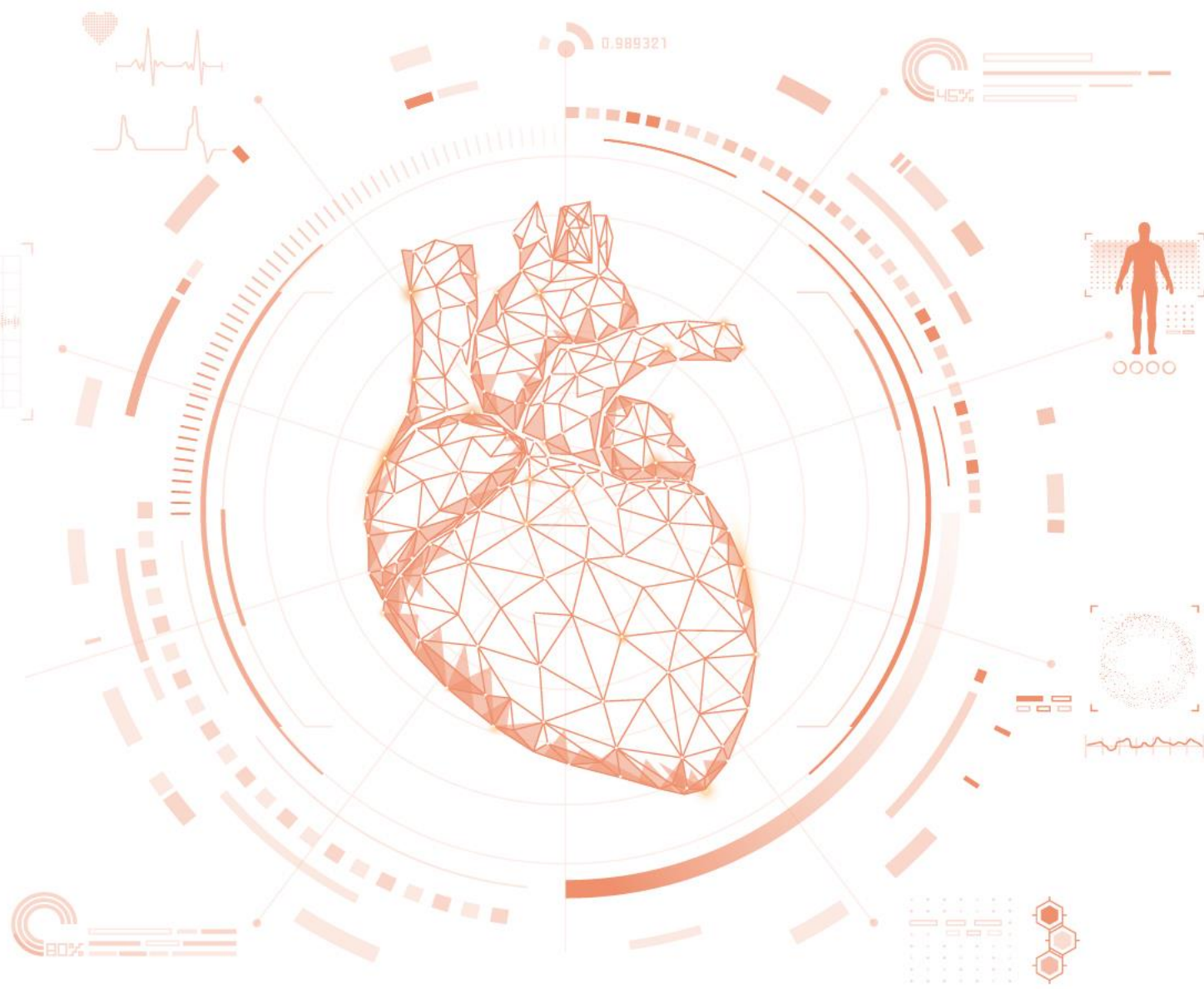
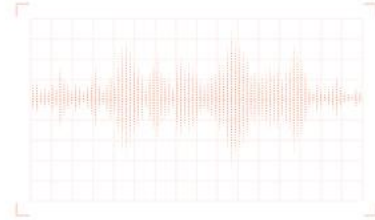


Liderando el conocimiento del mañana

Cardio**Advanced**Forum



Yo pediría un TC para...

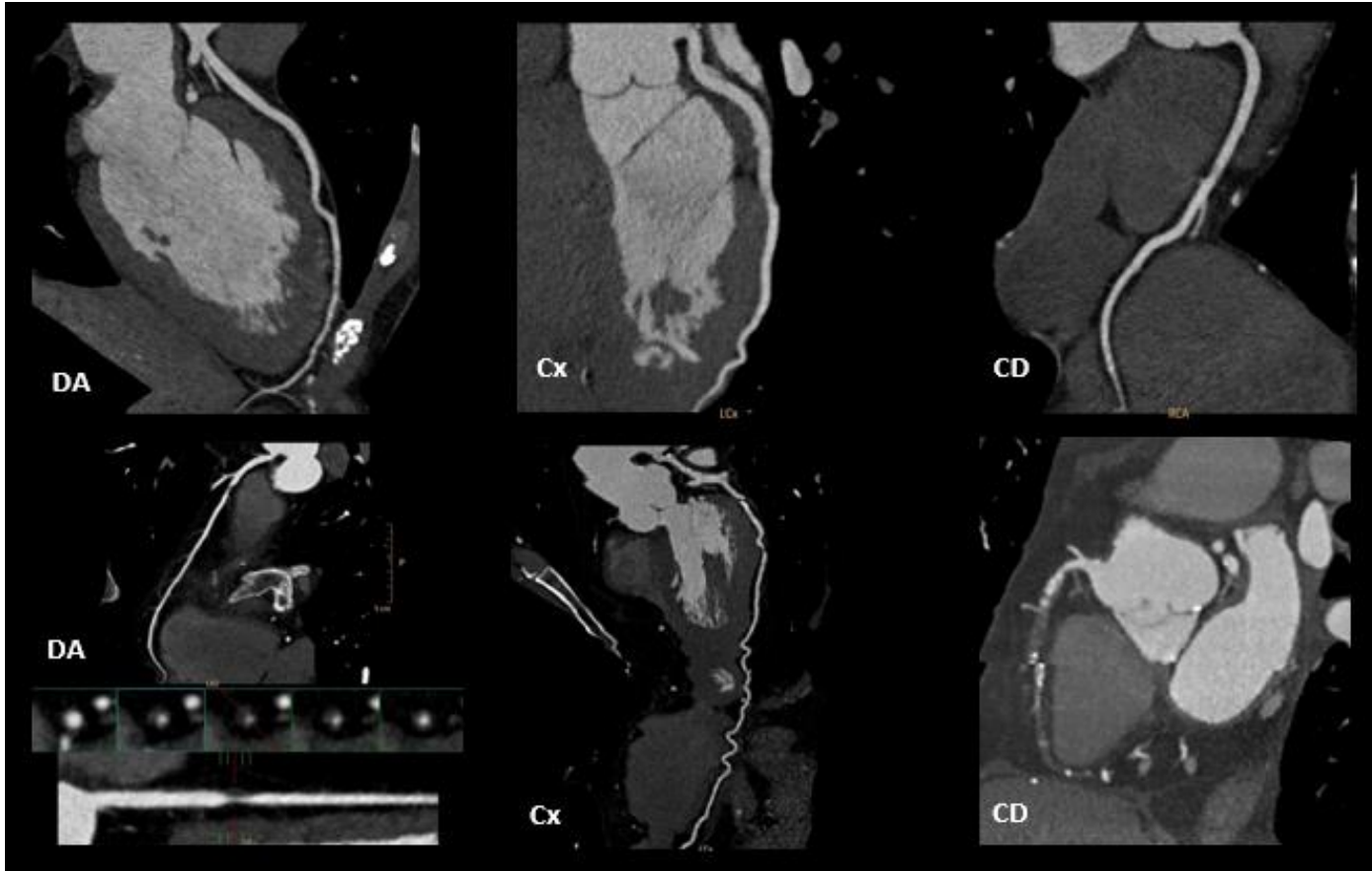
Novedades en diagnóstico cardiológico que modificarán la práctica clínica



TC coronario, ¿en este paciente?

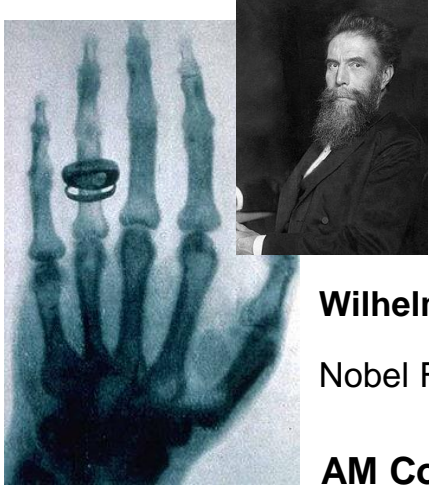


TC coronario, ¿en este paciente?



¿Qué es un TC cardiaco?

¿Cómo funciona un TC?

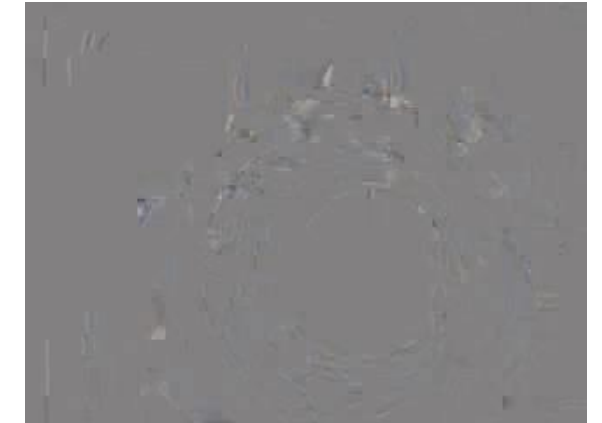
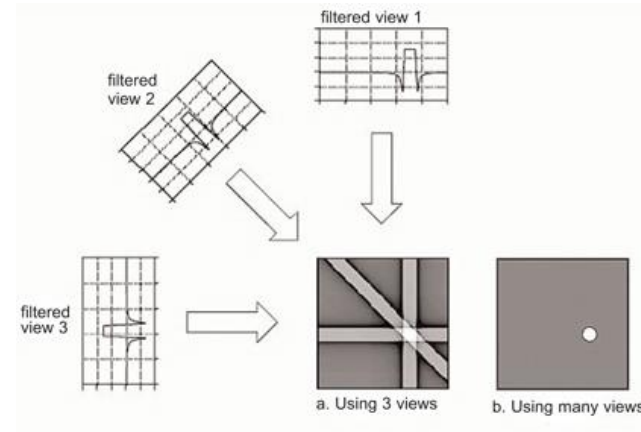
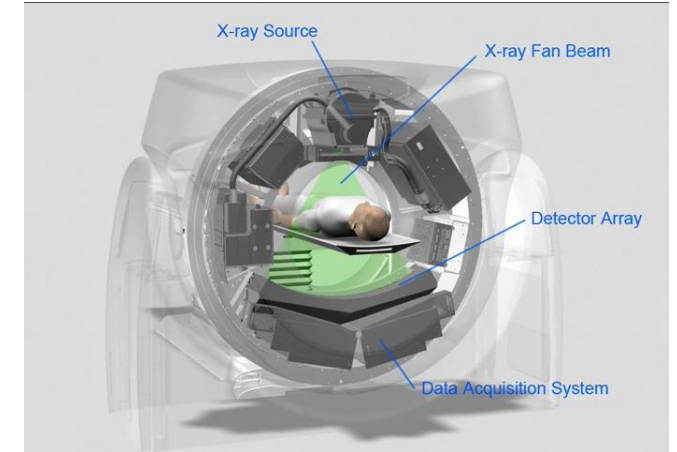
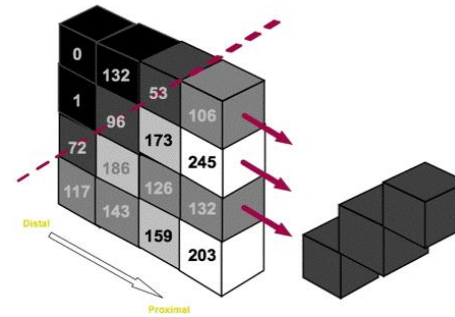
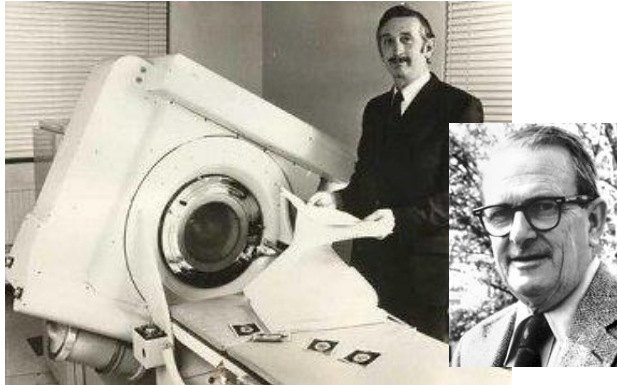
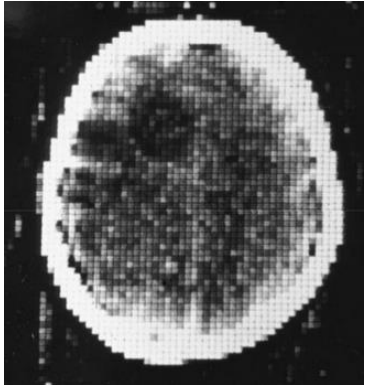


Wilhelm Röntgen, 1895

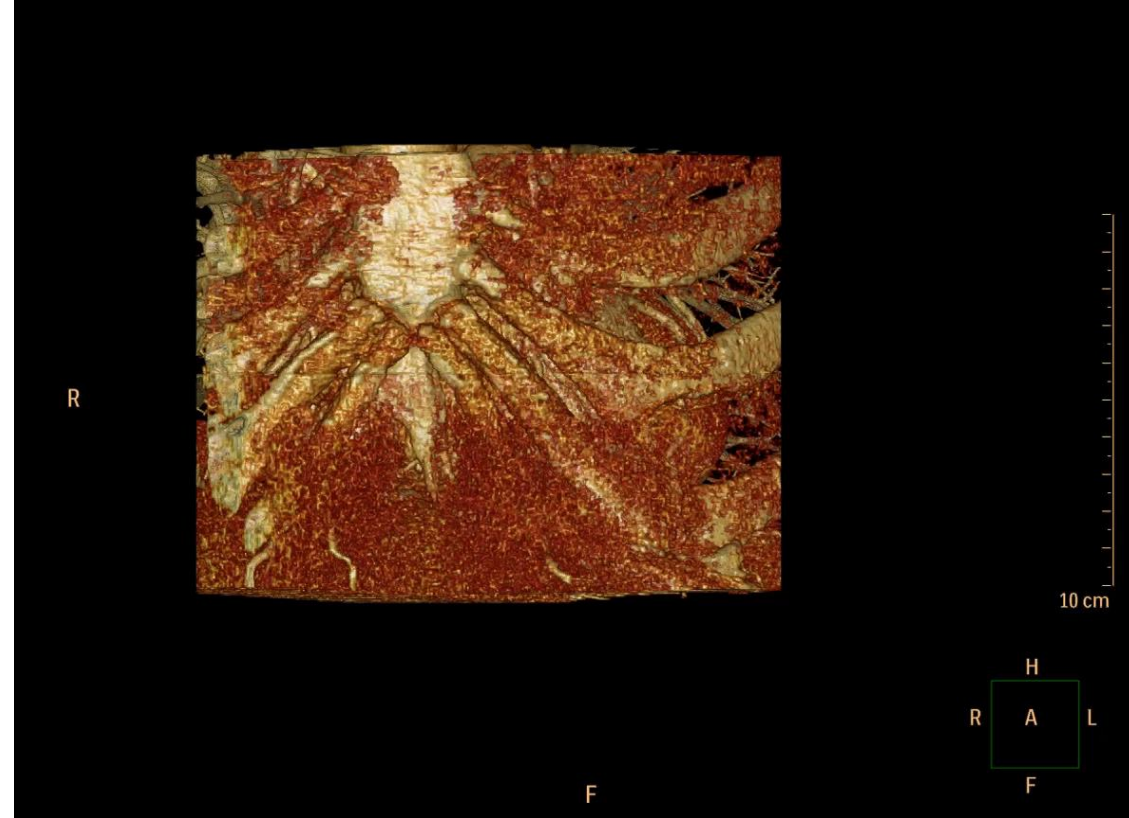
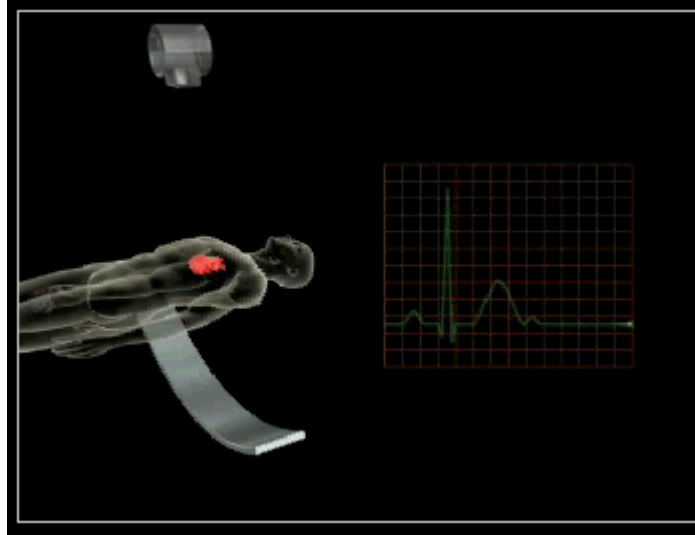
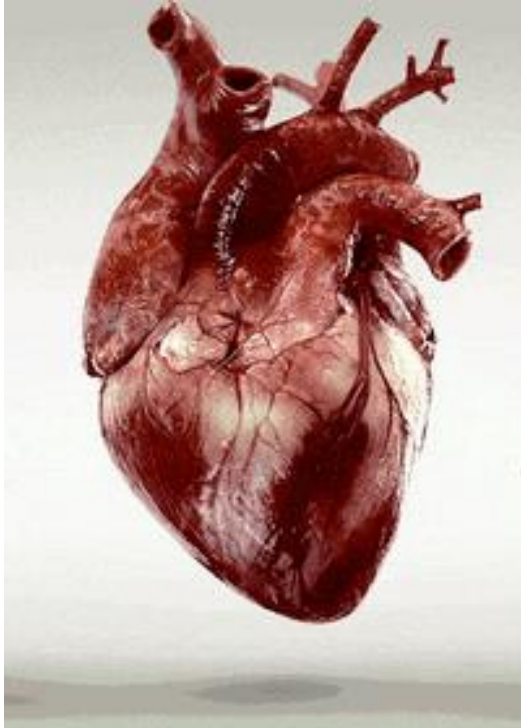
Nobel Física 1901

AM Cormack y GN Hounsfield, 1971

Nobel de Fisiología y Medicina 1979

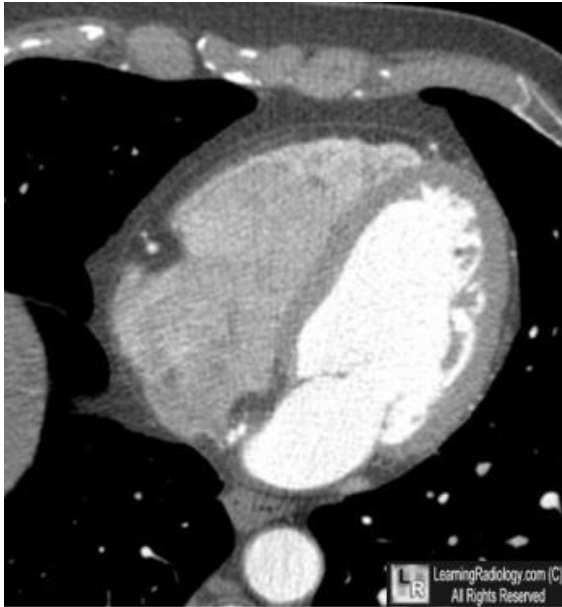


¿Y el movimiento cardiaco?

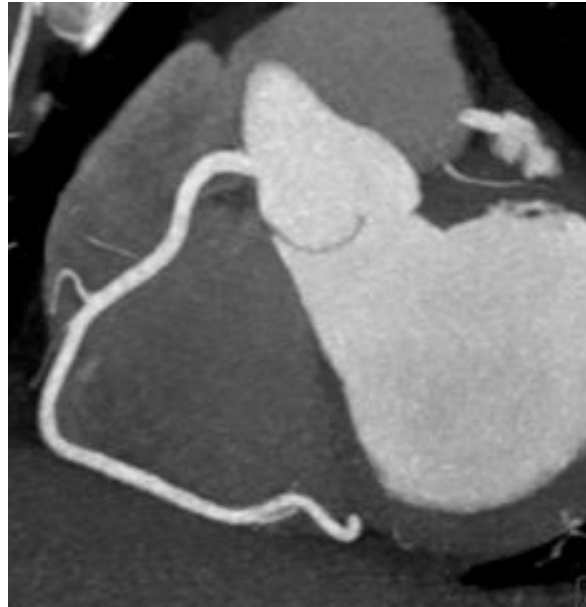


¿Cómo se puede visualizar un TC?

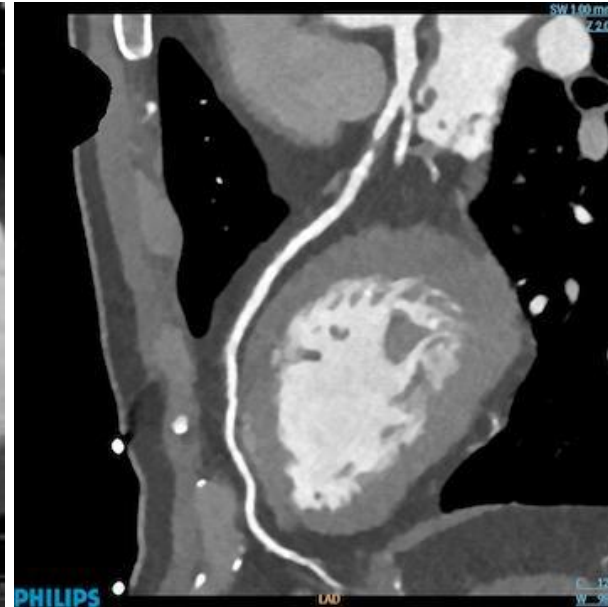
Axial



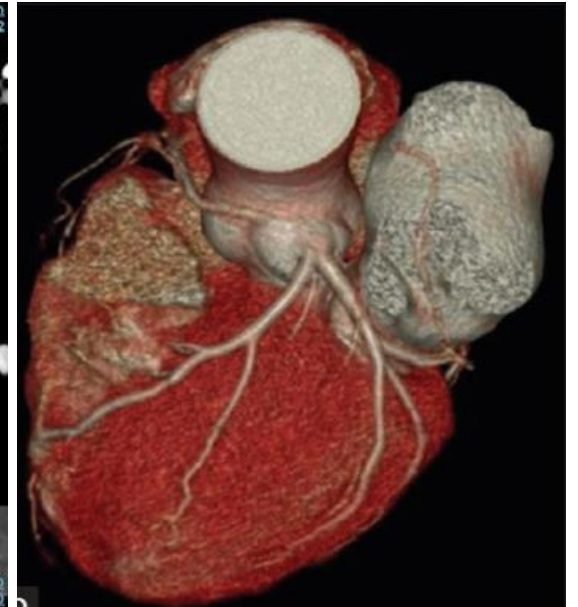
MIP



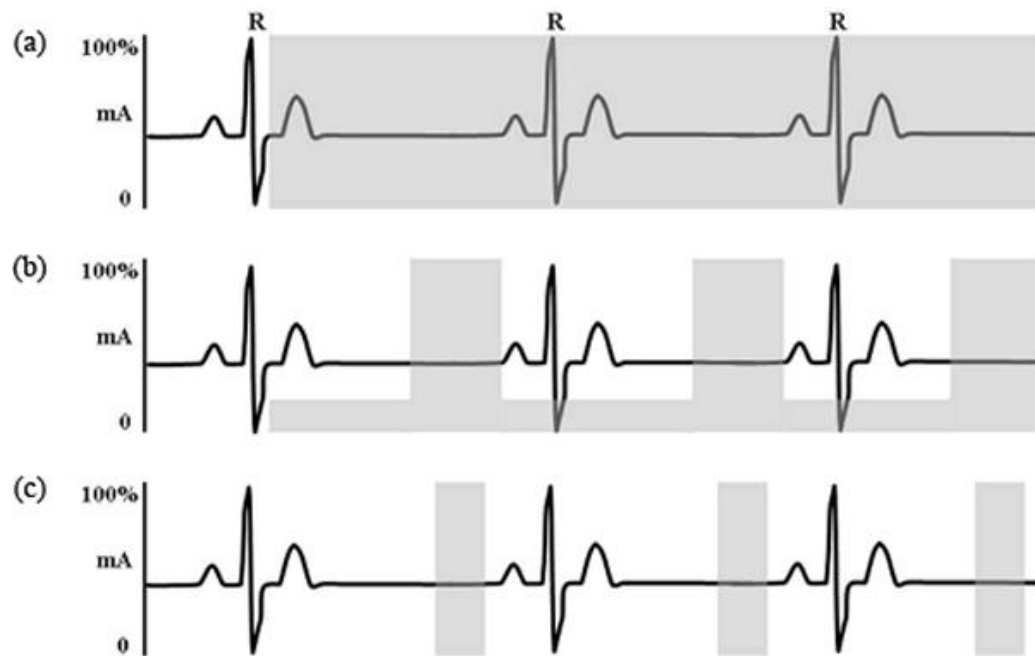
MPR curvado



3D volume render



¿Cuánta radiación supone un TC?



ALARA

means

As Low As Reasonably
Achievable

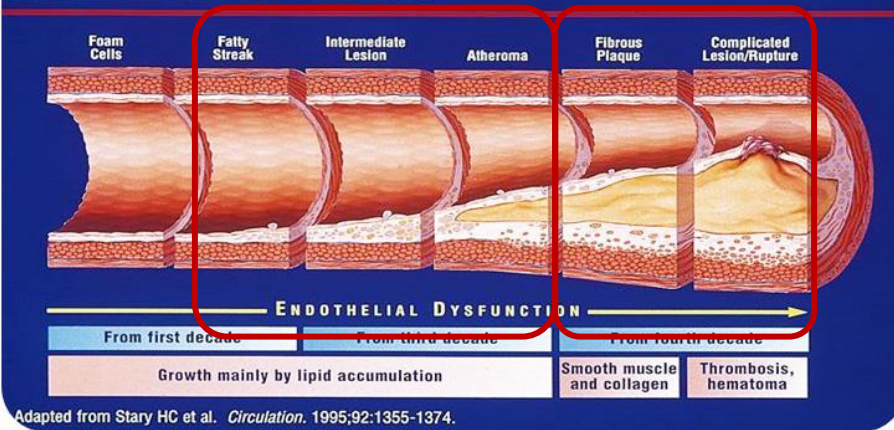
	mSv
Rx tórax (PA y lat)	0.1-0.3
TC tórax	7
Calcio coronario	0.8-1.2
TC coronarias 64	2-5
TC coronarias moderno	0.8-3
Coronariografía invasiva	7
Angioplastia/Ablación FR	15
Estudio perfusión	9

TC de arterias coronarias

TC arterias coronarias



Atherosclerosis Timeline



Journal of the American College of Cardiology
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Published by Elsevier Inc.

Vol. 52, No. 21, 2008
ISSN 0735-1097/08/\$34.00
doi:10.1016/j.jacc.2008.07.071

Cardiac Imaging

Diagnostic Performance of 64-Multidetector Row Coronary Computed Tomographic Angiography for Evaluation of Coronary Artery Stenosis in Individuals Without Known Coronary Artery Disease

Results From the Prospective Multicenter ACCURACY (Assessment by Coronary Computed Tomographic Angiography of Individuals Undergoing Invasive Coronary Angiography) Trial

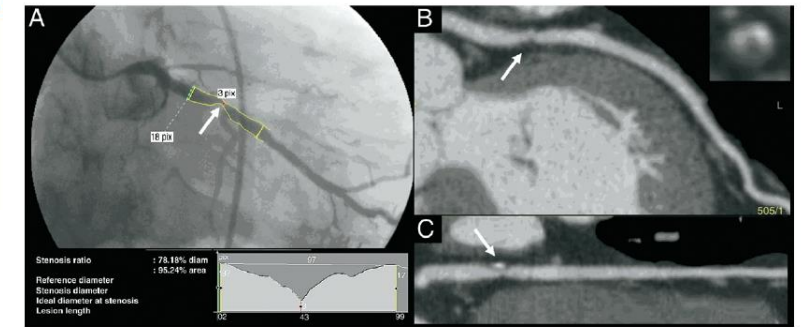


Figure 2 Computed Tomographic Angiogram Demonstrating Obstructive Disease of the Left Circumflex Artery With Quantitative Angiography Correlation

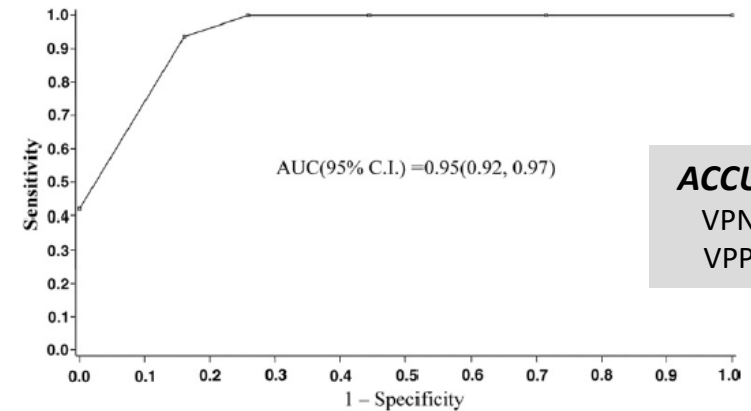


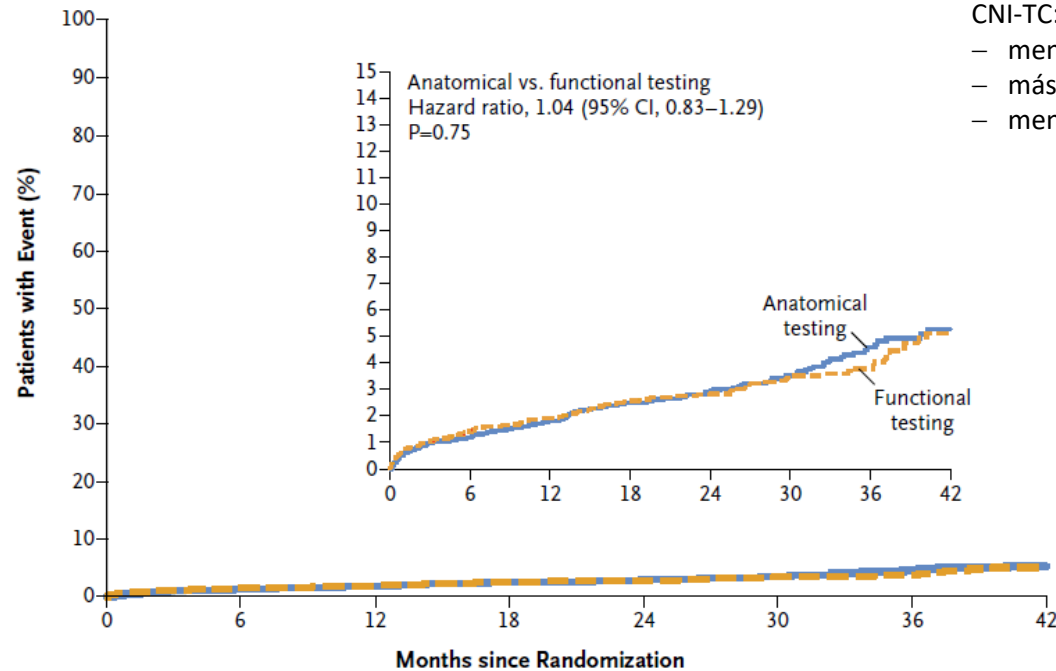
Figure 3 ROC Curve Evaluating Diagnostic Accuracy of CCTA Compared With Invasive Angiogram

¿Anatomía o función?

ORIGINAL ARTICLE

Outcomes of Anatomical versus Functional Testing for Coronary Artery Disease

Pamela S. Douglas, M.D., Udo Hoffmann, M.D., M.P.H., Manesh R. Patel, M.D., Daniel B. Mark, M.D., M.P.H., Hussein R. Al-Khalidi, Ph.D., Brendan Cavanaugh, M.D.



ESTUDIO PROMISE

10003 pacientes sintomáticos.
CNI-TC vs Funcional (ergometria, MPI o eco-estrés)
1º endpoint: muerte, AMI, AI
25 meses

CNI-TC:

- menor número de CI sin enfermedad obstructiva (3,4% vs 4,3%)
- más cateterismos (12,2% vs 8,1%)
- menor dosis radiación por paciente (10,0mSv vs. 11,3 mSv)

Table 1. Characteristics of the Trial Participants at Baseline, According to Study Group.*

Characteristic	CTA Strategy (N=4996)	Functional-Testing Strategy (N=5007)
Relevant medication — no./total no. (%)		
Beta-blocker	1205/4783 (25.2)	1194/4786 (24.9)
ACE inhibitor or ARB	2089/4783 (43.7)	2105/4786 (44.0)
Statin	2215/4783 (46.3)	2174/4786 (45.4)
Aspirin	2164/4783 (45.2)	2116/4786 (44.2)

¿Tiene impacto en el paciente?

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Coronary CT Angiography and 5-Year Risk of Myocardial Infarction

The SCOT-HEART Investigators*

2018

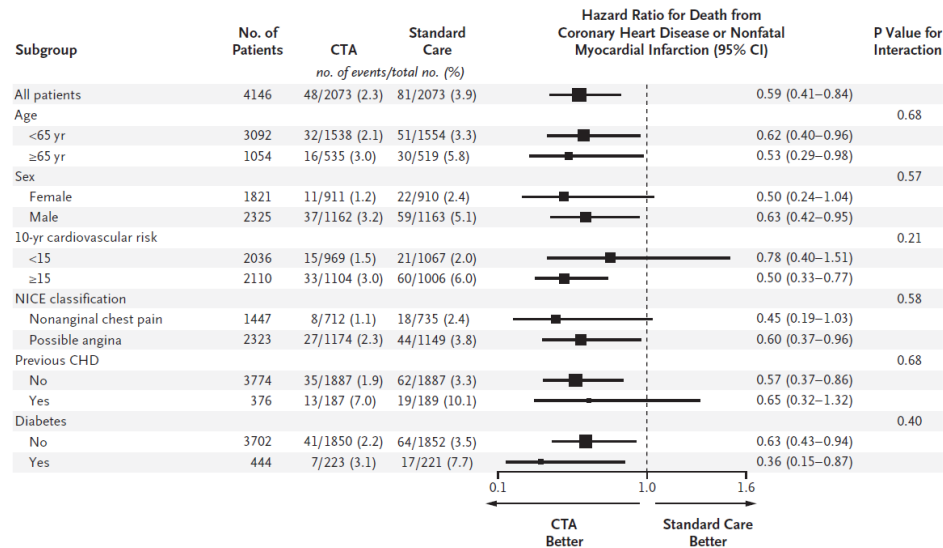


Table 2. Primary and Secondary End Points after a Median Follow-up of 4.8 Years.*

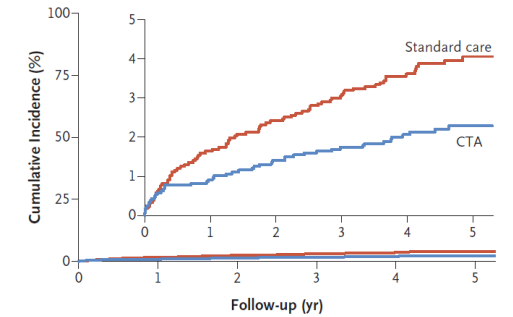
End Point	All Participants (N=4146)	Standard Care (N=2073)	Standard Care plus CTA (N=2073)	Hazard Ratio (95% CI)†
<i>number of patients (percent)</i>				
Primary end point: death from CHD or nonfatal myocardial infarction‡	129 (3.1)	81 (3.9)	48 (2.3)	0.59 (0.41–0.84)§
Secondary end points				
Death from CHD, nonfatal myocardial infarction, or nonfatal stroke‡	160 (3.9)	97 (4.7)	63 (3.0)	0.65 (0.47–0.89)
Nonfatal myocardial infarction	117 (2.8)	73 (3.5)	44 (2.1)	0.60 (0.41–0.87)
Nonfatal stroke	35 (0.8)	20 (1.0)	15 (0.7)	0.74 (0.38–1.44)
Death				
From CHD‡	13 (0.3)	9 (0.4)	4 (0.2)	0.46 (0.14–1.48)
From any cause	86 (2.1)	43 (2.1)	43 (2.1)	1.02 (0.67–1.55)
Cardiovascular	17 (0.4)	12 (0.6)	5 (0.2)	0.43 (0.15–1.22)
Noncardiovascular	69 (1.7)	31 (1.5)	38 (1.8)	1.24 (0.77–2.00)
Procedures				
Invasive coronary angiography	993 (24.0)	502 (24.2)	491 (23.7)	1.00 (0.88–1.13)
Revascularization¶	546 (13.2)	267 (12.9)	279 (13.5)	1.07 (0.91–1.27)
Percutaneous coronary intervention	431 (10.4)	212 (10.2)	219 (10.6)	1.06 (0.88–1.28)
Coronary-artery bypass grafting	131 (3.2)	62 (3.0)	69 (3.3)	1.12 (0.80–1.58)

Estudio multicéntrico aleatorizado en paralelo

- 2073 pacientes dolor torácico -> ergometría
- 2073 pacientes dolor torácico -> ergometría + CCTA

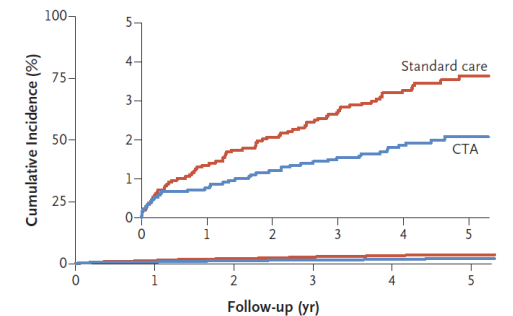
Seguimiento medio 4.8 años (20254 pacientes-año)

A Death from Coronary Heart Disease or Nonfatal Myocardial Infarction



No. at Risk	2073	2033	2008	1994	1572	856
Standard care	2073	2051	2029	2015	1588	872
CTA	2073	2051	2029	2015	1588	872

B Nonfatal Myocardial Infarction



No. at Risk	2073	2045	2030	2017	1597	881
Standard care	2073	2057	2048	2041	1618	891
CTA	2073	2057	2048	2041	1618	891

¿Y el dolor torácico agudo?

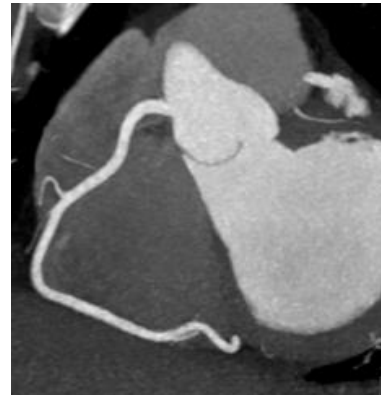


The NEW ENGLAND
JOURNAL of MEDICINE

ORIGINAL ARTICLE

Coronary CT Angiography versus Standard Evaluation in Acute Chest Pain

Udo Hoffmann, M.D., M.P.H., Quynh A. Truong, M.D., M.P.H., David A. Schoenfeld, Ph.D., Eric T. Chou, M.D., Pamela K. Woodard, M.D., John T. Nagurney, M.D., M.P.H., J. Hector Pope, M.D., Thomas H. Hauser, M.D., M.P.H., Charles S. White, M.D., Scott G. Weiner, M.D., M.P.H., Shant Kalanjan, M.D., Michael E. Mullins, M.D., Issam Mikati, M.D., W. Frank Peacock, M.D., Pearl Zakrofsky, B.A., Douglas Hayden, Ph.D., Alexander Goehler, M.D., Ph.D., Hang Lee, Ph.D., G. Scott Gazelle, M.D., M.P.H., Ph.D., Stephen D. Wiviott, M.D., Jerome L. Fleg, M.D., and James E. Udelson, M.D. for the ROMICAT-II Investigators
N Engl J Med 2012; 367:299-308 | July 26, 2012 | DOI: 10.1056/NEJMoa1201161



JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
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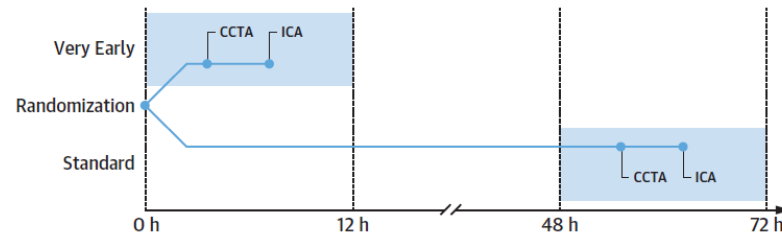
VOL. 75, NO. 5, 2020

ORIGINAL INVESTIGATIONS

Coronary CT Angiography in Patients With Non-ST-Segment Elevation Acute Coronary Syndrome



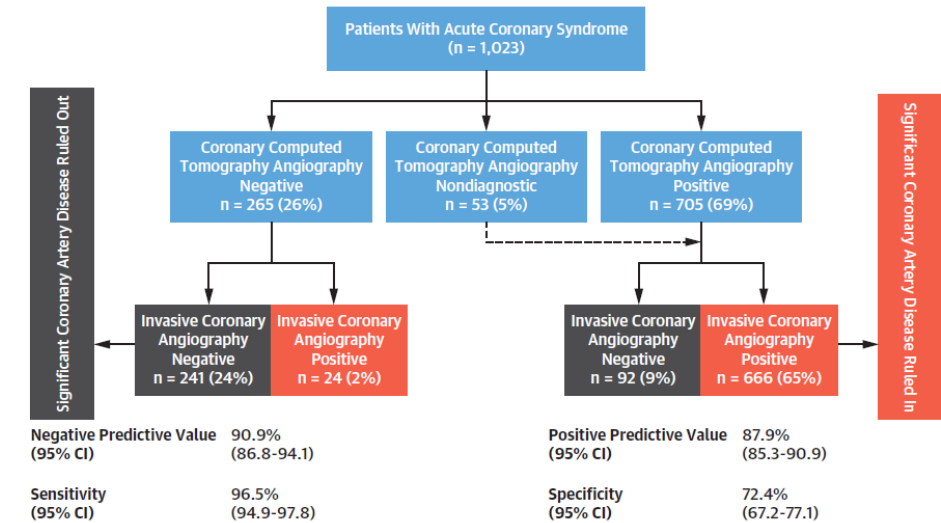
Jesper J. Linde, MD, PhD,^a Henning Kelbæk, MD, DSc,^b Thomas F. Hansen, MD, PhD,^c Per E. Sigvardsen, MD,^a Christian Torp-Pedersen, MD, DSc,^c Jan Bech, MD, PhD,^d Merete Heitmann, MD, PhD,^d Olav W. Nielsen, MD, DSc,^d



ROMICAT-II

- Es seguro
- Reduce tiempos de estancia en urgencias (8 horas)
- Aumenta altas (47% vs. 12%)
- Aumenta exposición a radiación y segundas exploraciones
- No reduce costes

CENTRAL ILLUSTRATION Diagnostic Accuracy of Coronary Computed Tomography Angiography Using Invasive Coronary Angiography as Reference Standard



Linde, J.J. et al. J Am Coll Cardiol. 2020;75(5):453-63.

Liderando el conocimiento del mañana

CardioAdvancedForum

¿Y el dolor torácico agudo?

CT Angiography for the Detection of Coronary Artery Stenoses in Patients Referred for Cardiac Valve Surgery

Systematic Review and Meta-Analysis

Maksymilian P. Opolski, MD,^a Adam D. Staruch, MD,^a Michal Jakubczyk, PhD,^b James K. Min, MD,^c Heidi Gransar, MS,^d Michal Staruch, MS,^e Adam Witkowski, MD,^a Cezary Kepka, MD,^f Won-Keun Kim, MD,^g Christian W. Hamm, MD,^h Helge Möllmann, MD,^h Stephan Achenbach, MDⁱ



17 estudios. 1107 pacientes.
Cirugía valvular.

JACC: CARDIOVASCULAR IMAGING
© 2016 BY THE AMERICAN COLLEGE OF RADIOLOGY FOUNDATION
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VOL. 9, NO. 9, 2016
ISSN 1936-878X/\$36.00
<http://dx.doi.org/10.1016/j.jcmg.2015.09.028>

FIGURE 3 Forest Plots of Per-Patient Sensitivity and Specificity of CTA Compared With Invasive Coronary Angiography

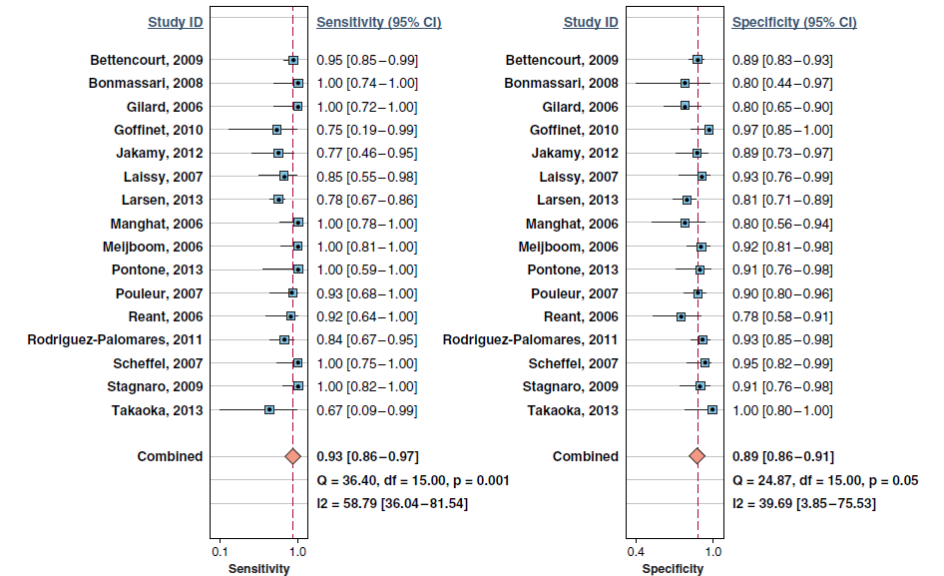


TABLE 2 Summary Estimates for Pooled Measures of Diagnostic Accuracy of Coronary CTA for Evaluating the Presence of Significant Coronary Stenoses Compared With Invasive Coronary Angiography on a Per-Patient Basis

	No. of Studies	Prevalence of CAD	Sensitivity (95% CI)	Specificity (95% CI)	Positive LR (95% CI)	Negative LR (95% CI)	DOR (95% CI)
Total	16	28%	93 (86-97)	89 (86-91)	8.4 (6.5-11)	0.07 (0.04-0.16)	114 (48-270)
Studies with <64 detectors	7	29%	94 (84-98)	86 (80-91)	6.9 (4.7-10.3)	0.07 (0.02-0.19)	105 (35-315)
Studies with ≥64 detectors	9	28%	94 (84-98)	90 (86-93)	9.5 (6.4-14.3)	0.06 (0.02-0.19)	148 (39-558)
Studies with AS	12	30%	93 (85-97)	87 (84-90)	7.4 (5.9-9.4)	0.08 (0.03-0.18)	95 (37-244)
Studies without AS	4	18%	94 (60-99)	96 (89-98)	21.2 (8.0-55.7)	0.07 (0.01-0.56)	325 (31-3,402)

CI = confidence interval; CTA = computed tomography angiography; DOR = diagnostic odds ratio; LR = likelihood ratio; other abbreviations as in Table 1.

¿Pero realmente cambia el manejo del paciente?

Selective Referral Using CCTA Versus Direct Referral for Individuals Referred to Invasive Coronary Angiography for Suspected CAD

A Randomized, Controlled, Open-Label Trial

JACC Cardiovasc Imaging. 2019;12(7 Pt 2):1303-1312.

823 pacientes; 22 centros

Pacientes referidos para coronariografía invasiva

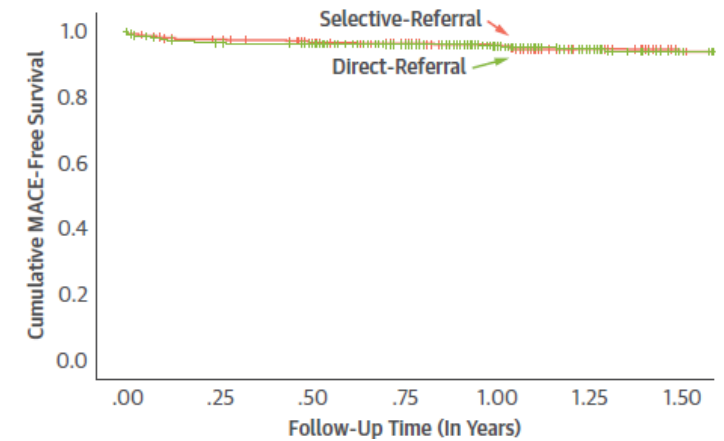
Seguimiento 1 año

No inferioridad (margen 1.33)

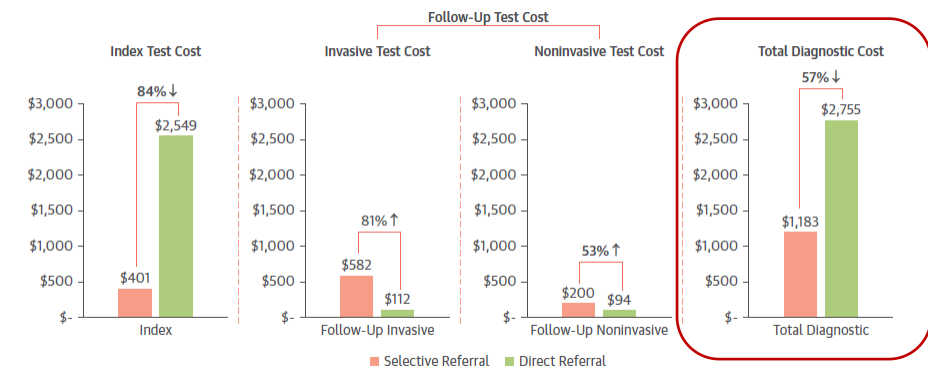
TABLE 1 Downstream Procedural Use Following Randomization

	Selective Referral (n = 784 Underwent Index CCTA)		Direct Referral (n = 719 Underwent Index ICA)		p Value
	Total	%	Total	%	
Invasive procedures					
Invasive coronary angiography	179	23	30	4	<0.001
Fractional flow reserve	0	0	41	6	<0.001
Percutaneous coronary intervention	89	11	109	15	<0.001
Coronary artery bypass surgery	9	1	18	3	0.075
Revascularization	98	13	127	18	0.007
Noninvasive CAD tests					
CCTA	3	0.4	1	1	<0.001
Exercise electrocardiography	108	14	79	11	0.12
Stress nuclear	14	2	10	1	0.67
Stress echocardiogram	9	1	9	1	0.95
Rest echocardiogram	281	36	95	13	<0.001
Overall % of downstream testing	1,204	153	199	29	<0.001

FIGURE 2 MACE-Free Survival



	Selective Referral (n = 784)	Direct Referral (n = 719)	Hazard Ratio (95% CI)	p Value
Any MACE (primary endpoint)	36 (4.6)	33 (4.6)	0.99 (0.62-1.58)	0.99
Composite of MACE or major bleed	36 (4.6)	35 (4.9)	0.93 (0.58-1.48)	0.75



¿Cómo se lee el estudio?



Phase 78%

22 Jan, 2016 / 10:49:27.16
 Coro S&S, 78%, iDose (4)
 Series 502 - Slice 1*
 Slice Pos: 101.8 mm
 iDose (4)

H GENERAL SALAMANCA
 Philips, ICT 256
 100 kV
 FOV 161.0 mm
 Thickness 0.80 mm
 Zoom 1.00
 Contrast

Average
 WL 90
 WW 750

Vol. Rend.
 Opacity 13
 CARDIAC.1

6/10/2017 4:19:29 PM

Verify correctness of the automatic segmentation. Correct using the segmentation editing tools, if required

Phase 78%

22 Jan, 2016 / 10:49:27.16
 Coro S&S, 78%, iDose (4)
 Series 502
 iDose (4)

H GENERAL SALAMANCA
 Philips, ICT 256
 Thickness 0.70 mm
 Zoom 1.0
 Contrast

Average
 WL 90
 WW 750

Vol. Rend.
 Opacity 30
 CARDIAC.1

6/10/2017 4:19:29 PM

Verify correctness of the automatic segmentation. Correct using the segmentation editing tools, if required

Calcified
 Non-calcified

Lumen Area: 4.0 mm²
 Wall Area: 16.7 mm²
 Remodeling Index: 2.2
 Min. Lumen Diameter: 2.0 mm
 Max. Wall Thickness: 2.7 mm
 Position: 25.8 mm

Measurements - LAD (Gaussian)							
Finding Name	VolumesError	Content	Non-calcified Cont.	Min. Lumen Area	Position (Min. Lum. A.)	Max. Burden	Finding Length
Finding 2	100.4560 m	15% C	10A	3.6 mm ²	26.7 mm	64 %	11.3 mm

¿Cómo puede ser el resultado?

CAD-RADS™ Coronary Artery Disease – Reporting and Data System.
 An expert consensus document of the Society of Cardiovascular
 Computed Tomography (SCCT), the American College of Radiology
 (ACR) and the North American Society for Cardiovascular Imaging
 (NASCI). Endorsed by the American College of Cardiology

Ricardo C. Cury ^{a,*}, Suhny Abbbara ^b, Stephan Achenbach ^c, Arthur Agatston ^d,

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Journal of Cardiovascular Computed Tomography

journal homepage: www.JournalofCardiovascularCT.com



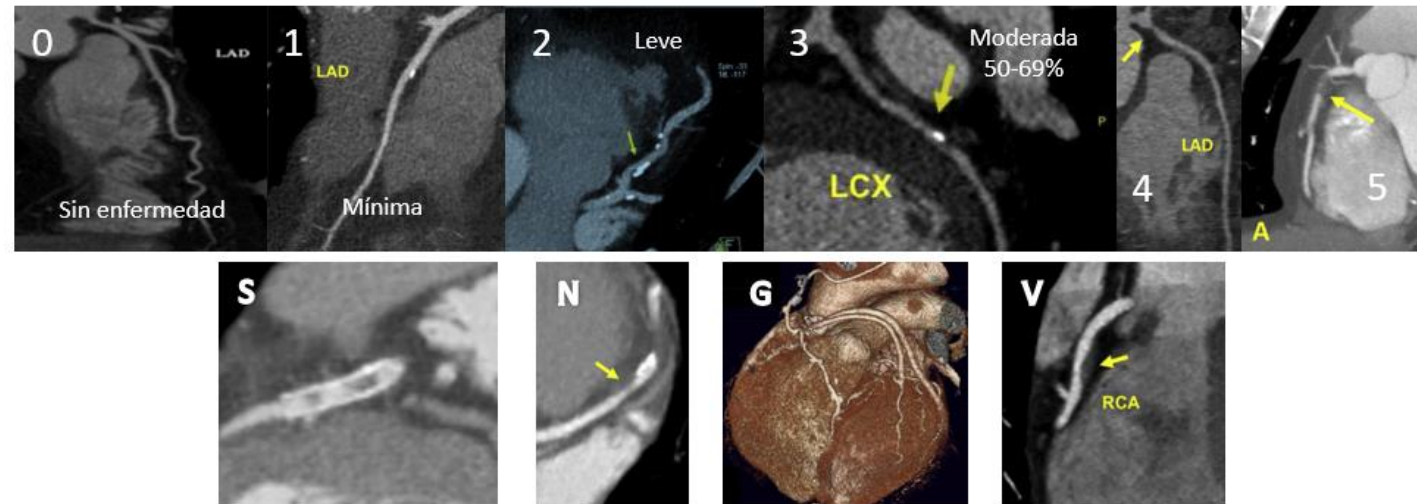
CAD-RADS reporting and data system for patients presenting with stable chest pain.

Degree of maximal coronary stenosis	Interpretation	Further Cardiac Investigation	Management
CAD-RADS 0 0% (No plaque or stenosis)	Documented absence of CAD ^a	None	- Reassurance. Consider non-atherosclerotic causes of chest pain
CAD-RADS 1 1–24% - Minimal stenosis or plaque with no stenosis ^b	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 ^c - Other treatments should be considered per guideline-directed care ^c
CAD-RADS 4 A - 70–99% stenosis or B - Left main >50% or 3- vessel obstructive (≥70%) disease	Severe stenosis	A: Consider ICA ^d 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 ^c - Other treatments (including options of revascularization) should be considered per guideline-directed care ^c
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 ^c - Other treatments (including options of revascularization) should be considered per guideline-directed care ^c
CAD-RADS N Non-diagnostic study	Obstructive CAD cannot be excluded	Additional or alternative evaluation may be needed	

Table 1

SCCT grading scale for stenosis severity.

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



Indicaciones en guías clínicas recientes

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

The Task Force for the diagnosis and management of chronic coronary syndromes of the European Society of Cardiology (ESC)

Non-invasive functional imaging for myocardial ischaemia^c or coronary CTA is recommended as the initial test to diagnose CAD in symptomatic patients in whom obstructive CAD cannot be excluded by clinical assessment alone.^{4,5,55,73,78–80}

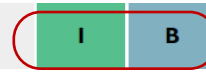
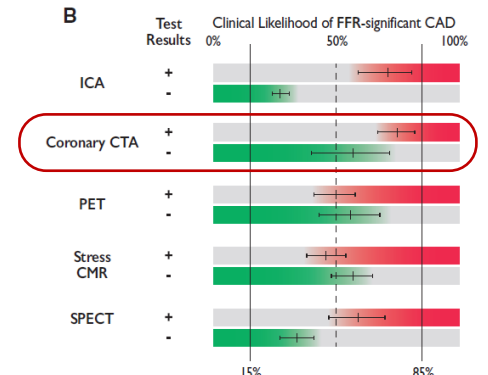


Table 5 Pre-test probabilities of obstructive coronary artery disease in 15 815 symptomatic patients according to age, sex, and the nature of symptoms in a pooled analysis⁶⁴ of contemporary data^{7,8,62}

Age	Typical		Atypical		Non-anginal		Dyspnoea ^a	
	Men	Women	Men	Women	Men	Women	Men	Women
30–39	3%	5%	4%	3%	1%	1%	0%	3%
40–49	22%	10%	10%	6%	3%	2%	12%	3%
50–59	32%	13%	17%	6%	11%	3%	20%	9%
60–69	44%	16%	26%	11%	22%	6%	27%	14%
70+	52%	27%	34%	19%	24%	10%	32%	12%

©ESC 2019



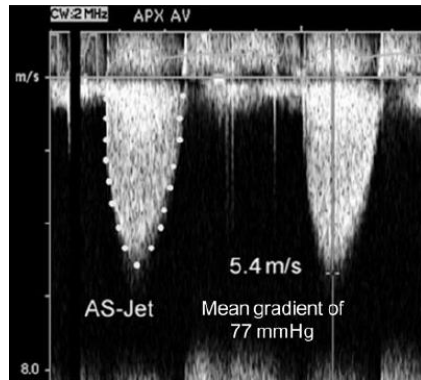
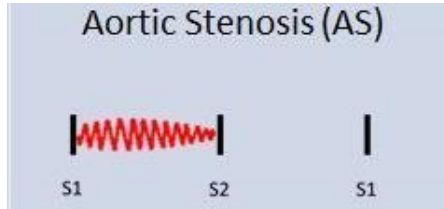
2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation

Imaging	Class	Level
In patients presenting with cardiac arrest or haemodynamic instability of presumed cardiovascular origin, echocardiography is recommended and should be performed by trained physicians immediately following a 12-lead ECG.	I	C
In patients with no recurrence of chest pain, normal ECG findings, and normal levels of cardiac troponin (preferably high sensitivity), but still with a suspected ACS, a non-invasive stress test (preferably with imaging) for inducible ischaemia or CCTA is recommended before deciding on an invasive approach. ^{91,92,98,101,105–108}	I	B
Echocardiography is recommended to evaluate regional and global LV function and to rule in or rule out differential diagnoses. ^c	I	C
CCTA is recommended as an alternative to ICA to exclude ACS when there is a low-to-intermediate likelihood of CAD and when cardiac troponin and/or ECG are normal or inconclusive. ^{105,108,110–114}	I	A

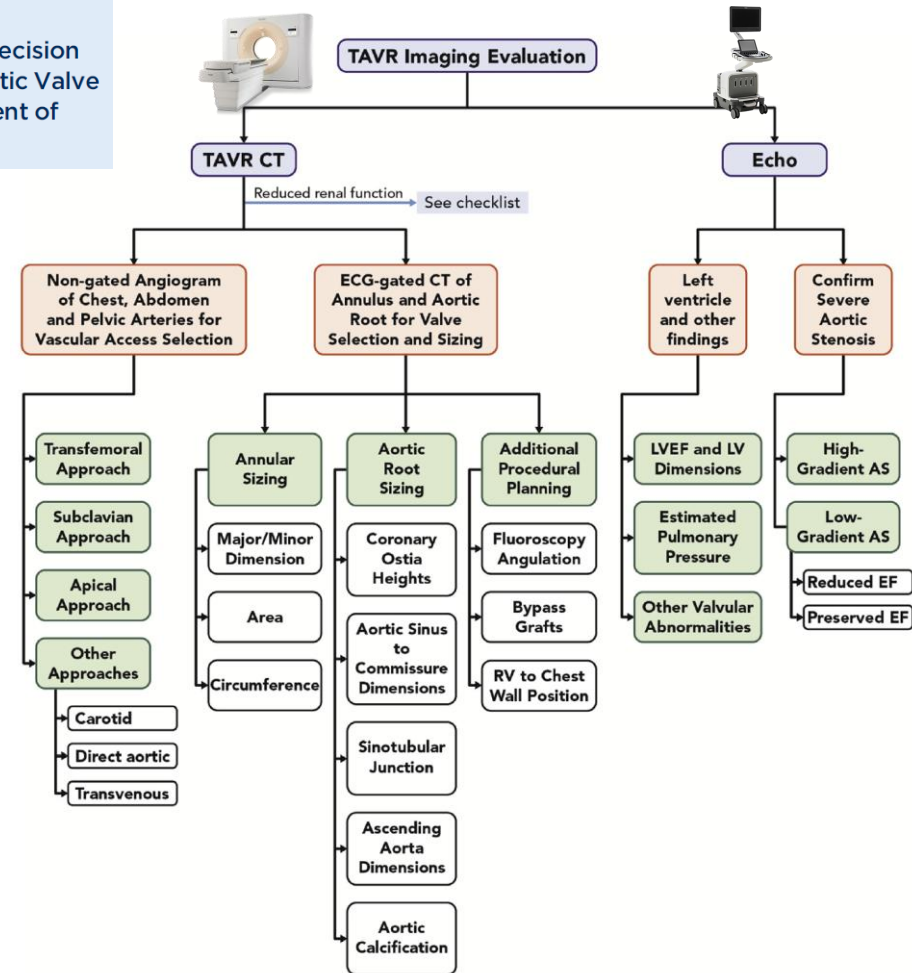


TC previo intervencionismo

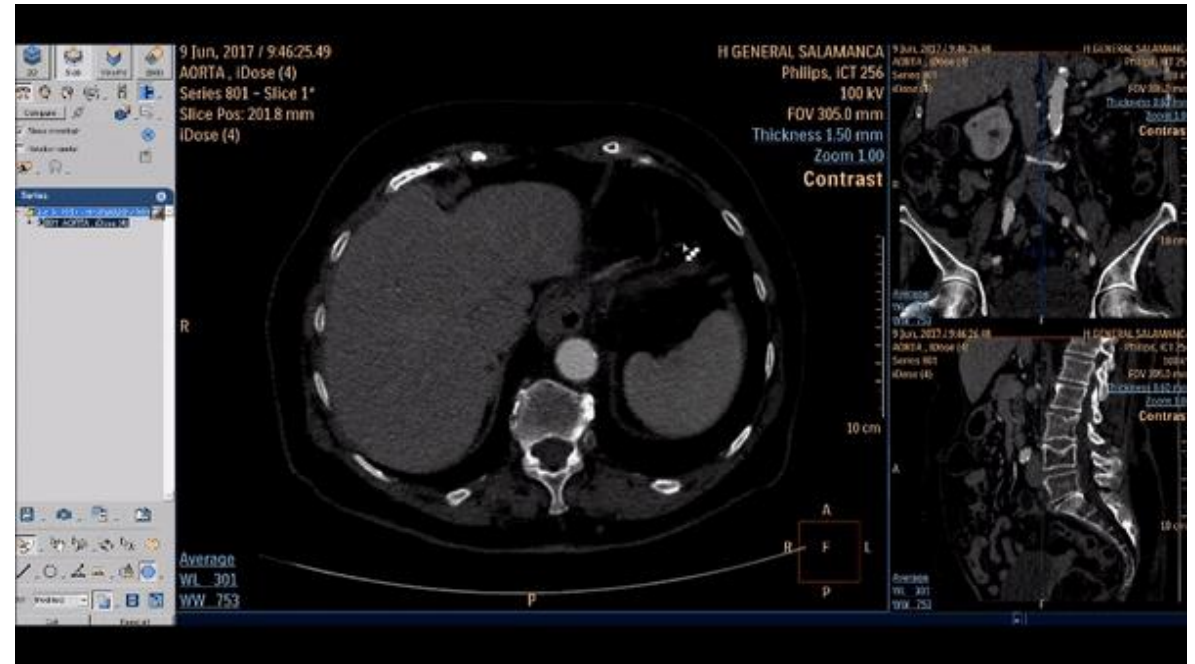
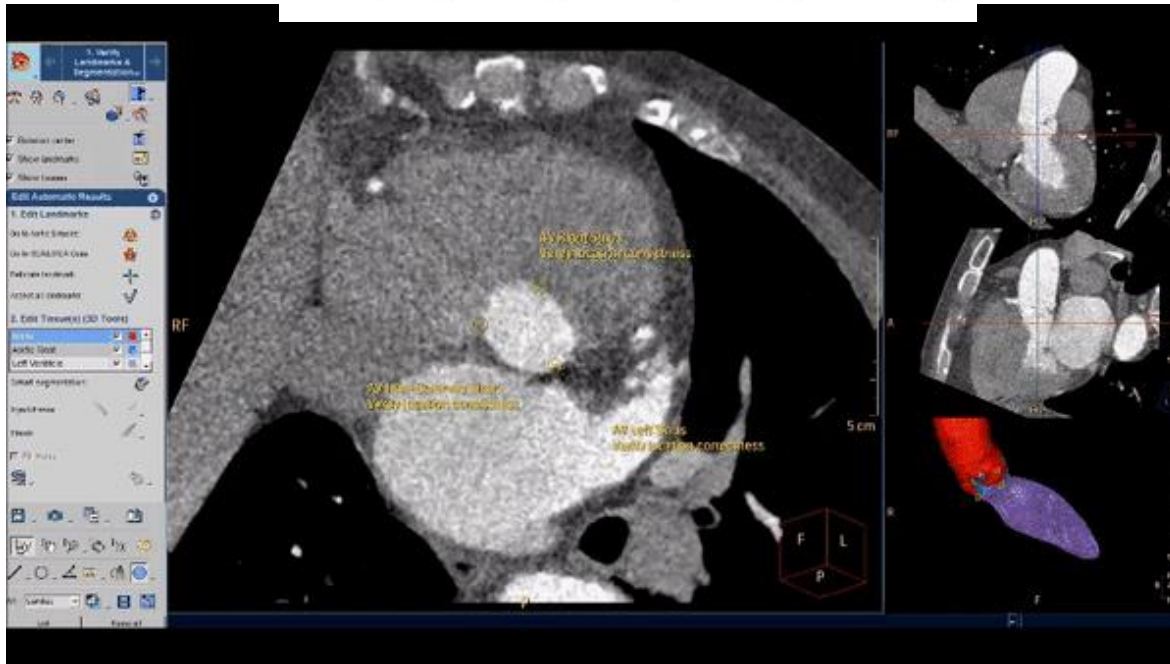
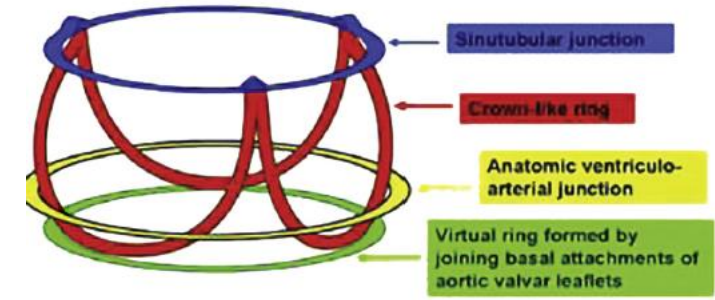
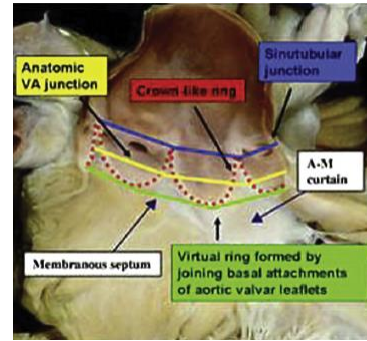
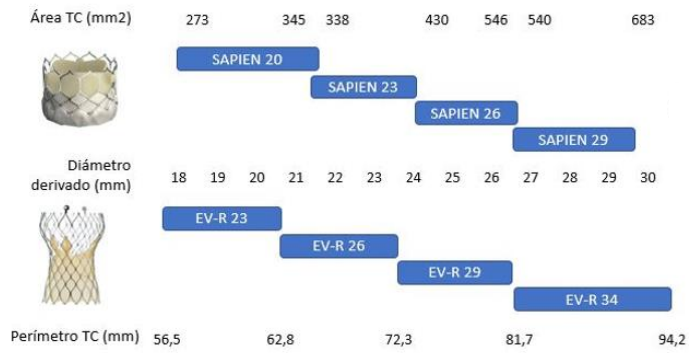
TC en estenosis aórtica



ACC CLINICAL DOCUMENT
2017 ACC Expert Consensus Decision Pathway for Transcatheter Aortic Valve Replacement in the Management of Adults With Aortic Stenosis



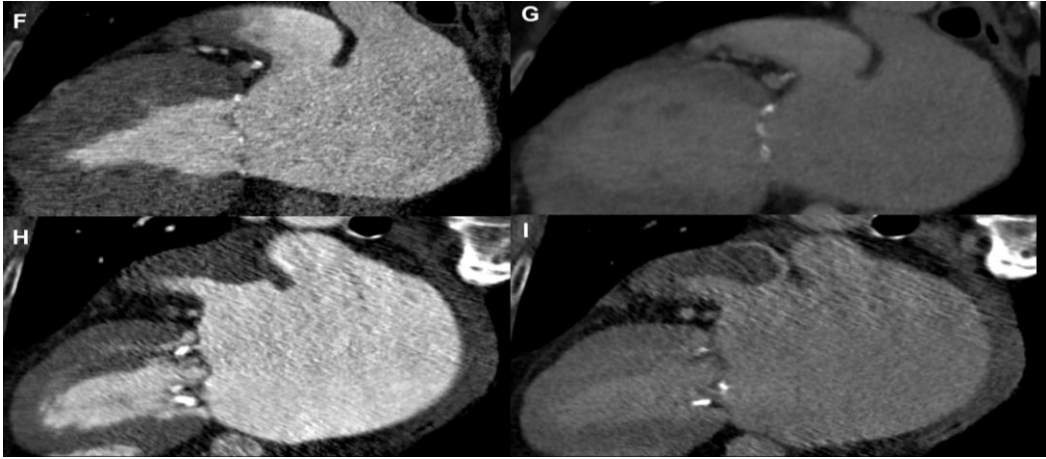
TC en estenosis aórtica



TC en cierre de orejuela izquierda

Fase arterial

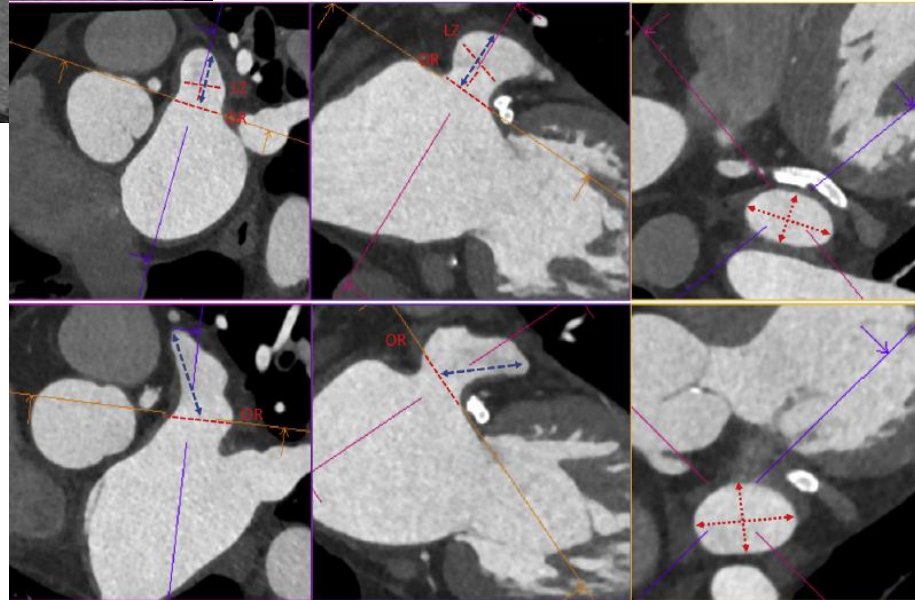
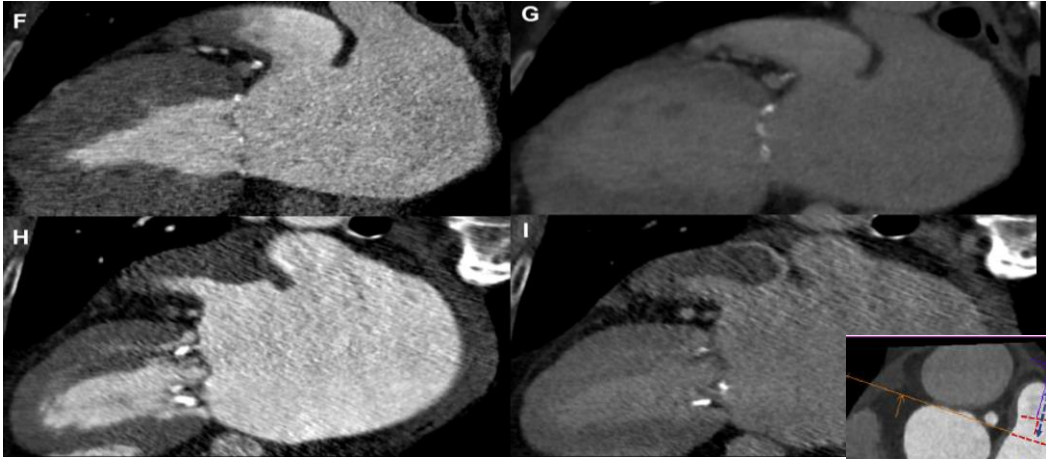
Fase venosa



TC en cierre de orejuela izquierda

Fase arterial

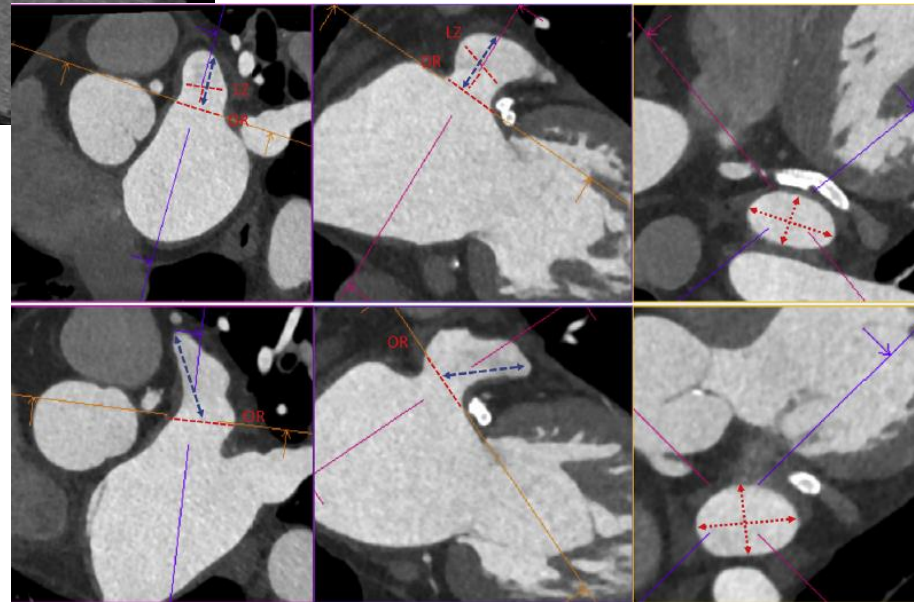
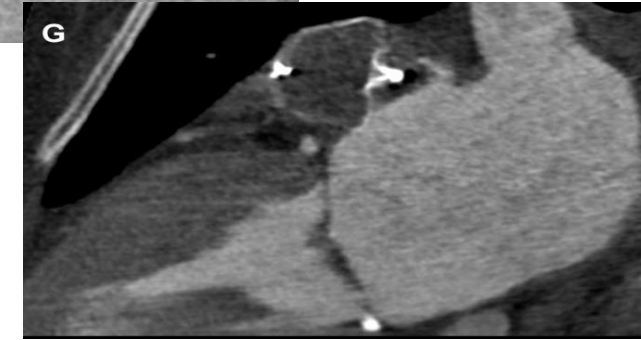
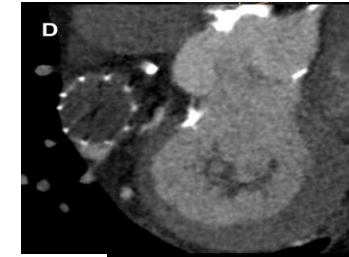
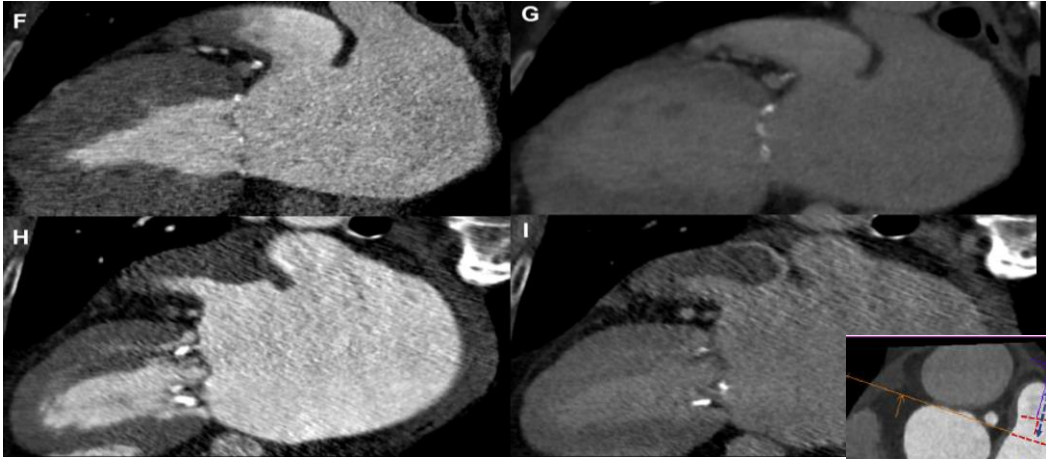
Fase venosa



TC en cierre de orejuela izquierda

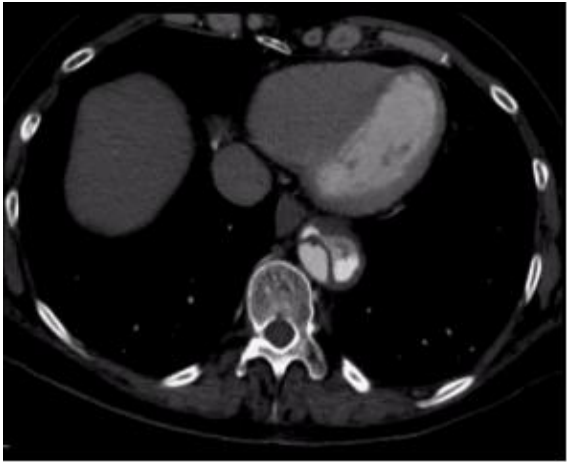
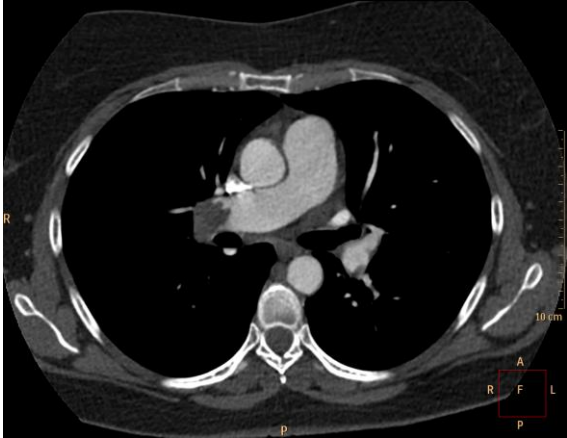
Fase arterial

Fase venosa

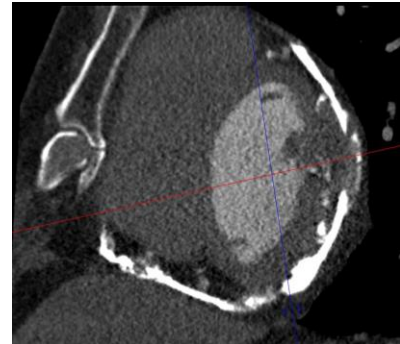
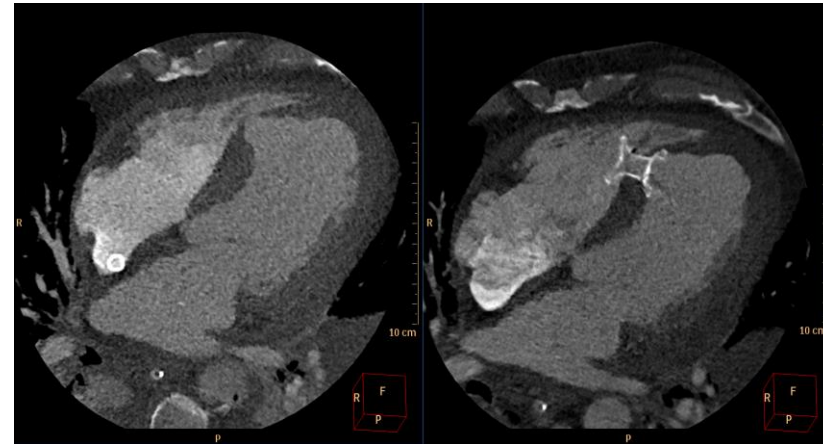
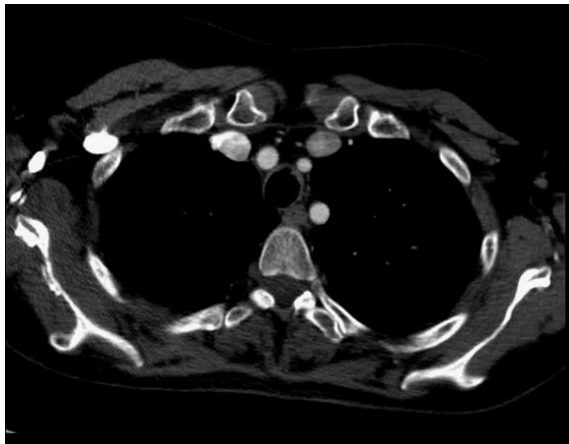
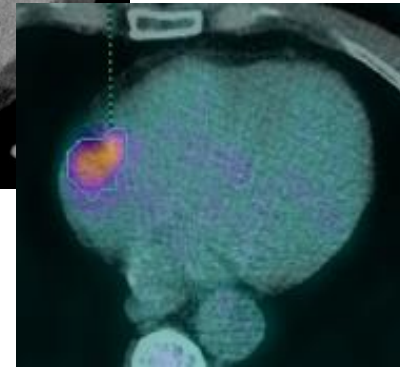
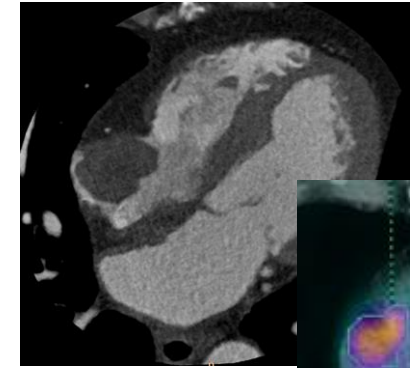
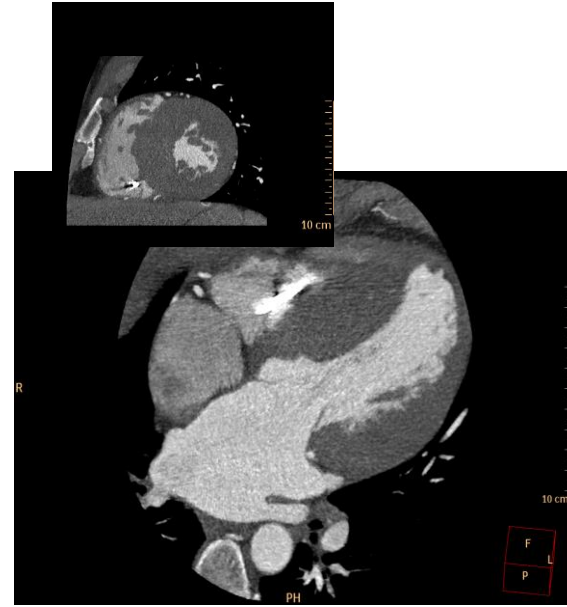
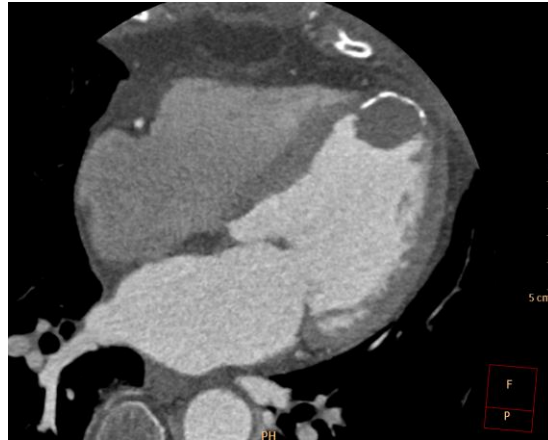
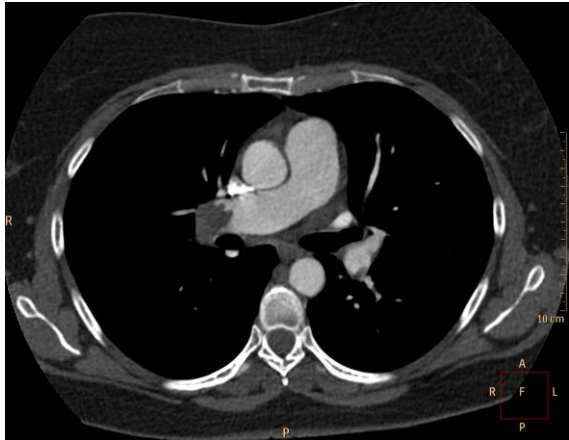


Otros usos del TC

Otros usos TC



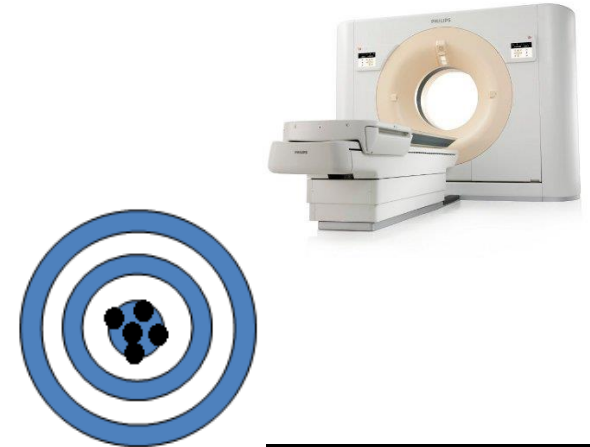
Otros usos TC



Mensajes para llevar a casa

Mensajes para llevar a casa

- La TC es una herramienta versátil con elevada resolución espacial y progresivamente menores dosis de radiación
- La angiografía coronaria no invasiva con TC como primera opción permite:
 - Descartar pacientes sin enfermedad coronaria: **fin proceso diagnóstico**
 - Iniciar tratamiento prevención secundario en enfermedad coronaria no significativa: **mejorar pronóstico**
 - Enfermedad coronaria significativa: **seleccionar y escalar** pruebas de isquemia o estrategia invasiva
 - **Reducir la estrategia invasiva y los costes totales** por paciente
- El TC cardiaco es la primera opción previo al intervencionismo estructural, especialmente TAVI
- Es una alternativa y complemento a otras técnicas de imagen en diferentes patologías CV.





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