

Stabil angina pectoris A CT szerepe

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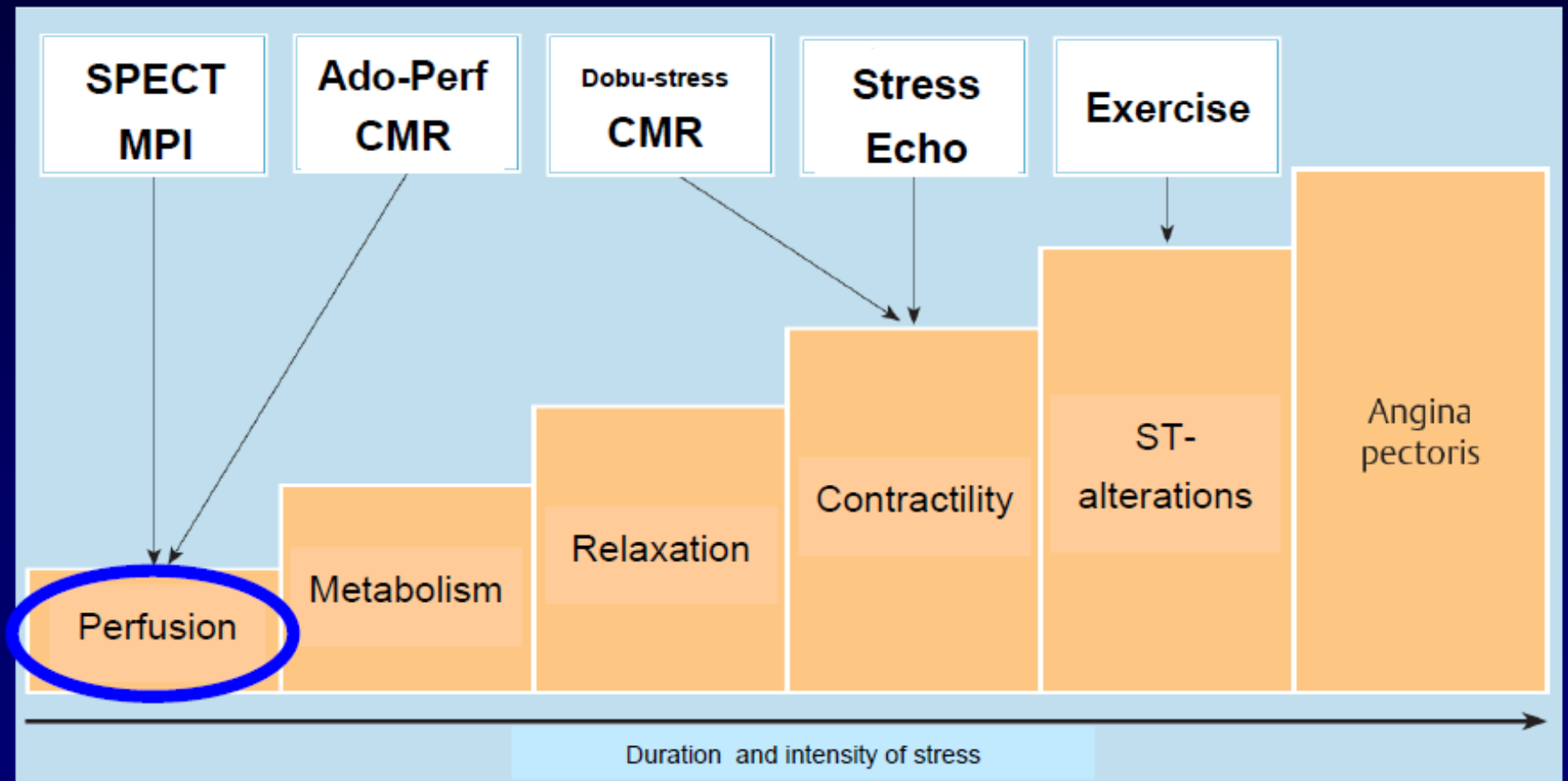
KE - Eü. Központ

Stabil Angina pectoris

Typical angina (definite)	Meets all three of the following characteristics: <ul style="list-style-type: none">• substernal chest discomfort of characteristic quality and duration;• provoked by exertion or emotional stress;• relieved by rest and/or nitrates within minutes.
Atypical angina (probable)	Meets two of these characteristics.
Non-anginal chest pain	Lacks or meets only one or none of the characteristics.



Ischemic cascade



Diagnosis of coronary atherosclerosis

NON INVASIVE

ECG

ECHO

SPECT MR

PET

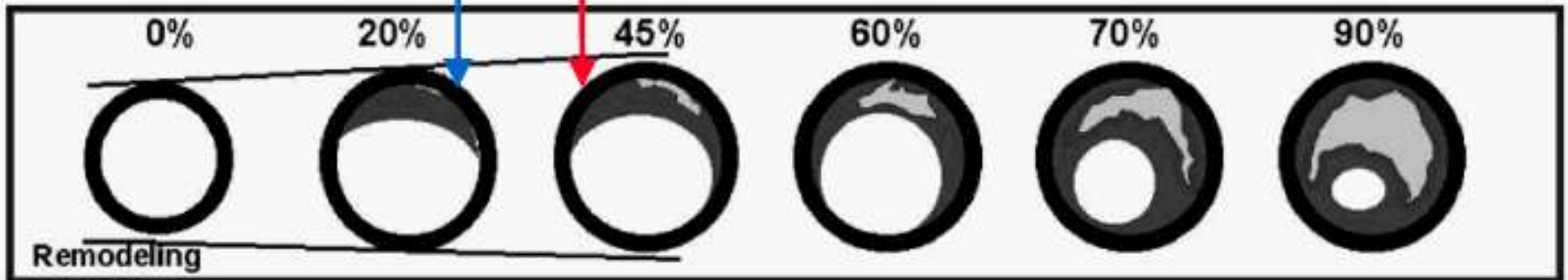
CT CORONARY ANGIOGRAPHY

CORONARY CALCIUM SCORING

INVASIVE

INTRACORONARY ULTRASOUND

CORONARY ANGIOGRAPHY





Wilhelm C.
Roentgen
1895

Első spirál CT
1989

16-szeletes CT
2002

Dual-source
CT
2006-

2nd. Generation
DSCT
2009-



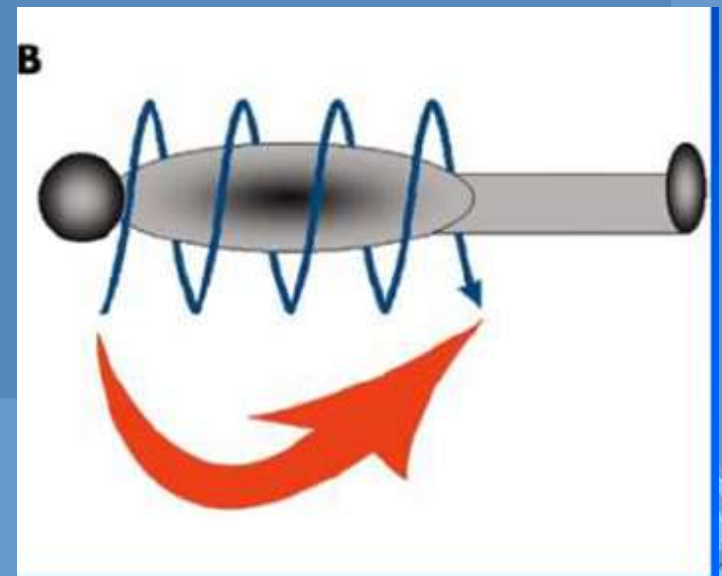
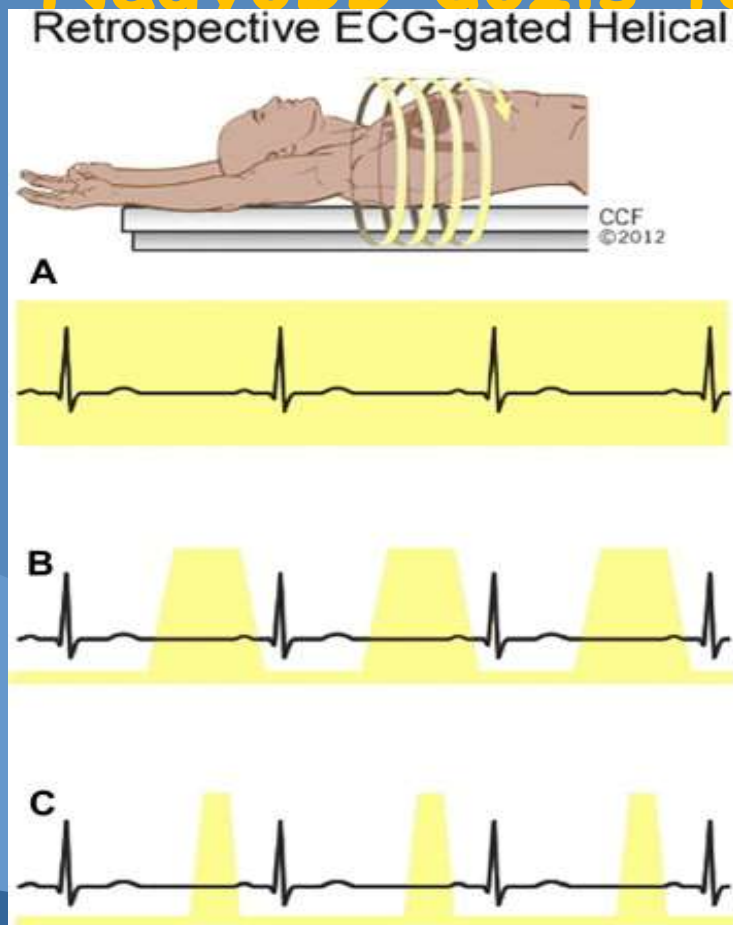
1971
Sir Godfrey Hounsfield
Első CT berendezés

1998
MDCT
4-szeletes CT

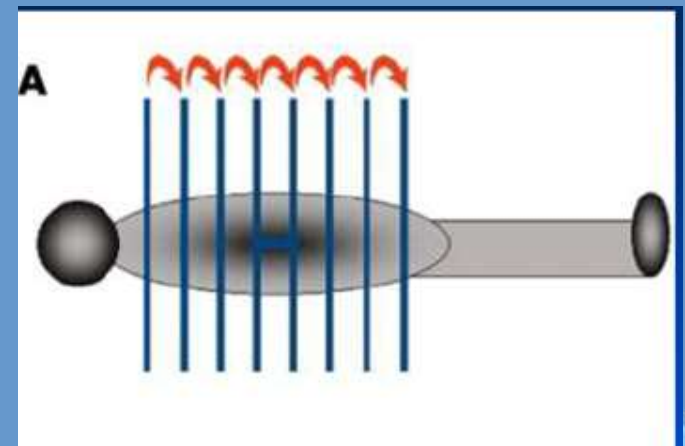
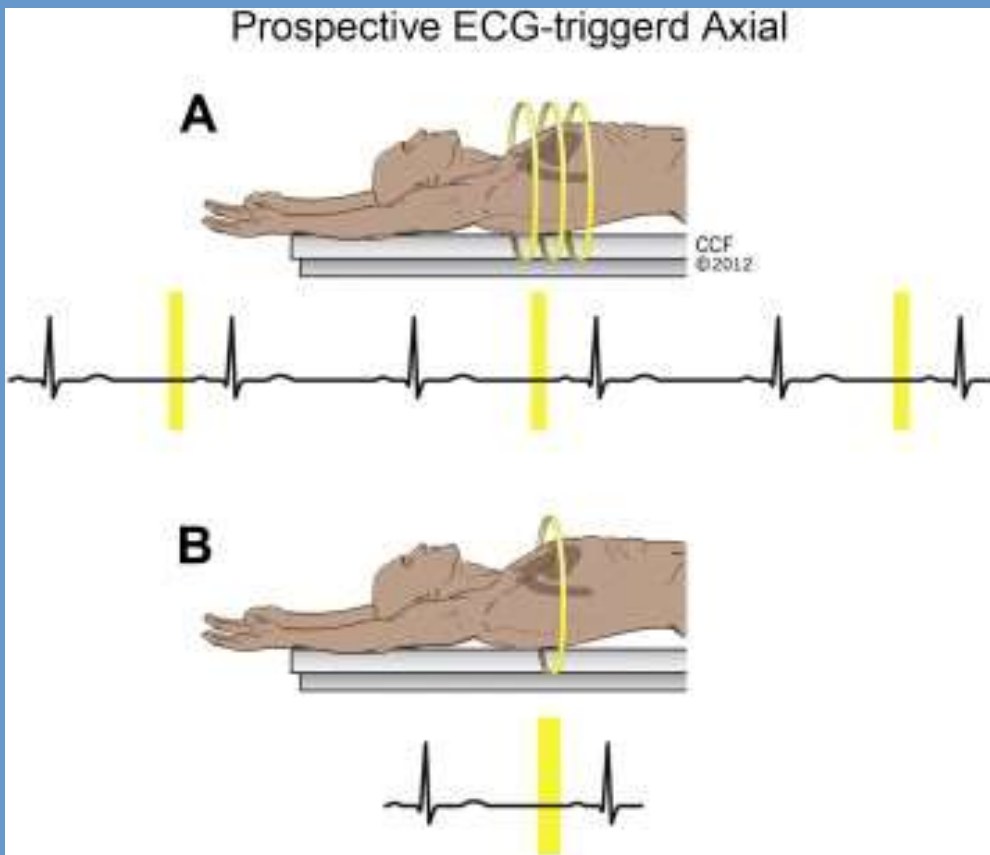
2005
64-szeletes CT



Retrospektív EKG vezérelt spirál vizsg.: utólagos kapuzás, azaz utólag kiválasztható a legjobb fázis. Nagyobb dózis terhelés.



Prospektív EKG vezérelt szekvenciális vizsg.: előre meghatározott kapuzás („step and shoot”), utólagos fázisválasztás nem lehetséges. Hosszú vizsgálat esetén nincs egyenletes kontrasztanyag halmozás



Dual Source CT felépítése és működése

A röntgencső

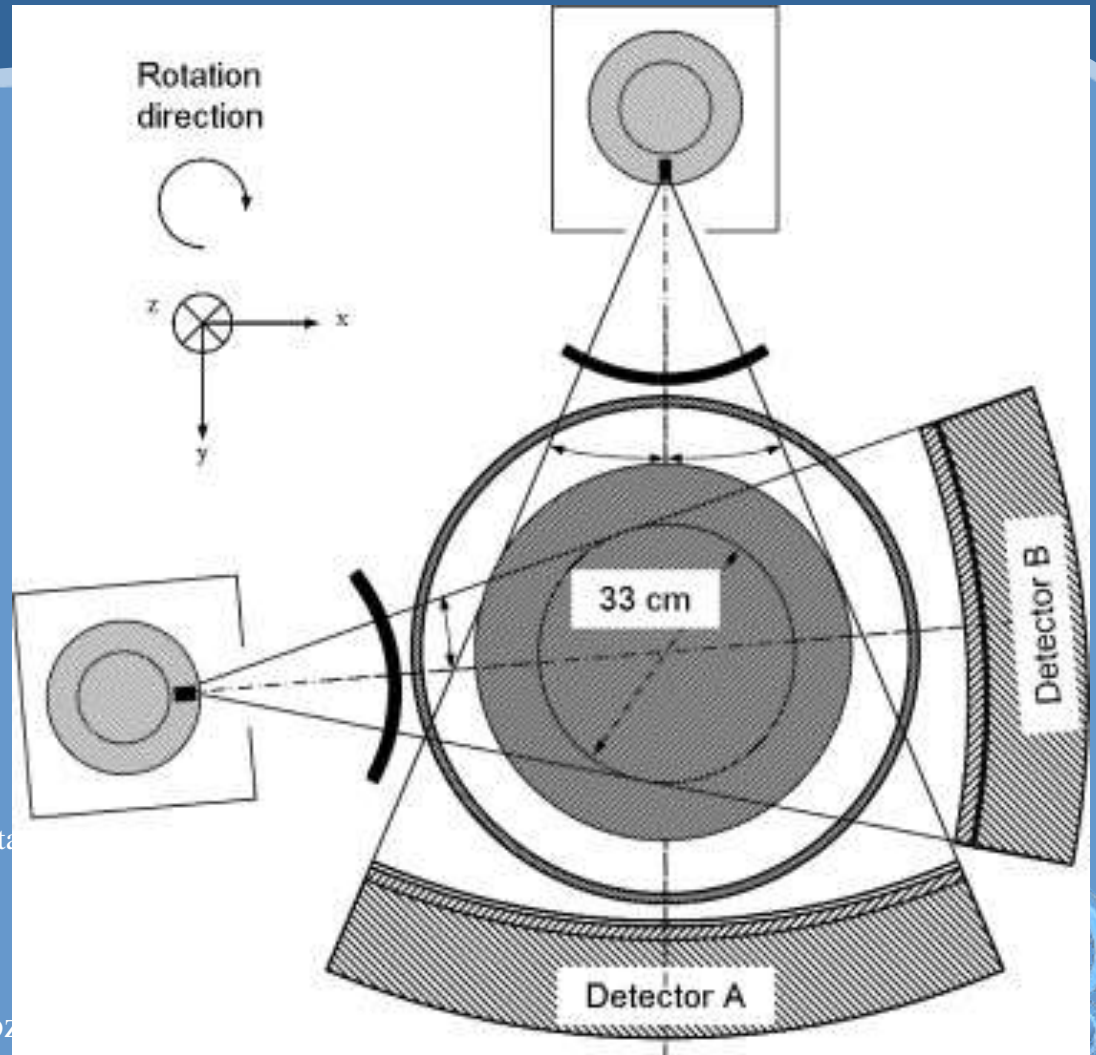
- Alacsony csőfeszültség
- 50 cm látómező

B röntgencső

- Magas csőfeszültség
- 33 cm látómező
- Ón Szelektív Foton Szűrő

(Sn Selective Photon Shield)

(Siemens Somatom Sensation Flash Workflow Assista



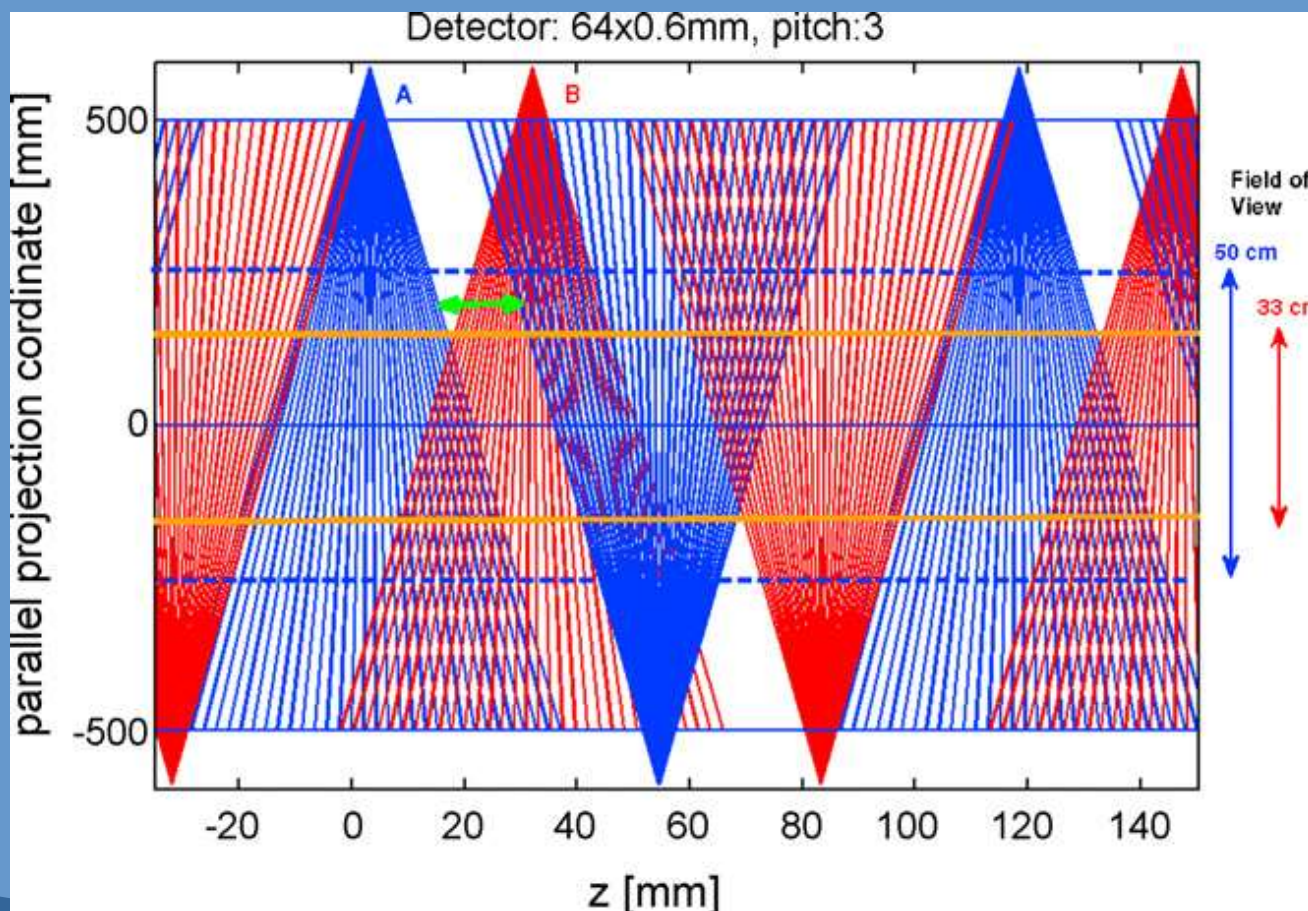
Dual energy CT (DECT): A és B cső különböző

Dual Source CT (DSCT): A és B cső azonos csőfeszültséggel vizsgál

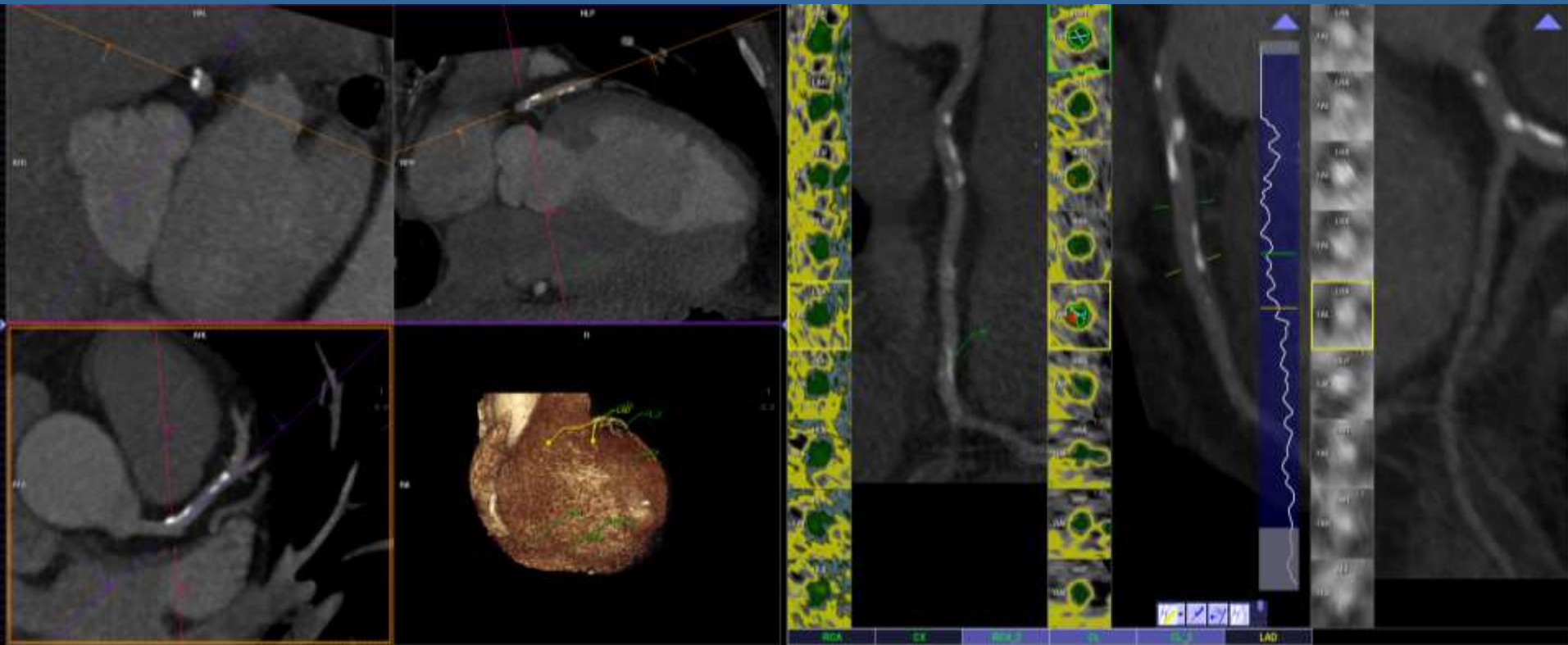
Kettős sugárforrású Coronaria CT

FLASH Coronária CT

A kettős sugárforrás lehetővé teszi, hogy z tengelyen mentén A cső által le nem fedett területeket a B cső adataiból rekonstruáljuk. Egy szív ciklus alatt elvégezhető a vizsgálat, alacsony beteg dózissal



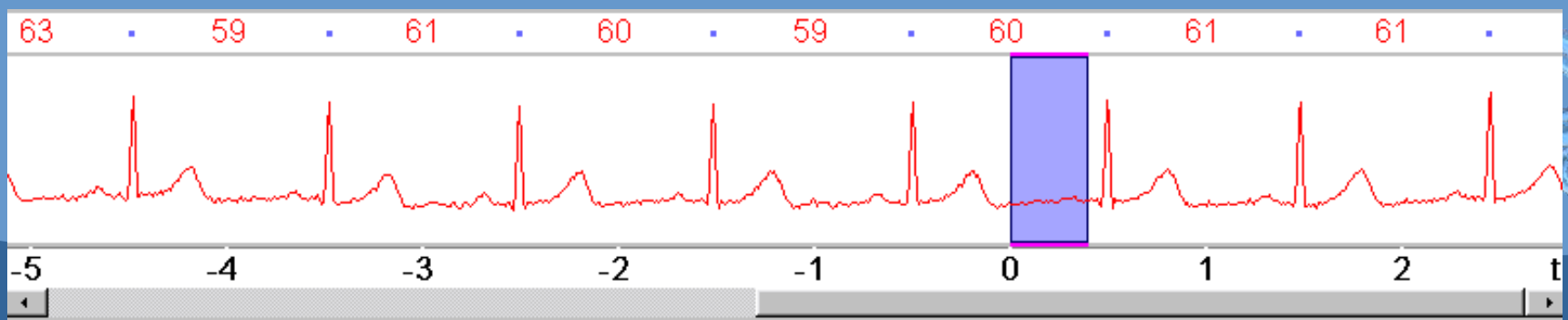
RCA – LAD - Cx



0.8 mSv FLASH CT

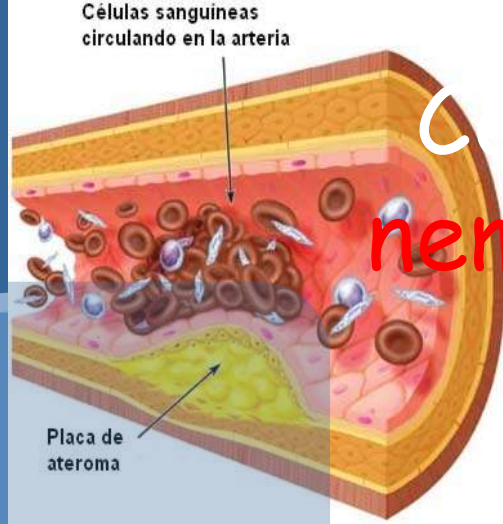
9 mSV DSCT

7-21mSv SSCT Korábbi diára!!!!!!



Angiográfia invazív

- Diagnosztika
- és terápia
- Dinamikus
- Ismételhető



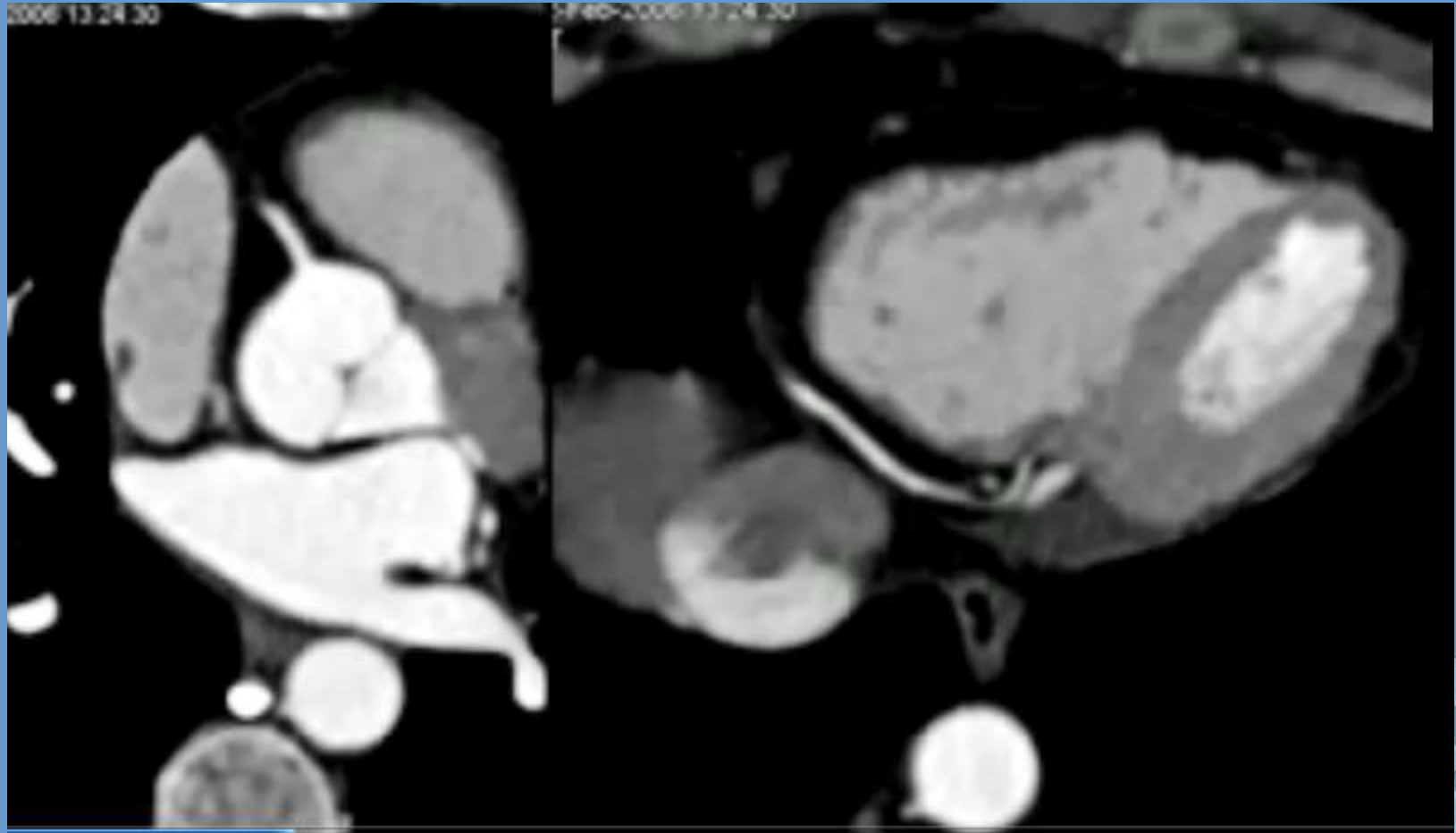
Coronaria CTA nem invazív

- Diagnosztika
- Döntően statikus
- Ismétlés problémás

	Térbeli felbontás (mm)	Időbeli felbontás (ms)
Invazív koronarográfia	0,2	5-20
16 szeletes CT	0,5	200
64 szeletes CT	0,4	165
2×64 szeletes DSCT	0,4	83
64 szeletes HDCT	0,23	175
320 szeletes CT	0,5	175
2×128 szeletes DSCT	0,4	75



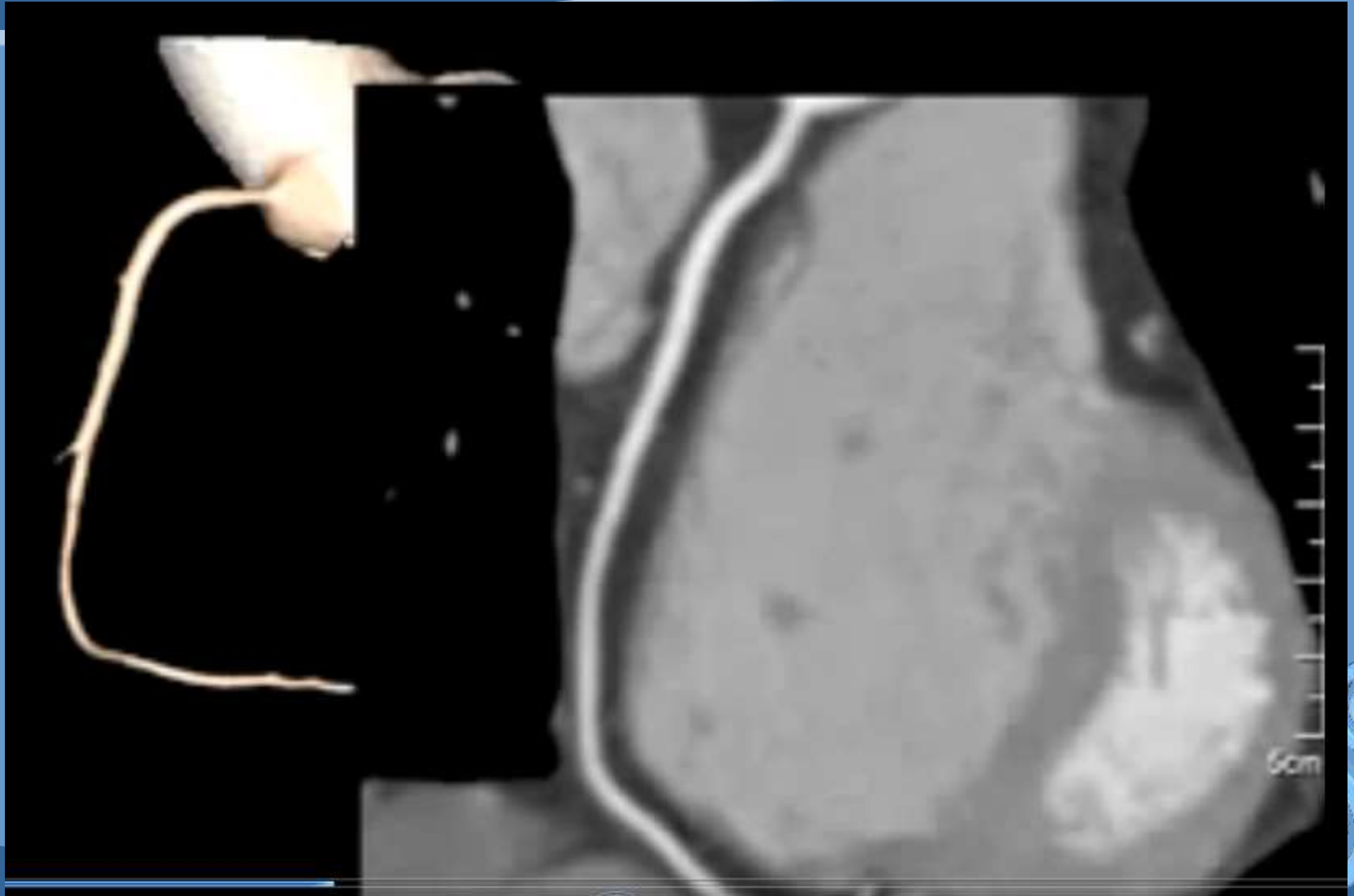
Axial images- RCA



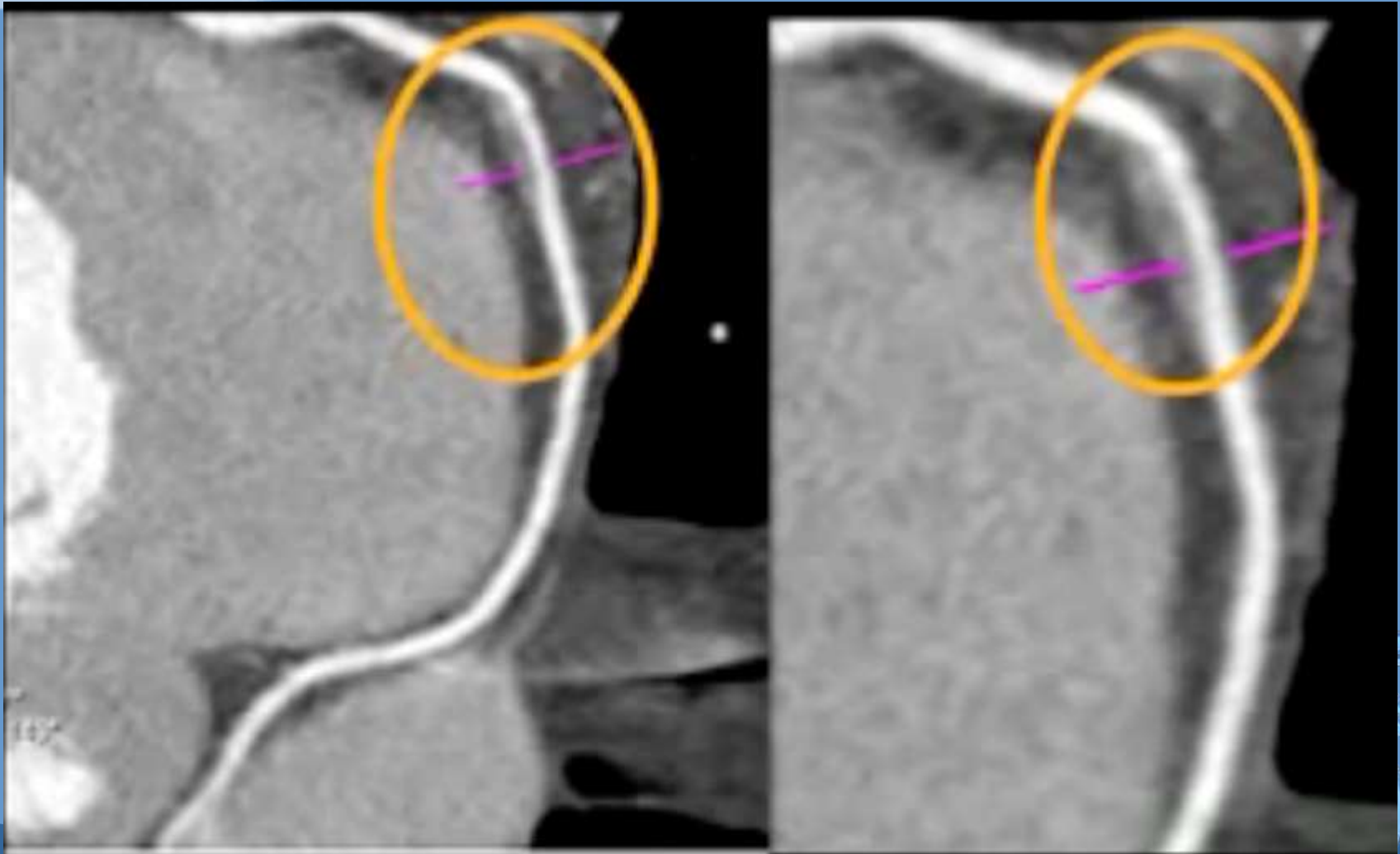
VRT - RCA



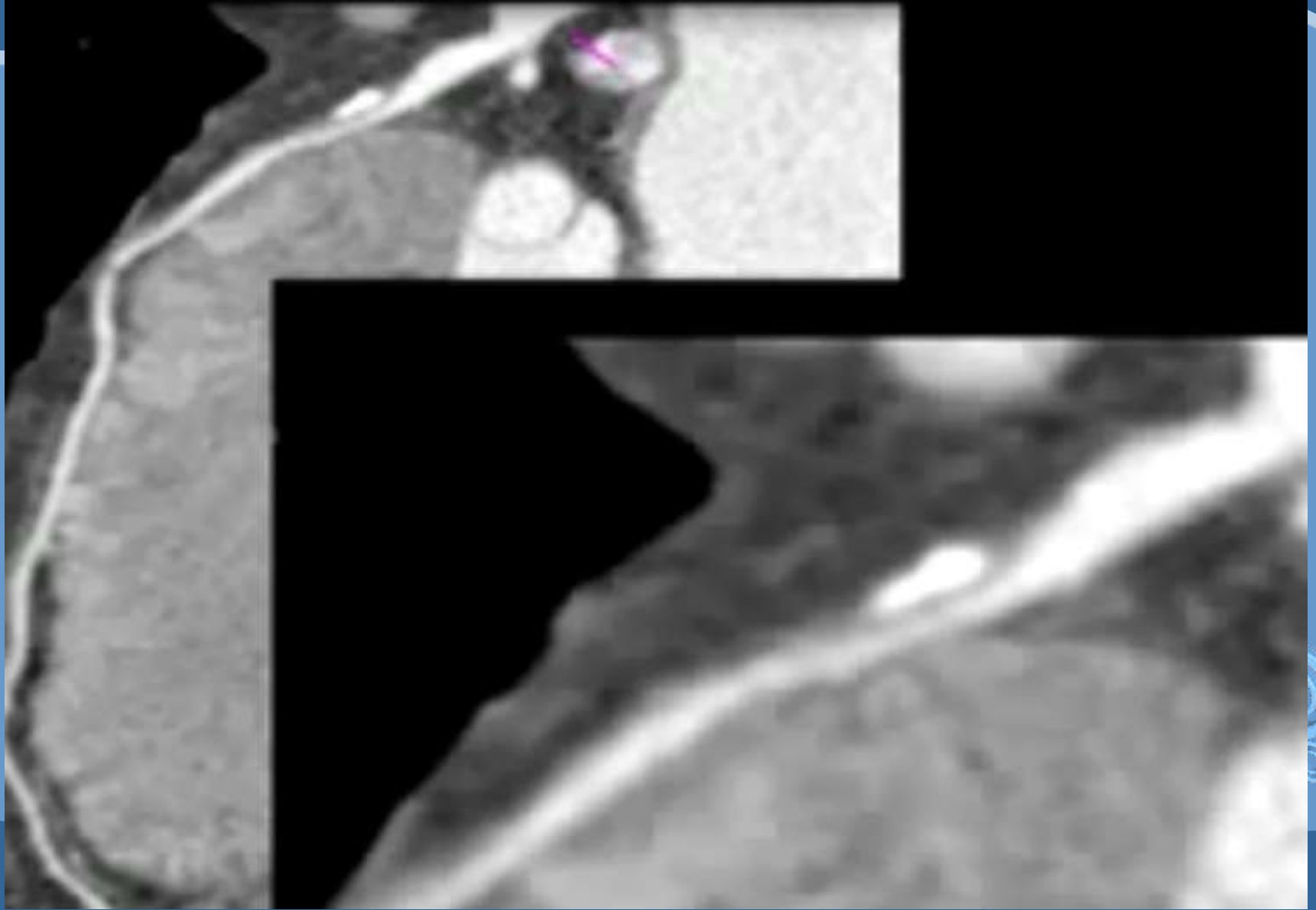
Isolated RCA



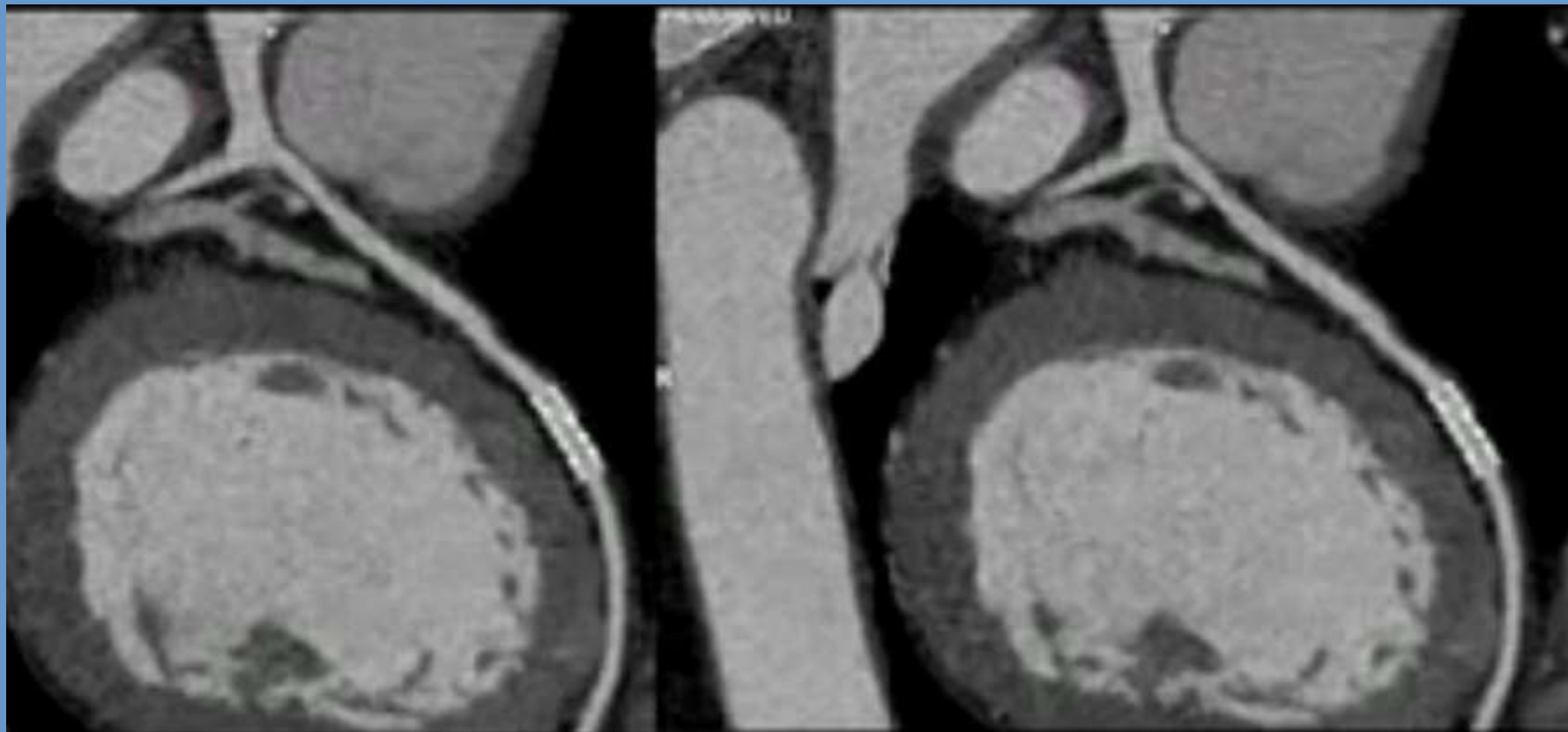
Extensiv non calcified plaque



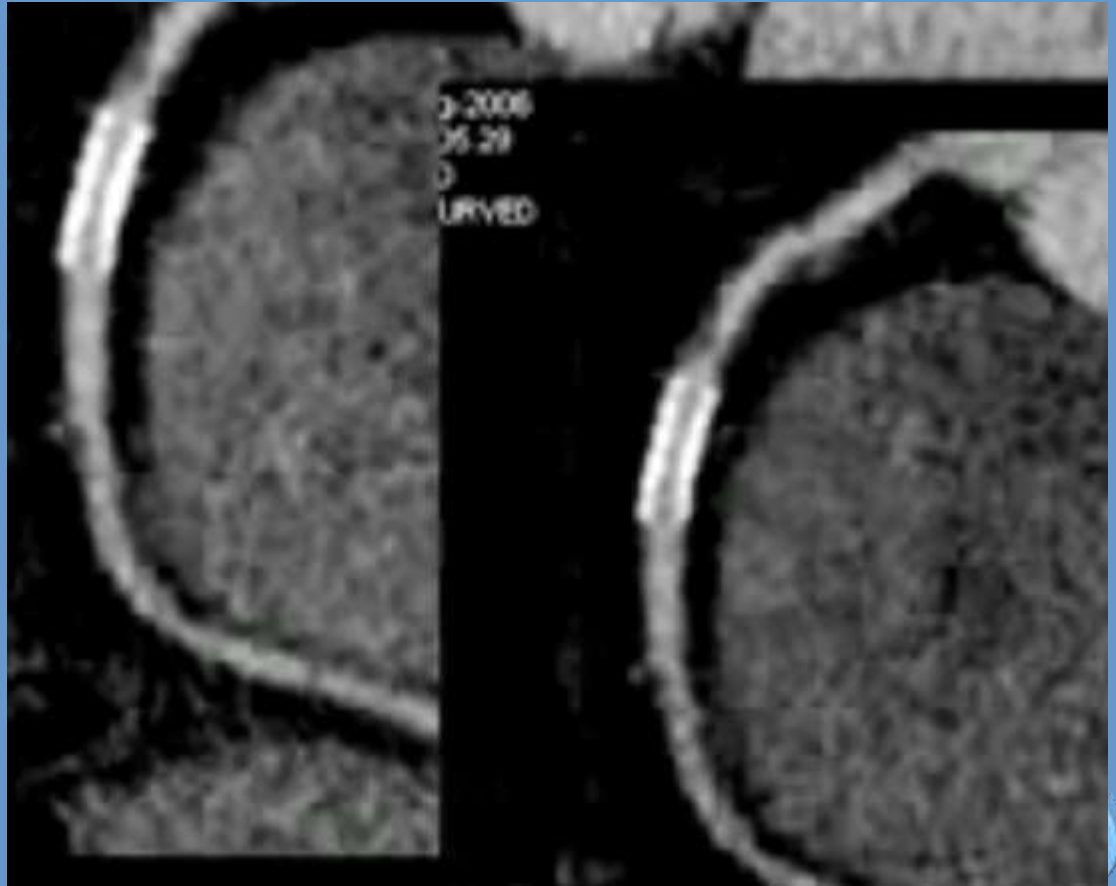
Partially calcified plaque



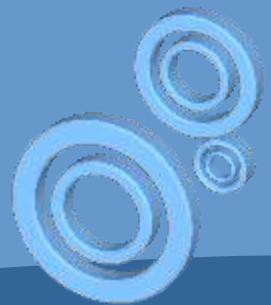
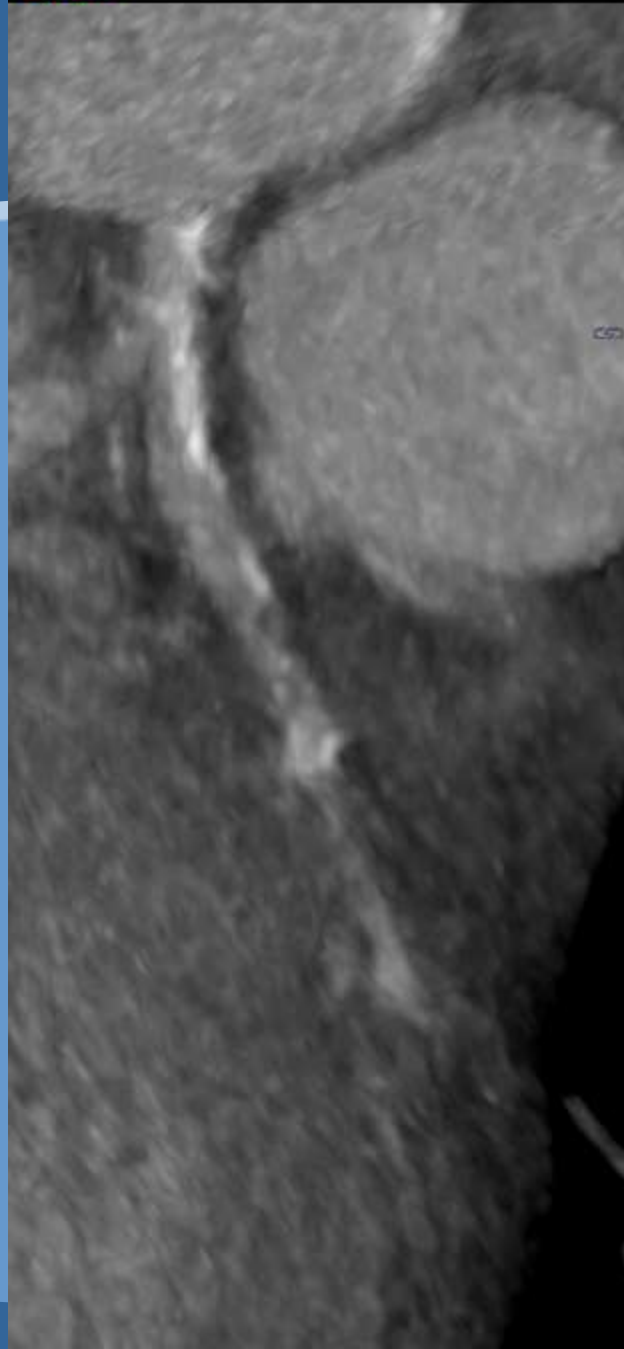
Stent



Stent and stenosis



LAD



Exclude contraindications

- Patient safety
- Study quality



Contraindications: patient safety

- Contrast
 - renal insufficiency
 - allergy (anaphylaxis)
- Radiation
 - pregnancy
 - radiation dose/age
- Claustrophobia
- Medically unstable

Contraindications: patient safety

- Contrast
 - renal insufficiency

GFR (ml/min/1.73 m ²)	Risk of contrast induced nephrotoxicity	Intravenous iodinated contrast media
60	Negligible	Safe
30–60	Moderate	Use only if clinically essential prophylaxis required
<30	High	Contraindicated

Contraindications: study quality

- Motion
 - Breath hold
 - Gating
- Artifact
 - Inability to raise arms
 - Metal
 - Obesity



Contraindications: study quality

- Motion
 - Gating
 - atrial fibrillation or frequent PVCs



Contraindications: study quality

- Artifact
 - Inability to raise arms
 - Metal
 - Obesity



The ideal patient

- HR < 65, sinus
- Calm
- Thin
- Large veins
- Pearl diver (able to hold breath)
- Able to follow commands



Ideális a CCTA-ra?



YES



NO



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EUROPEAN
SOCIETY OF
CARDIOLOGY®

European Heart Journal
doi:10.1093/eurheartj/ehs296

ESC GUIDELINES

2013 ESC guidelines on the management of stable coronary artery disease

**The Task Force on the management of stable coronary artery disease
of the European Society of Cardiology**



Pretest probability

Age	Typical angina		Atypical angina		Non-anginal pain	
	Men	Women	Men	Women	Men	Women
30–39	59	28	29	10	18	5
40–49	69	37	38	14	25	8
50–59	77	47	49	20	34	12
60–69	84	58	59	28	44	17
70–79	89	68	69	37	54	24
>80	93	76	78	47	65	32

This risk is modified if

- ECG indicates abnormalities
- LV EF < 50%

Genders TS, Steyerberg EW, Alkadhi H, Leschka S, Desbiolles L, Nieman K, Galema TW, Meijboom WB, Mollet NR, de Feyter PJ, Cademartini F, Maffei E, Dewey M, Zimmermann E, Laule M, Pugliese F, Barbagallo R, Sinitsyn V, Bogaert J, Goetschalckx K, Schoepf UJ, Rowe GW, Schuijf JD, Bax JJ, de Graaf FR, Knuuti J, Kajander S, van Mieghem CA, Meijis MF, Cramer MJ, Gopalan D, Feuchtner G, Friedrich G, Krestin GP, Hunink MG. A clinical prediction rule for the diagnosis of coronary artery disease: validation, updating, and extension. *Eur Heart J* 2011;**32**:1316–1330.

Iszkémia -Anatómia

Table 12 Characteristics of tests commonly used to diagnose the presence of coronary artery disease

	Diagnosis of CAD	
	Sensitivity (%)	Specificity (%)
Exercise ECG ^{a, 91, 94, 95}	45–50	85–90
Exercise stress echocardiography ⁹⁶	80–85	80–88
Exercise stress SPECT ⁹⁶⁻⁹⁹	73–92	63–87
Dobutamine stress echocardiography ⁹⁶	79–83	82–86
Dobutamine stress MRI ^{b,100}	79–88	81–91
Vasodilator stress echocardiography ⁹⁶	72–79	92–95
Vasodilator stress SPECT ^{96, 99}	90–91	75–84
Vasodilator stress MRI ^{b,98, 100-102}	67–94	61–85
Coronary CTA ^{c,103-105}	95–99	64–83
Vasodilator stress PET ^{97, 99, 106}	81–97	74–91

Testi

Anat



Testing for Diagnostic Purposes

Patients with suspected SCAD and intermediate PTP of 15% - 85%

Consider:

- Patient criteria^a/suitability for given test
- Availability
- Local expertise

Stress testing for ischaemia

PTP 15-65% and LVEF \geq 50%

Exercise ECG if feasible - stress imaging testing^b preferred (echo^c, CMR^d, SPECT^e, PET^f) if local expertise and availability permits

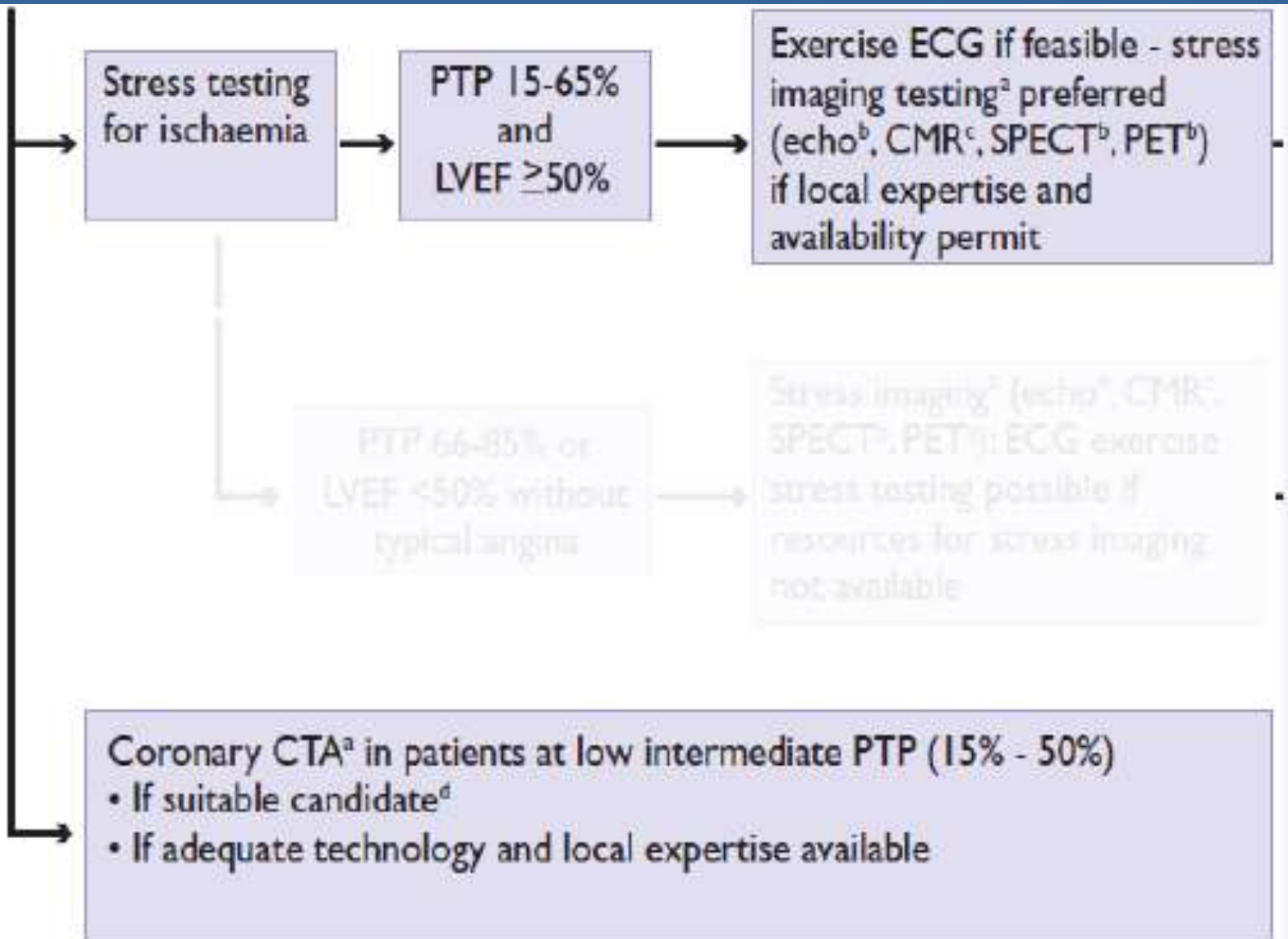
PTP 66-85% or LVEF $<$ 50% without typical angina

Stress imaging^b (echo^c, CMR^d, SPECT^e, PET^f); ECG exercise stress testing possible if resources for stress imaging not available

Coronary CTA^a in patients at low intermediate PTP (15% - 50%)

- If suitable candidate^d
- If adequate technology and local expertise available





Stress testing
for ischaemia

PTP 15-65%
and
LVEF \geq 50%

Exercise ECG if feasible - stress
imaging testing^a preferred
(echo^b, CMR^c, SPECT^b, PET^b)
if local expertise and
availability permit

PTP 66-85% or
LVEF <50% without
typical angina

Stress imaging^a (echo^b, CMR^c,
SPECT^b, PET^b); ECG exercise
stress testing possible if
resources for stress imaging
not available

Coronary CTA^a in patients at low intermediate PTP (15% - 50%)

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..... és tovább

Patients with suspected SCAD and intermediate PTP of 15% - 85%

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Coronary CTA^a in patients at low intermediate PTP (15% - 50%)

- If suitable candidate^d
- If adequate technology and local expertise available

Unclear

Ischaemia

No ischaemia

No stenosis

Stenosis

Unclear

2nd (imaging) stress test (if not done before)^f

Coronary CTA in suitable patient^d (if not done before)^e

ICA (with FFR when necessary)

Determine patient characteristics and preferences^b

Consider functional CAD Investigate other causes

Diagnosis SCAD established further risk stratification (see Fig. 3)

Ischaemia testing using stress imaging if not done before^f

Panaszos, nem ismert szívbeteg (2010)

Table 1 Detection of CAD in Symptomatic Patients Without Known Heart Disease*

Indication		Appropriate Use Score (1-9)			
		Low	Intermediate	High	
Nonacute Symptoms Possibly Representing an Ischemic Equivalent					
		Pretest Probability of CAD	Low	Intermediate	High
1.	<ul style="list-style-type: none"> • ECG interpretable AND • Able to exercise 		U (5)	A (7)	I (3)
2.	<ul style="list-style-type: none"> • ECG uninterpretable OR • Unable to exercise 		A (7)	A (8)	U (4)
Acute Symptoms With Suspicion of ACS (Urgent Presentation)					
3.	<ul style="list-style-type: none"> • Definite MI 			I (1)	
4.	<ul style="list-style-type: none"> • Persistent ECG ST-segment elevation following exclusion of MI 			U (6)	
5.	<ul style="list-style-type: none"> • Acute chest pain of uncertain cause (differential diagnosis includes pulmonary embolism, aortic dissection, and ACS ["triple rule out"]) 			U (6)	
		Pretest Probability of CAD	Low	Intermediate	High
6.	<ul style="list-style-type: none"> • Normal ECG and cardiac biomarkers 		A (7)	A (7)	U (4)
7.	<ul style="list-style-type: none"> • ECG uninterpretable 		A (7)	A (7)	U (4)
8.	<ul style="list-style-type: none"> • Nondiagnostic ECG OR • Equivocal cardiac biomarkers 		A (7)	A (7)	U (4)

A indicates appropriate; I, inappropriate; and U, uncertain.

*Note: All indications are for CTA unless otherwise noted.

Korábbi tesztek után

Prior ECG Exercise Testing

20.	<ul style="list-style-type: none"> Prior normal ECG exercise test Continued symptoms 	A (7)		
	Duke Treadmill Score—Risk Findings	Low	Intermediate	High
21.	<ul style="list-style-type: none"> Prior ECG exercise testing 	I (2)	A (7)	I (3)

Sequential Testing After Stress Imaging Procedures

22.	<ul style="list-style-type: none"> Discordant ECG exercise and imaging results 	A (8)		
	Test Result/Ischemia	Equivocal	Mild	Moderate or Severe
23.	<ul style="list-style-type: none"> Prior stress imaging procedure 	A (8)	U (6)	I (2)

Prior CCS

24.	<ul style="list-style-type: none"> Zero CCS >5 y ago 			U (4)	
25.	<ul style="list-style-type: none"> Positive CCS >2 y ago 			I (2)	
	CCS	<100	100–400	401–1000	>1000
26.	Diagnostic impact of coronary calcium on the decision to perform contrast CTA in symptomatic patients	A (8)	A (8)	U (6)	U (4)

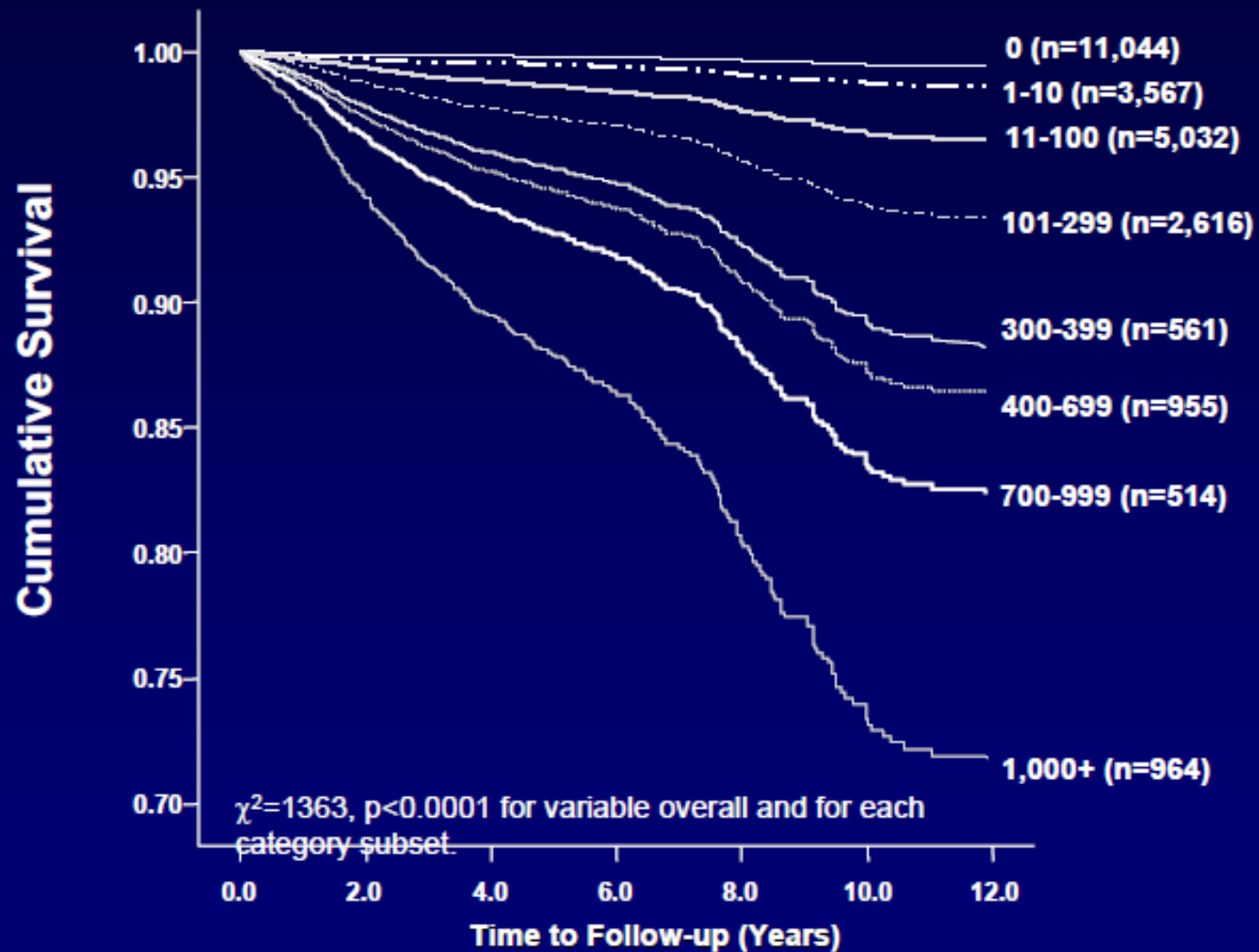
Asymptomatic OR Stable Symptoms Periodic Repeat Testing in the Setting of Prior Stress Imaging or Prior Coronary Angiography

	Last Study Done	<2 y Ago	≥2 y Ago
27.	<ul style="list-style-type: none"> No known CAD 	I (2)	I (3)
28.	<ul style="list-style-type: none"> Known CAD 	I (2)	I (3)

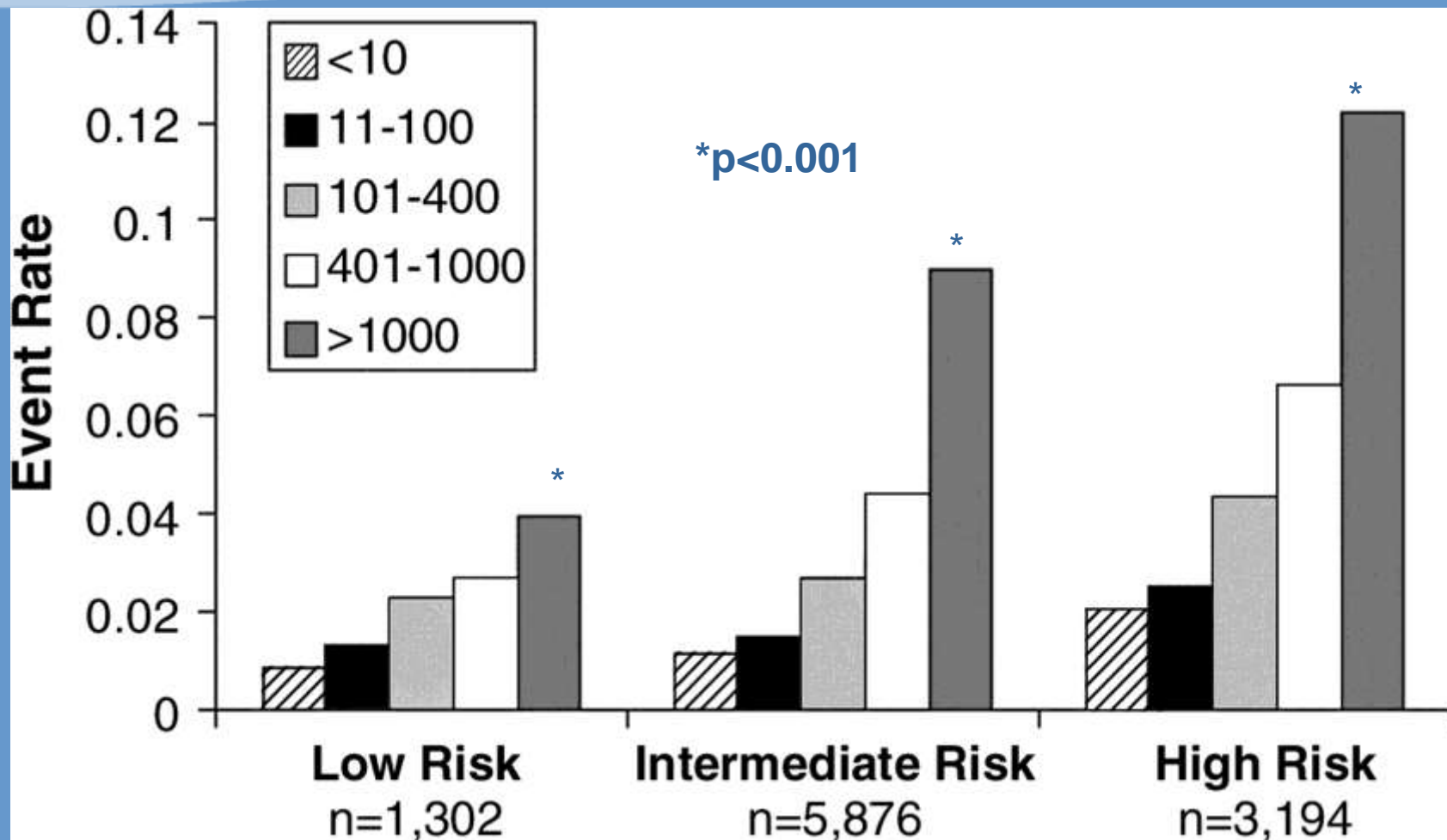
Evaluation of New or Worsening Symptoms in the Setting of Past Stress Imaging Study

	Previous Stress Imaging Study	Normal	Abnormal
29.	<ul style="list-style-type: none"> Evaluation of new or worsening symptoms 	A (8)	U (6)

Long-term prognosis predicted by calcium scoring



Five-Year Mortality Rates in Framingham Risk Subsets by Coronary Calcium Score



Revaszkularizáció után

Table 6 Risk Assessment Postrevascularization (PCI or CABG)

Indication		Appropriate Use Score (1-9)	
<u>Symptomatic (Ischemic Equivalent)</u>			
39.	• Evaluation of graft patency after CABG	A (8)	
40.	• Prior coronary stent with stent diameter <3 mm or not known	I (3)	
41.	• Prior coronary stent with stent diameter ≥3 mm	U (6)	
Asymptomatic—CABG			
Time Since CABG		<5 y Ago	≥5 y Ago
42.	• Prior CABG	I (2)	U (5)
<u>Asymptomatic—Prior Coronary Stenting</u>			
43.	• Prior left main coronary stent • Stent diameter ≥3 mm	A (7)	
Time Since PCI		<2 y	≥2 y
44.	• Stent diameter <3 mm or not known	I (2)	I (2)
45.	• Stent diameter ≥3 mm	I (3)	U (4)

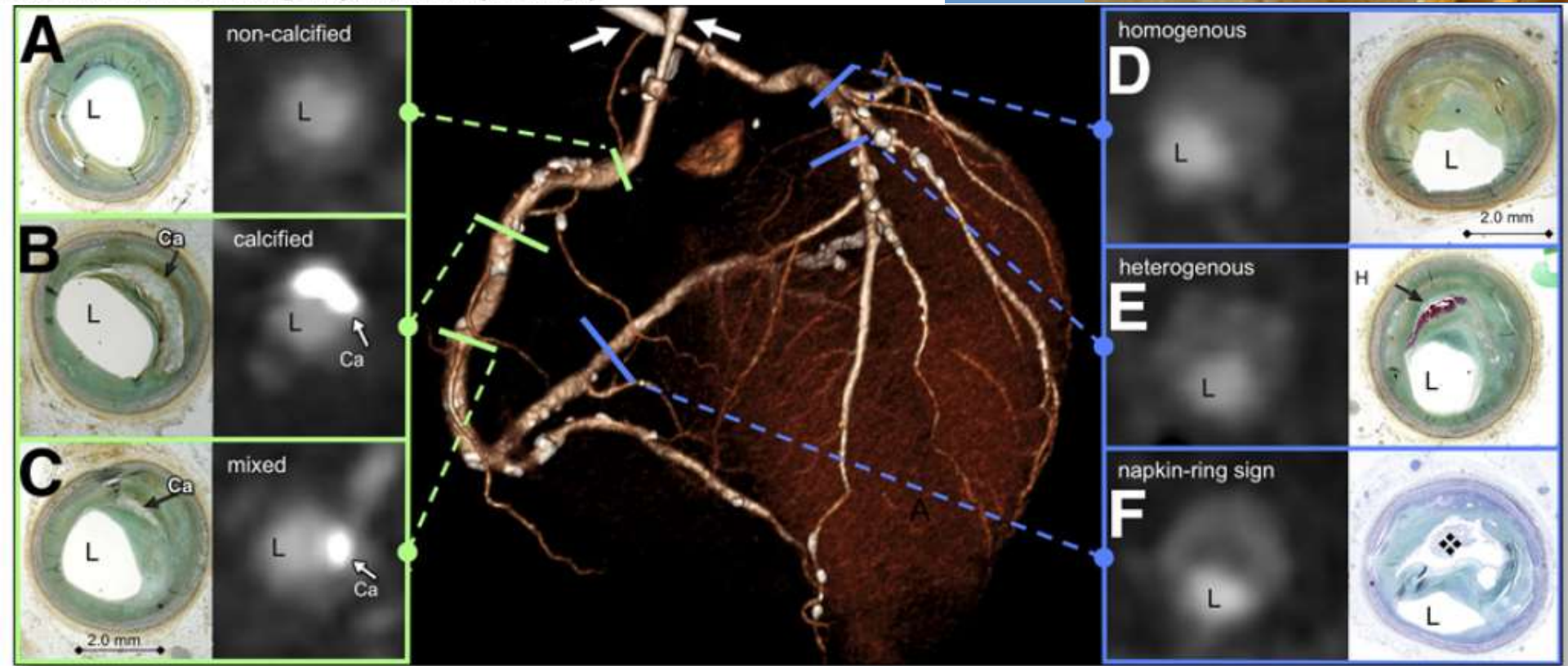
Risk Assessment

Exercise stress ECG ^b	High risk Intermediate risk Low risk	CV mortality >3%/year. CV mortality between 1 and 3%/year. CV mortality <1%/year.
Ischaemia imaging	High risk Intermediate risk Low risk	Area of ischaemia >10% Area of ischaemia between 1 to 10% No ischaemia.
Coronary CTA ^c	High risk Intermediate risk Low risk	Significant lesions of high risk category Significant lesion(s) in large and proximal coronary artery(ies) Normal coronary artery or plaques only.

The Napkin-Ring Sign Indicates Advanced Atherosclerotic Lesions in Coronary CT Angiography

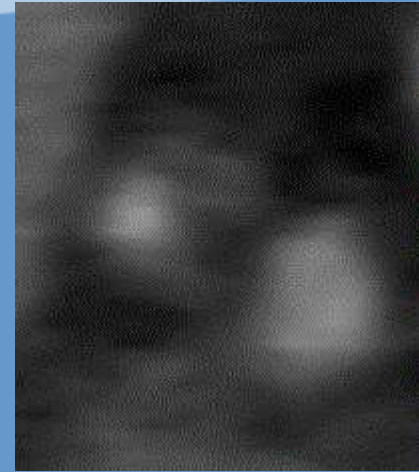
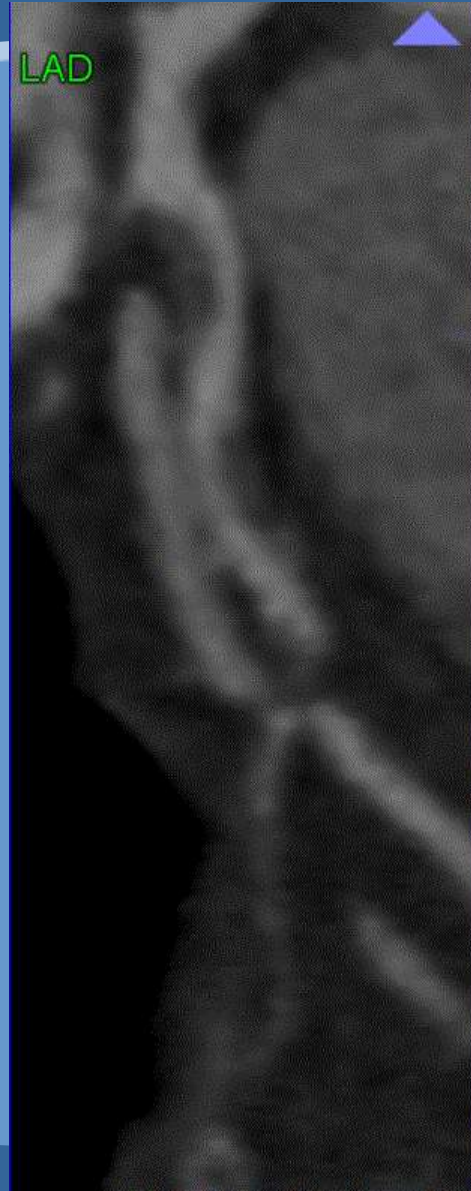
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Paul Stolzmann, MD,* Hans Scheffel, MD,* Maros Ferencik, MD, PhD,* Matthias F. Kriegl, MD,*
Harald Seifarth, MD,* Renu Virmani, MD,‡ Udo Hoffmann, MD, MPH*

Boston, Massachusetts; Gaithersburg, Maryland; and Budapest, Hungary



2011

2014



2010 Revascularisation guideline

Table 7 Indications of different imaging tests for the diagnosis of obstructive coronary artery disease and for the assessment of prognosis in subjects without known coronary artery disease^a

	Asymptomatic (screening)	Symptomatic			Prognostic value of positive result ^a	Prognostic value of negative result ^a	References
		Pretest likelihood ^b of obstructive disease					
		Low	Intermediate	High			
Anatomical test							
Invasive angiography	III A	III A	IIb A	I A	I A	I A	12
MDCT angiography	III B ^c	IIb B	IIa B	III B	IIb B	IIa B	17–20
MRI angiography	III B	III B	III B	III B	III C	III C	22
Functional test							
Stress echo	III A	III A	I A	III A ^d	I A	I A	12
Nuclear imaging	III A	III A	I A	III A ^e	I A	I A	12
Stress MRI	III B	III C	IIa B	III B ^d	IIa B	IIa B	12, 23–25
PET perfusion	III B	III C	IIa B	III B ^d	IIa B	IIa B	26

2014 Revascu

Intermediate (15-85%)

eline

Class ^c	Level ^d
--------------------	--------------------

	Asymptomatic ^a	
	Class ^c	Level ^d
Anatomical detection of CAD		
Invasive angiography	III	A
CT angiography ^{4,5}	III	B
Functional test		
Stress echo	III	A
Nuclear imaging	III	A
Stress MRI	III	B
PET perfusion	III	B
Combined or hybrid imaging test		
	III	C

IIb	A
IIa	A
I	A
I	A
I	A
I	A
I	A

Disease ^b		Ref ^e
Class ^c	Level ^d	
High (>85%)		
I	A	50-52,54
III	B	57-62
III	A	63-65
III	A	60,66-70
III	B	71-75
III	B	67,69,70,76,77
III	B	78-83

IIa	B
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KÖSZÖNÖM A FIGYELMET!

