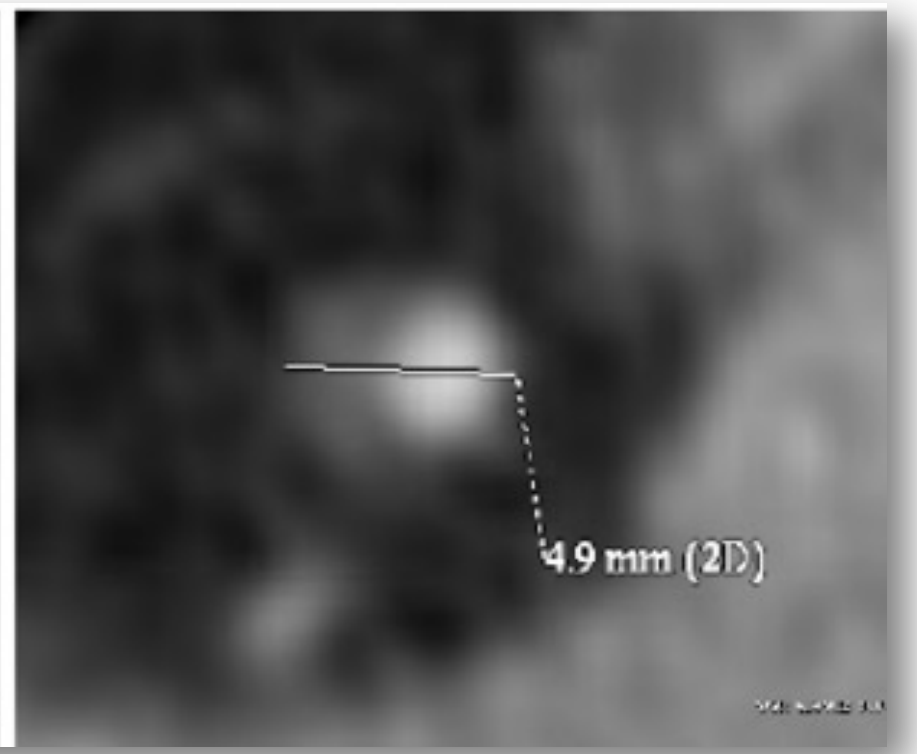




Hoffmann U et al. J Am Coll Cardiol. 2006 Apr 18;47(8):1655-62. doi: 10.1016/j.jacc.2006.01.041
Gauss S et al. Heart. 2011 Jun;97(12):991-7. doi: 10.1136/hrt.2011.223024
Puchner SB et al. J Am Coll Cardiol. 2014 Aug 19;64(7):684-92. doi: 10.1016/j.jacc.2014.05.039

POSITIVE REMODELING

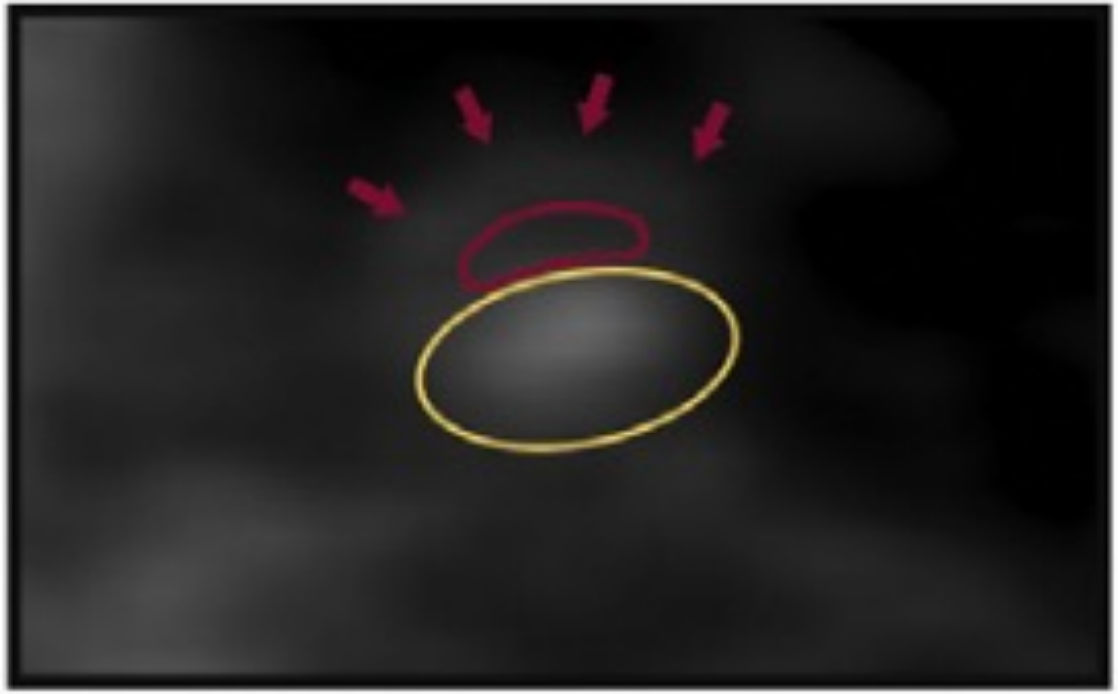


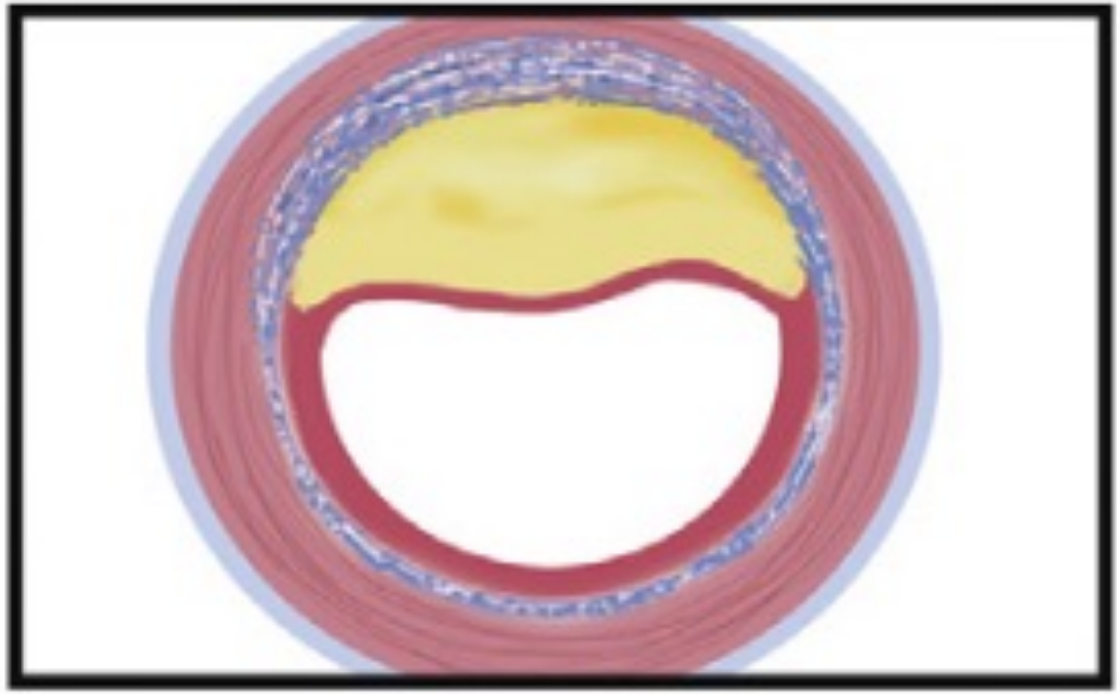


Remodeling Index: $\frac{4.9}{4.3} = 1.14$

NAPKIN-RING SIGN

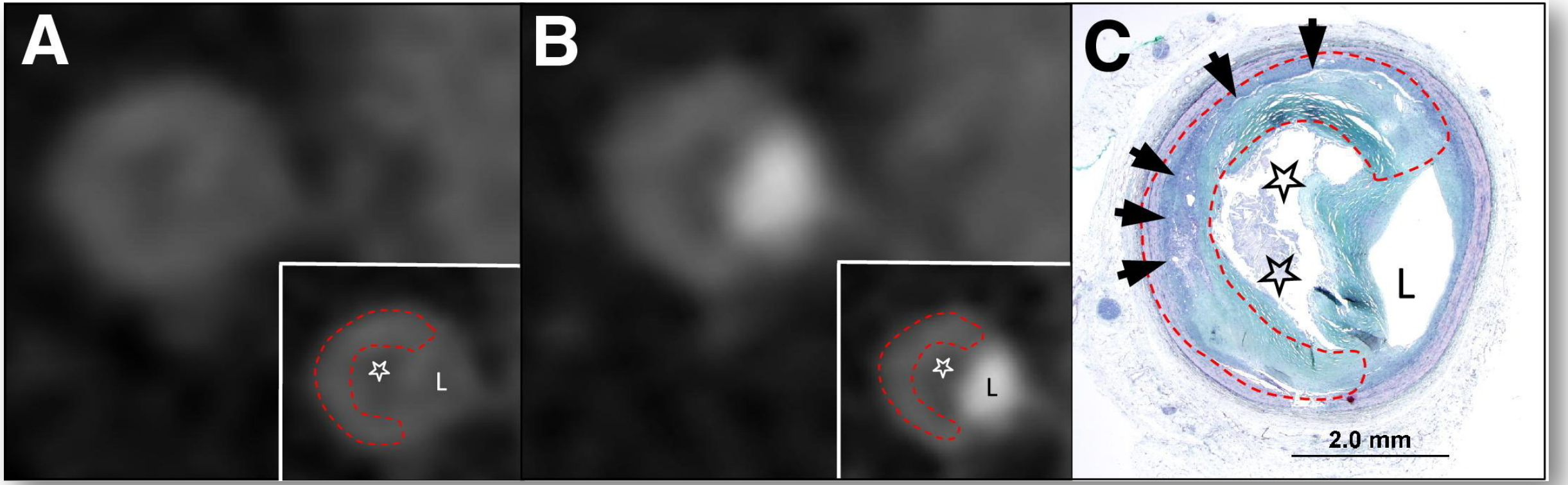
Ring-like peripheral higher attenuation of the non-calcified portion of the plaque





Maurovich-Horvat P et al. JACC Cardiovasc Imaging. 2010 Apr;3(4):440-4. doi: 10.1016/j.jcmg.2010.02.003
Puchner SB et al. J Am Coll Cardiol. 2014 Aug 19;64(7):684-92. doi: 10.1016/j.jacc.2014.05.039

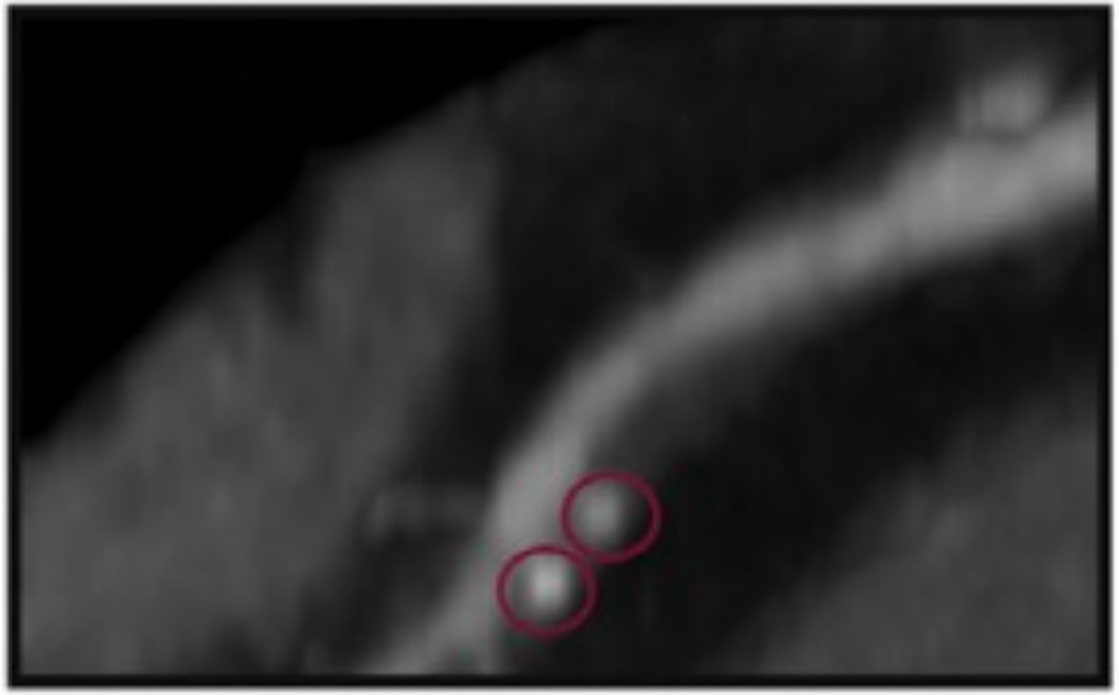
NAPKIN-RING SIGN

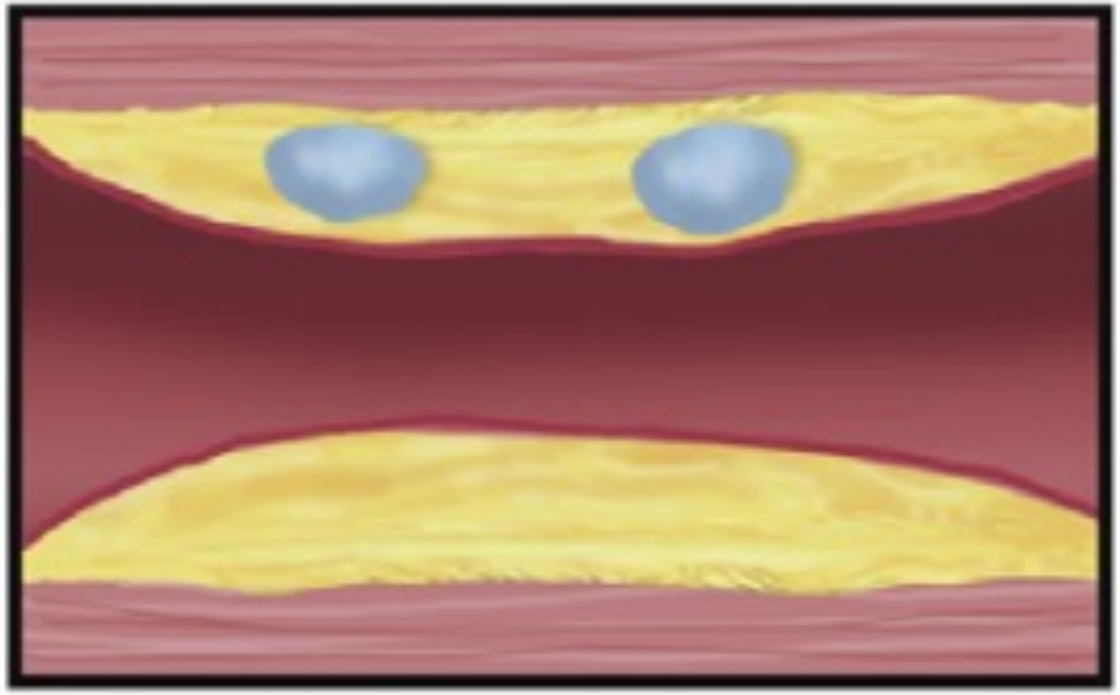


Maurovich-Horvat P et al. JACC Cardiovasc Imaging. 2010 Apr;3(4):440-4. doi: 10.1016/j.jcmg.2010.02.003
Puchner SB et al. J Am Coll Cardiol. 2014 Aug 19;64(7):684-92. doi: 10.1016/j.jacc.2014.05.039

SPOTTY CALCIFICATIONS

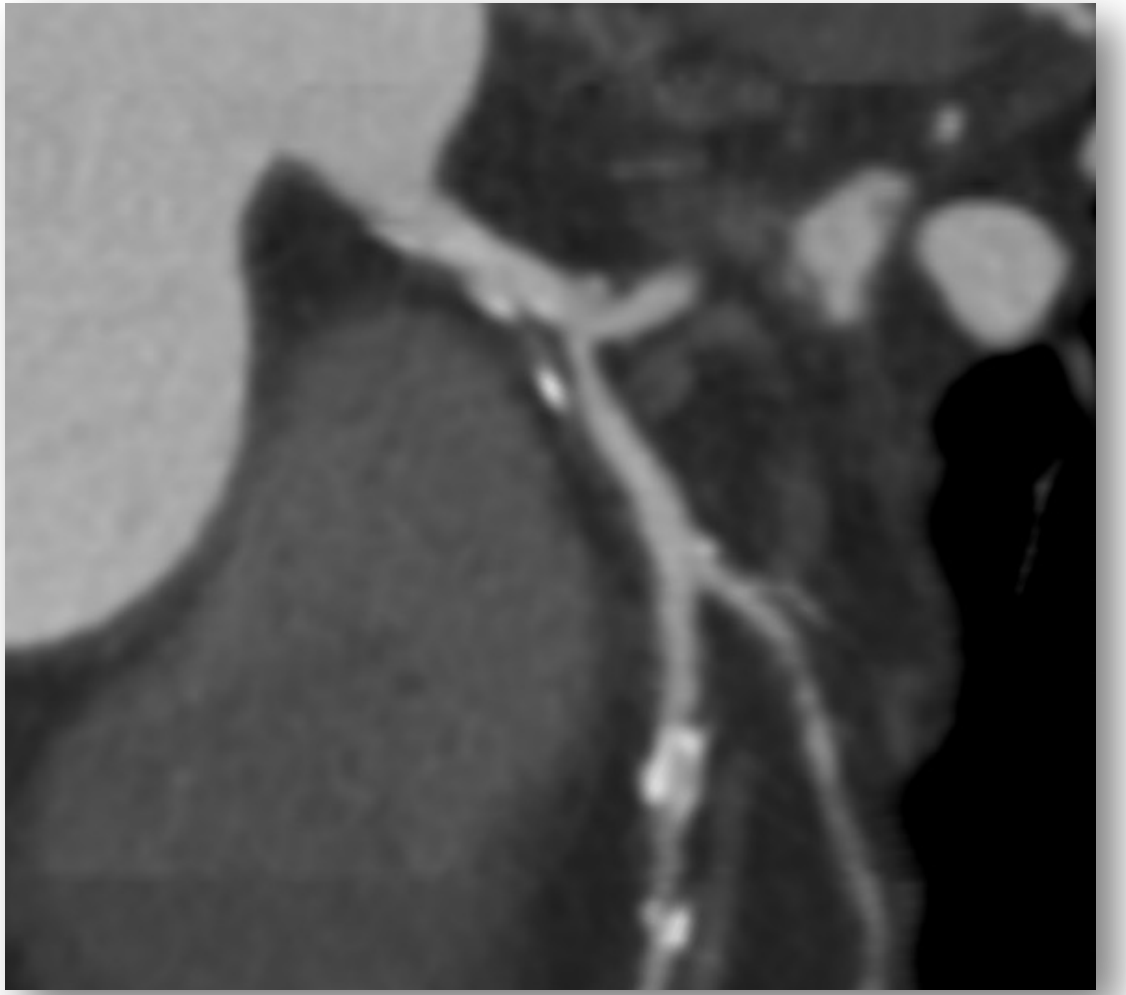
- Calcified plaque with a ⌀ < 3 mm in any direction
- Length of the calcium < 1.5 times the vessel ⌀
- Width of the calcification < 2/3 of the vessel ⌀

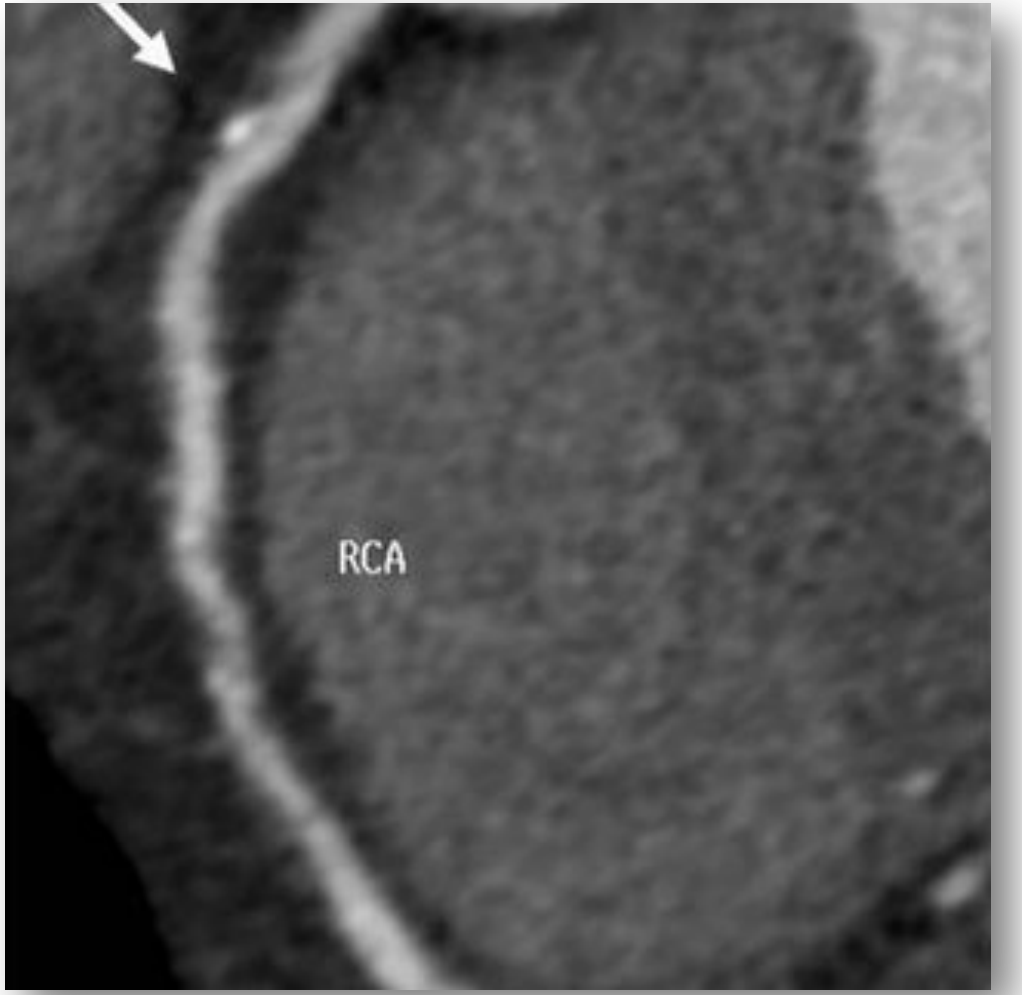




Puchner SB et al. J Am Coll Cardiol. 2014 Aug 19;64(7):684-92. doi: 10.1016/j.jacc.2014.05.039

SPOTTY CALCIFICATIONS

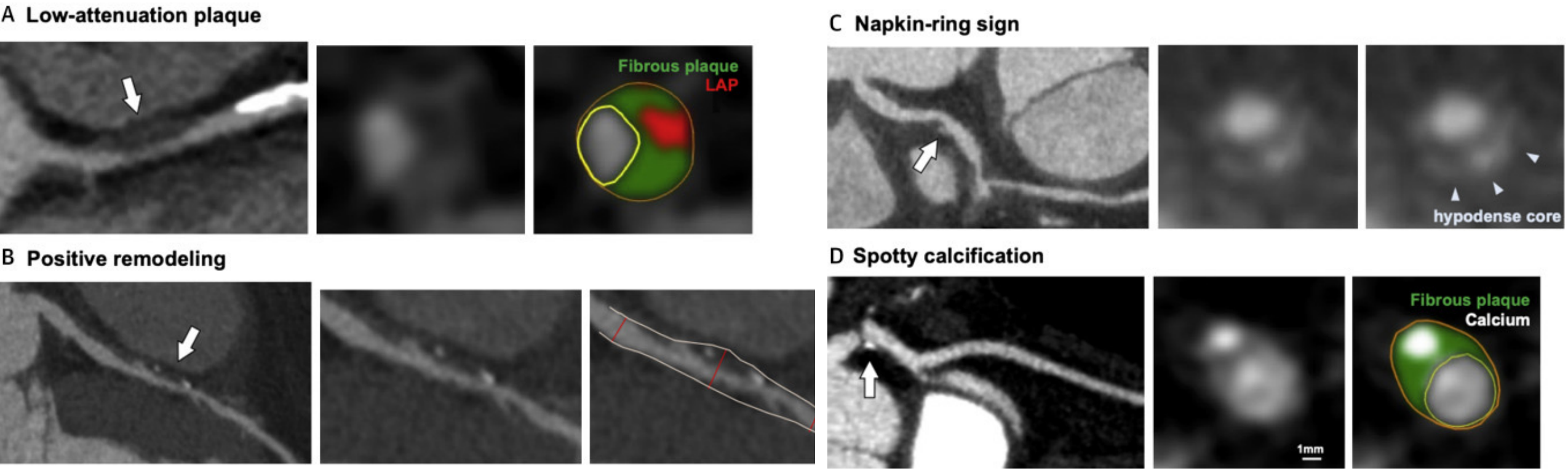




Puchner SB et al. J Am Coll Cardiol. 2014 Aug 19;64(7):684-92. doi: 10.1016/j.jacc.2014.05.039

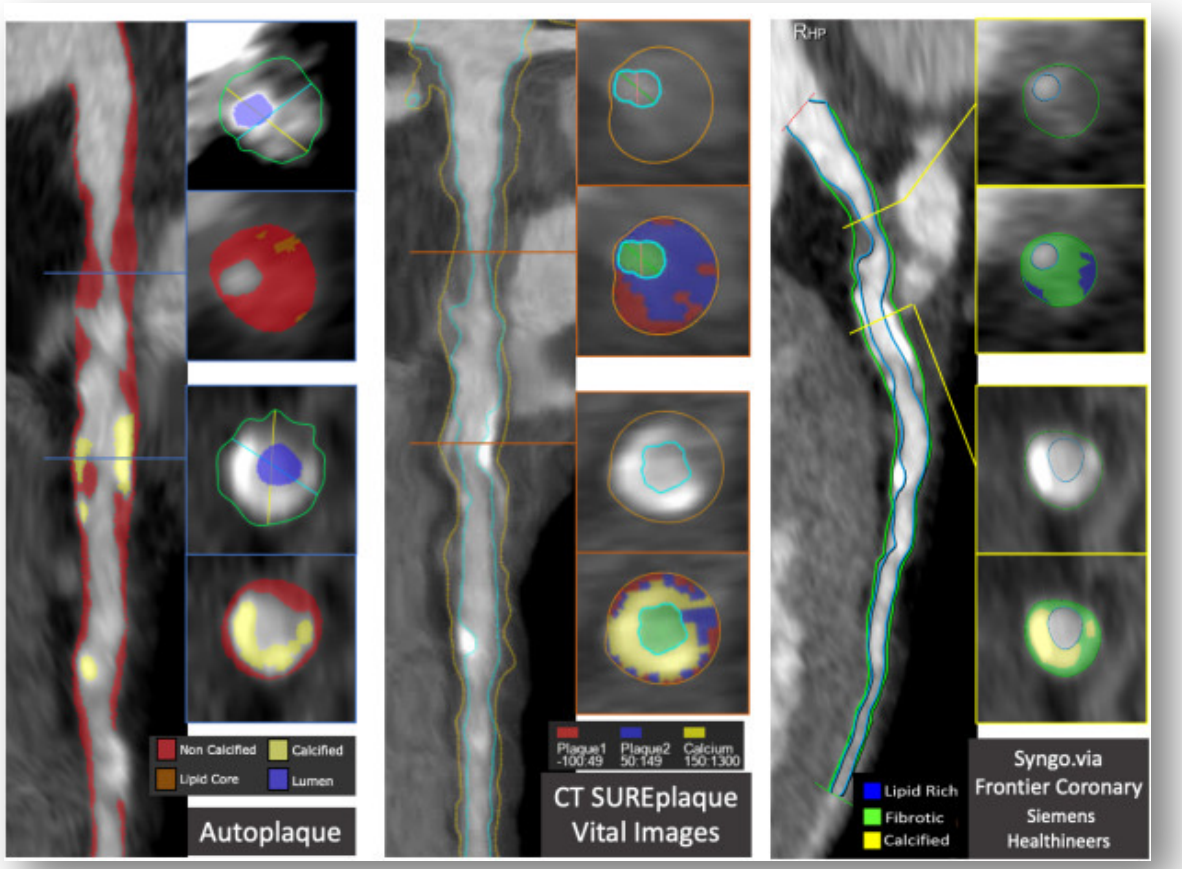
VULNERABLE PLAQUE

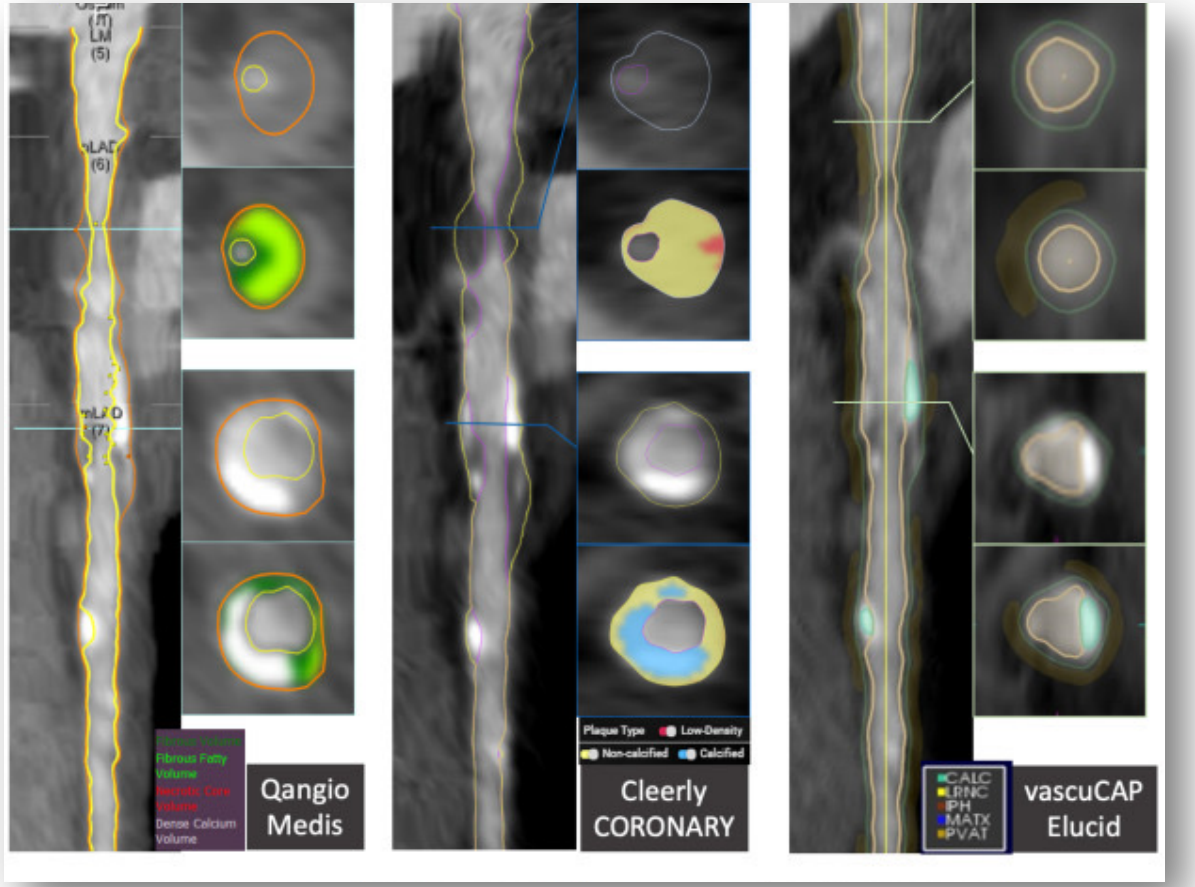
Recap…



PLAQUE ANALYSIS

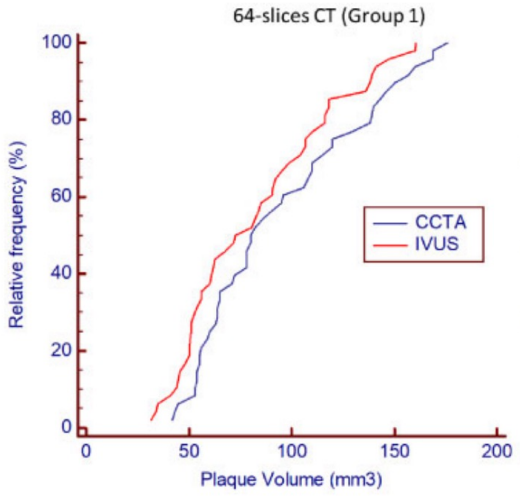
Esistono oggi molti software a supporto del radiologo in grado di analizzare automaticamente la composizione di una placca oltre che di definirne il grado di stenosi

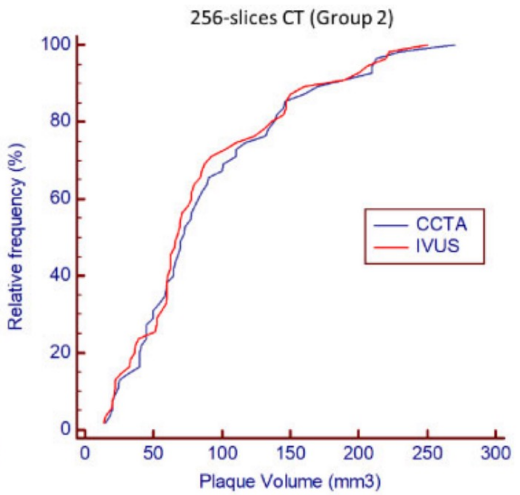


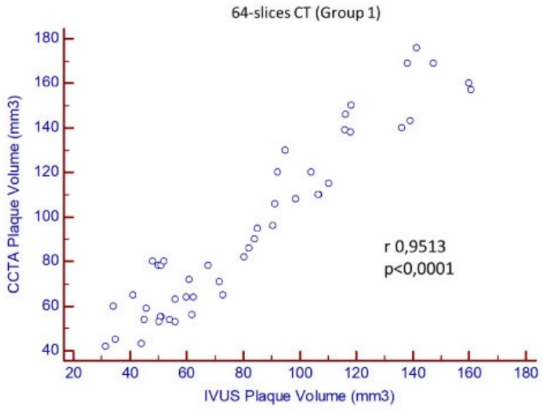


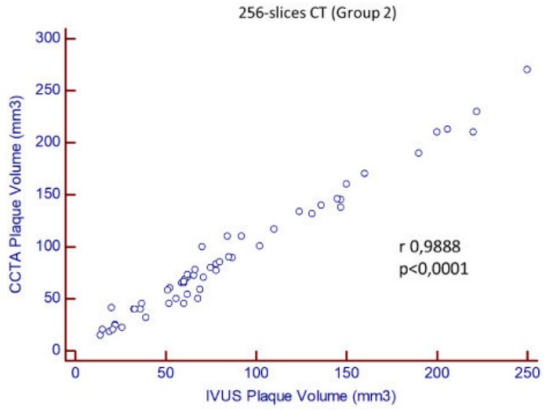
Spesso è necessaria una segmentazione manuale/semi-automatica

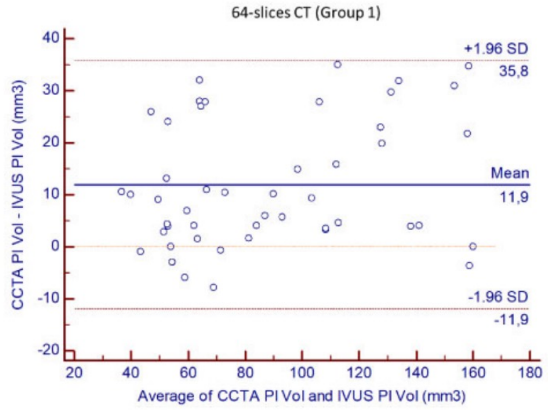
AUTOMATED PLAQUE QUANTIFICATION - INFLUENCE OF CT TECHNOLOGY

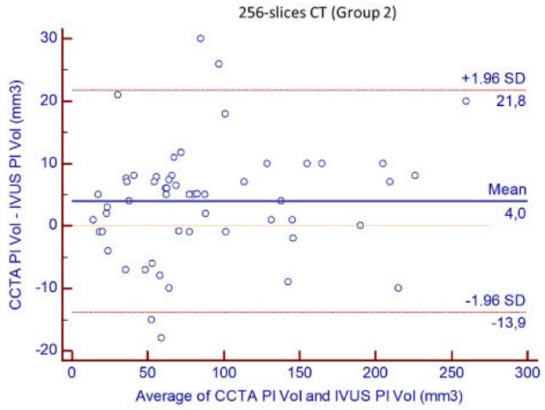


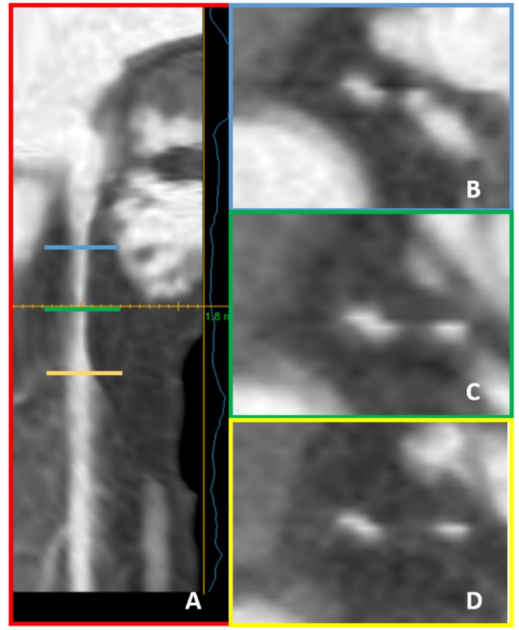












Conte E. et al. European Heart Journal - Cardiovascular Imaging (2020) 21, 191–201 doi:10.1093/ehjci/jez089

SAPIENZA UNIVERSITÀ DI ROMA

REPORT

SISTEMA SANITARIO REGIONALE
AZIENDA OSPEDALIERO-UNIVERSITARIA SANT'ANDREA

What's needed:

- Quantification of coronary calcium (**CaSC** – Agatson Score)
- Plaque **localization** (LAD, LCx, RCA)
- Plaque **composition**
  - Calcified
  - Non-calcified
    - Fatty
    - Fibro-fatty
  - Mixed
- Plaque **Geometry**
  - Eccentric
  - Concentric
- **Vulnerability features**
  - Low-density
  - Positive Remodeling
  - Napkin Ring Sing
  - Spotty Calcifications

What's Missing?

Stenosis Severity
(CAD-RADS 2.0)

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
U.O.C. di Radiologia
AOU Sant'Andrea Sapienza Università di Roma

SISTEMA SANITARIO REGIONALE
AZIENDA OSPEDALIERO-UNIVERSITARIA SANT'ANDREA

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Dept of Medical-Surgical Science and Translational Imaging

Sapienza - University of Rome

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