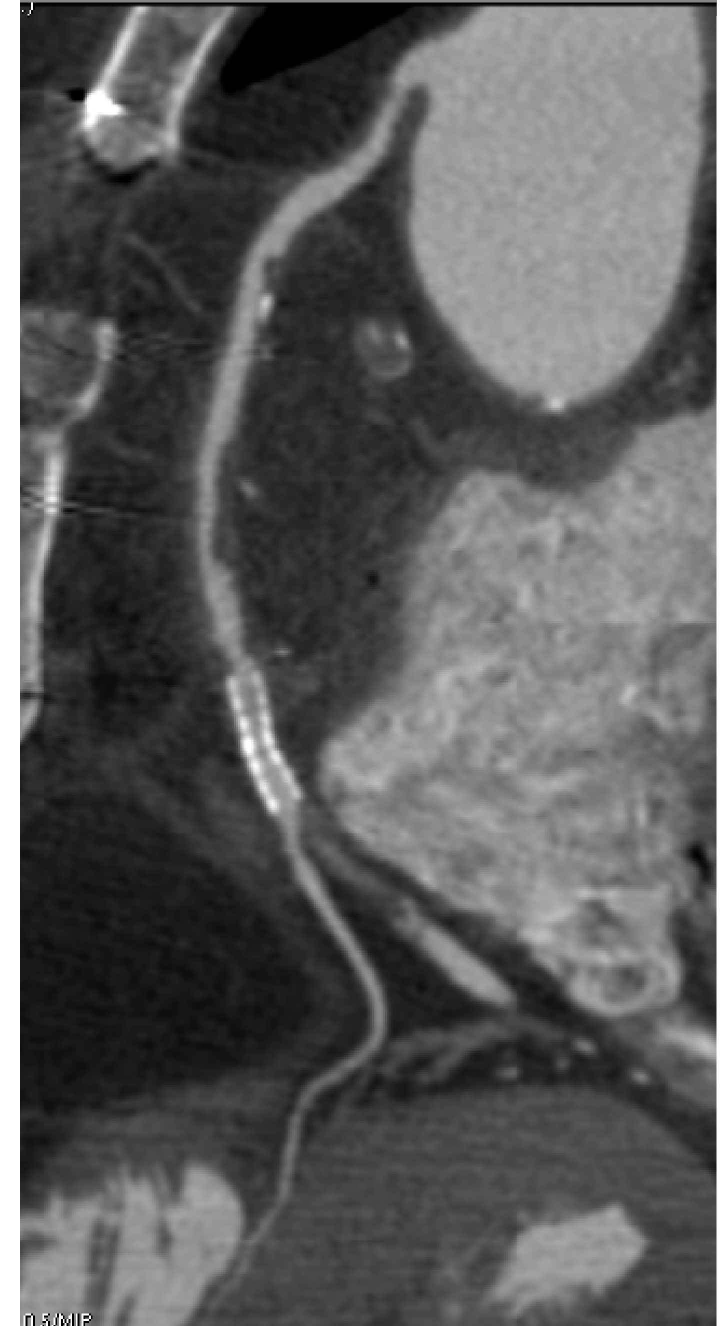
VCT in Cardiology

Indications and Guidelines

The Cardiologists View

Michel Romanens, MD
Olten



VCT in Cardiology

kardiolab

Overview

Who should do the test
- cardioradiology versus radiocardiology
- be cautious with the baby

Just another test
- how to judge, how good it is in
  - vascular risk prediction
  - coronary obstructive disease

Coronary Calcium Scoring
- state-of-the art

Coronary Obstruction
- ischemia versus obstruction

Conclusion and a Glance at the Future

VCT in Cardiology

kardiolab

Overview

- Who should do the test
  - cardioradiology versus radiocardiology
  - be cautious with the baby
- Just another test
  - how to judge, how good it is in
    - vascular risk prediction
    - coronary obstructive disease
- Coronary Calcium Scoring
  - state-of-the art
- Coronary Obstruction
  - ischemia versus obstruction
- Conclusion and a Glance at the Future

VCT in Cardiology

kardiolab

Keep it simple an clear

Four Field Table as the base for estimating the value of a test

		Reality	
		Healthy	**Sick**
Test	**Healthy**	**TN**	**FN**
	Sick	**FP**	**TP**

VCT in Cardiology

kardiolab

Keep it simple an clear

Four Field Table as the base for estimating the value of a test

Assessing Test Performance in Scientific Tables

TP	TN	FP	FN	SENS	SPEZ	PPV	NPV	ACC	ALL	pLR	nLR	PRE%
25	75	25	75	25	75	50	50	50	200	1.00	1.00	50
5	75	25	15	25	75	17	83	67	120	1.00	1.00	17

VCT in Cardiology

kardiolab

Keep it simple an clear ... and evidence based

Four Field Table as the base for estimating the value of a test

		Good Test
positive likelihood ratio	**sensitivity / 1- specificity**	**> 2.0**
negative likelihood ratio	**1- sensitivity / specificity**	**< 0.5**

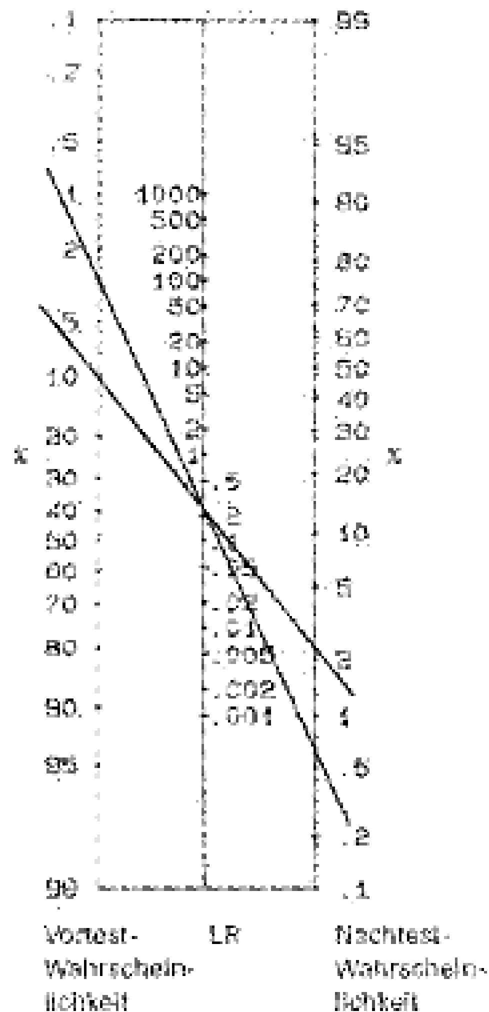
Fagan calculator:

Pretest probability * pLR = posttest probability for a positive test result

Pretest probability * nLR = posttest probability for a negative test result

VCT in Cardiology

Abbildung 1.
Nomogramm nach Fagan [10].
Bestimmung der Nachtest-Wahrscheinlichkeit aus Vortest-Wahrscheinlichkeit und Likelihood Ratio (LR).



VCT in Cardiology

kardiolab

Overview

Who should do the test
- cardioradiology versus radiocardiology
- be cautious with the baby

Just another test
- how to judge, how good it is in
  - vascular risk prediction
  - coronary obstructive disease

Coronary Calcium Scoring
- state-of-the art

Coronary Obstruction
- ischemia versus obstruction

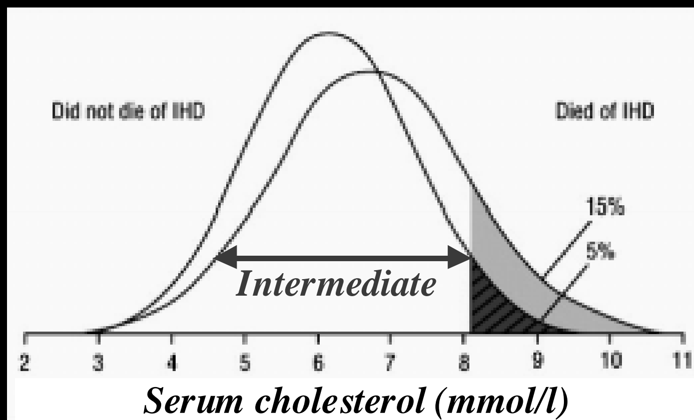
Conclusion and a Glance at the Future

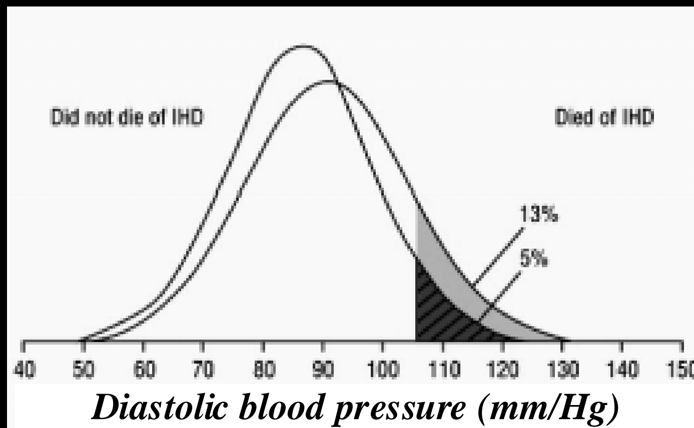
kardiolab

Conventional Risk Factor Testing

Relative distributions of risk factors

22 000 men, 10-year follow-up





~80% overlap!

Wald NJ, Law MR. BMJ. 2003; 326:1419-

Integration of Test Results – Posterior Probabilities

Test Performance for the End Point of Cardiac Death using Different Risk measurements

	Sensitivity (%)	Specificity (%)
NCEP II Guidelines	45	86
Total Cholesterol	47	76
HDL Cholesterol	48	74
LDL Cholesterol	47	76
T-C / HDL-C	58	76

Grover et al, JAMA 1995;274:801

Test Performance for EBCT for the Combined End Point of Myocardial Infarction and Cardiac Death

CS > 160	Sensitivity (%)	Specificity (%)
Men	86	80
Women	75	87

JACC 2000;36:1253

Test Performance for Carotid IMT for the Combined End Point of Myocardial Infarction and Cardiac Death

IMT > 3. tertile	Sensitivity (%)	Specificity (%)
Men	55	67
Women	67	67

Chambless L. Am J Epidemiol 1997;146:483

M. Romanens 04/2002

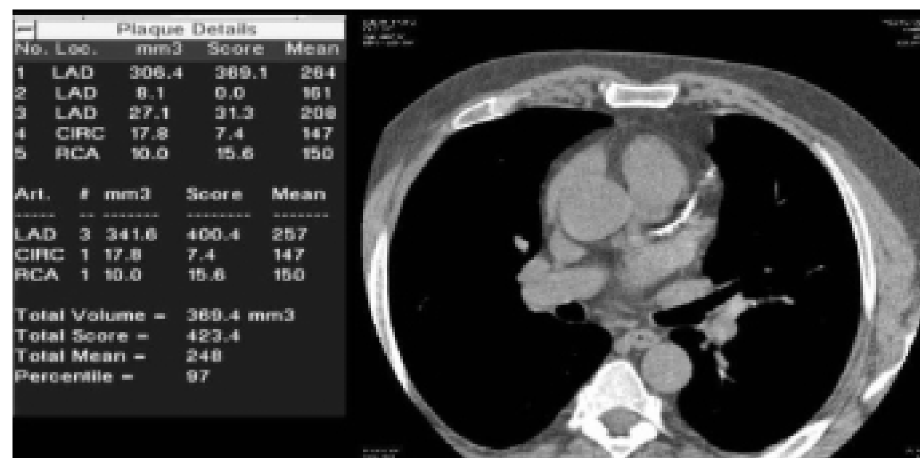
Integration of Test Results – Posterior Probabilities

What we need to know from a test:

is a new test better than the old test ?
is the test sensitivity and specificity known ?
are the results of a test transferrable to our patients ?
can the new test be integrated on top of the old test ?
is the new test reproducible ?
does the new test infer some possible harm ?
is the new test available widely ?
has the new test established cost efficiency ?
can the result be „treated“ – does treatment reduce risk ?

Discussions within the Taskforce

CAC, CS	**(Coronary artery calcium, Coronary Calcium Percentiles**
Who	Subjects of any age at intermediate or moderate high risk
How	EBCT or MSCT 4-64 rows with imaging during diastoly
	Agatston score based on plaque area and density
Posttest	established
Incremental value	established
Comment	there is some controversy about this test because of it's radiation burden and abuse in the past

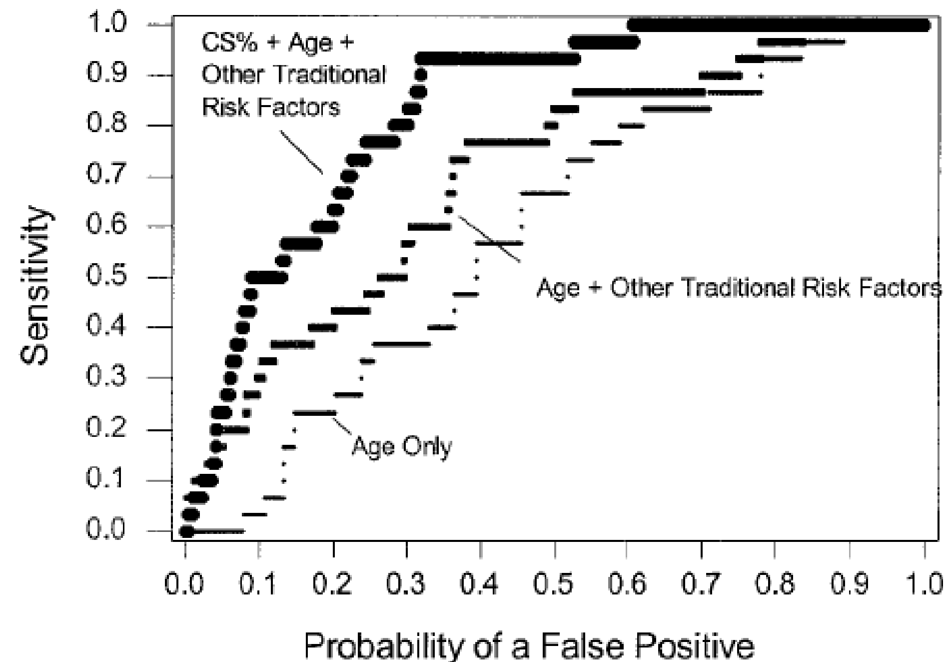


Posterior Probability as a Problem Solver

Calcium Score Percentiles (CS%)

Test accuracy in 676 men and women with 30 myocardial infarctions during follow-up of 2.7 years.

Age:	61%
Risk factors:	71%
CS%:	82%
Combination:	84%



Comparison of three ROC curves based on (1) age alone *(very thick curve)*, (2) age and other traditional risk factors (sex, smoking, diabetes mellitus, hypertension, and hypercholesterolemia, *thick curve*), and (3) age, other traditional risk factors, and CS% *(thin curve)*.

kardiolab

Atherosclerosis imaging

Coronary calcium predicts mortality from any cause better than the Framingham Score.

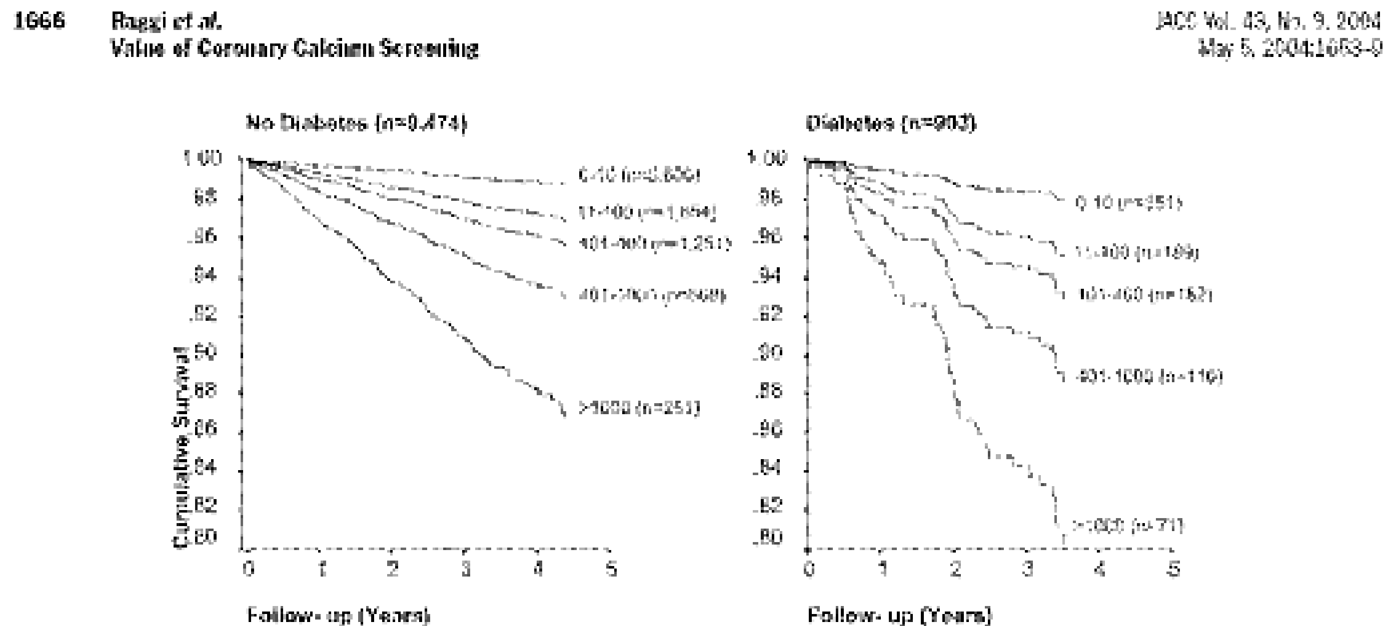


Figure 2. Cox proportional hazards survival (n = 10,377) by electron beam tomography coronary calcium measurements in subjects with and without diabetes mellitus (chi-square = 204, p < 0.0001). The number of subjects in each calcium score category is in parentheses.

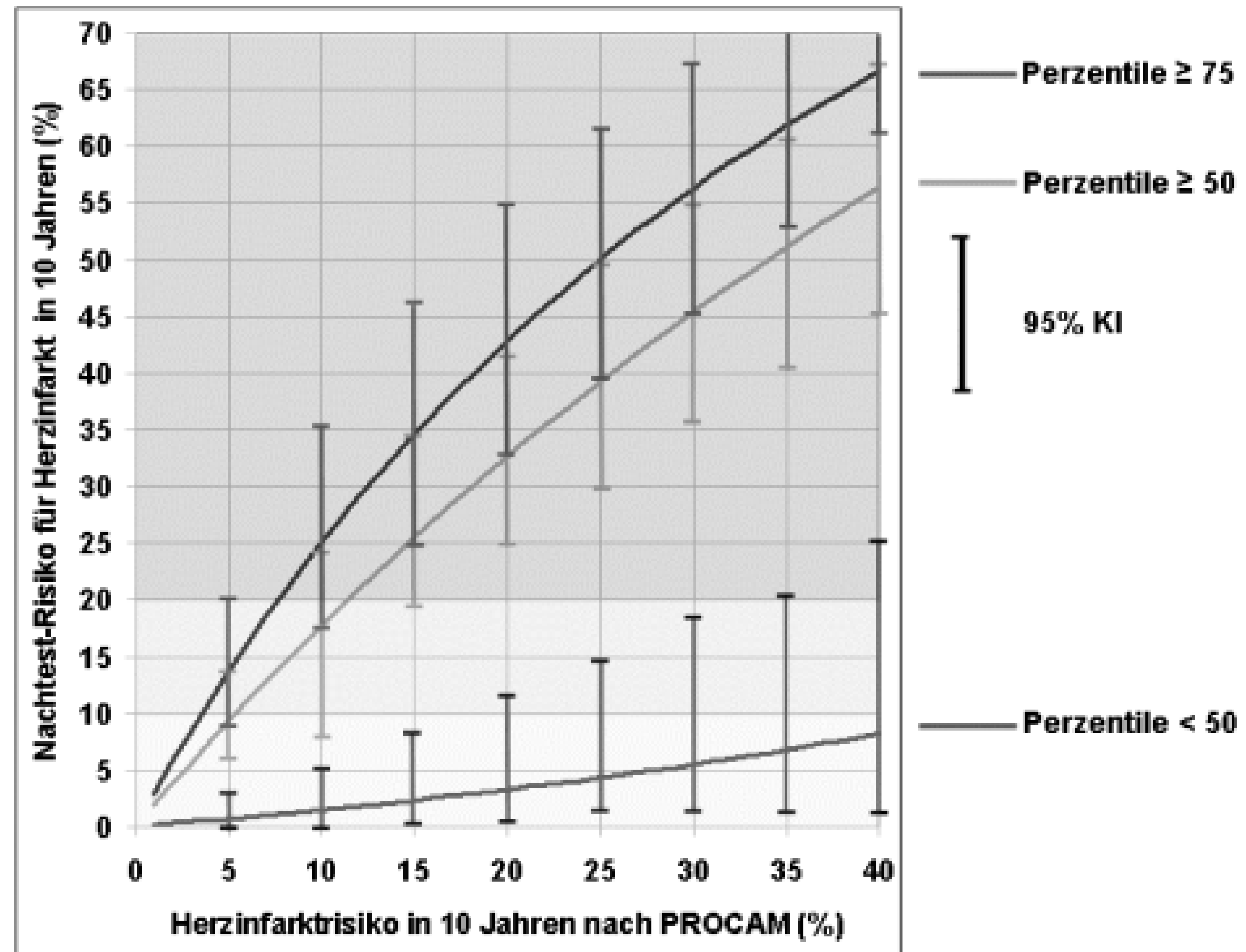
Coronary Calcium Scoring

Current Evidence based on ROC analysis in 19751 subjects

Author	Publication	N	Outcome	Age	ROC RF	ROC CAC	p
Shaw	**Radiol. 2003**	**10377**	**Mortality**	**53**	**0.72**	**0.78**	**0.001**
Raggi	**JACC 2004**	**903**	**Mortality**	**57**	**0.50**	**0.72**	**0.0001**
Vliegenthart	**CIRC 2005**	**1795**	**CAD**	**71**	**0.75**	**0.77**	**0.02**
Arad	**JACC 2005**	**4903**	**CAD**	**59**	**0.68**	**0.79**	**0.0006**
Taylor	**JACC 2005**	**2000**	**CAD**	**43**	**0.50**	**0.89**	**NS**
Raggi	**AHJ 2001**	**676**	**CAD**	**52**	**0.71**	**0.82**	**0.03**

Coronary Calcium Scoring

Nomogram to calculate posterior probabilities based on calcium score percentiles



Sequential Testing

Avoid treatment gap

e.g. ankle-arm index becomes to late positive

Chose subjects with intermediate or low- to intermediate pretest probabilities

Perform „atherosclerosis imaging“ e.g. using TPA if carotid arteries

If posttest risk is high (heavy plaque burden), then treat patient accordingly

If posttest risk is very low, change lifestyle as appropriate

If posttest risk is intermediate or low- to intermediate,

use other measures of plaque risque, e.g.

aortic wall elastance or
coronary calcium scoring

Atherosclerosis Tracking

Increase of > 15% of coronary calcium volume per year infers higher risk in subjects treated with statins

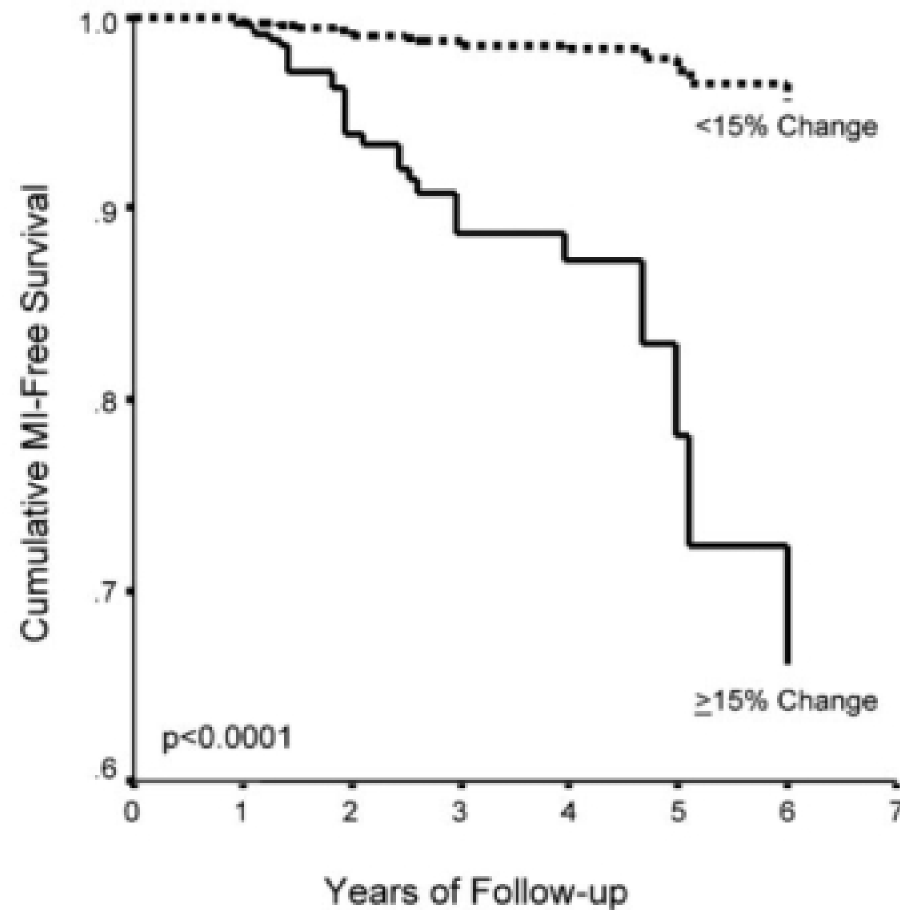


Figure 2. Cox proportional hazards survival curves demonstrating time to acute MI for patients with a yearly calcium volume score change ≥15% or <15%.

Atherosclerosis Tracking

Carotid total plaque area (TPA)
Spence D. Carotid plaque area. A tool for Targeting and Evaluating Vascular Preventive Therapy.
Stroke 2002;33:2916-2922

A tool for
Atherosclerosis tracking

Combined endpoint of fatal or nonfatal myocardial infarction and stroke

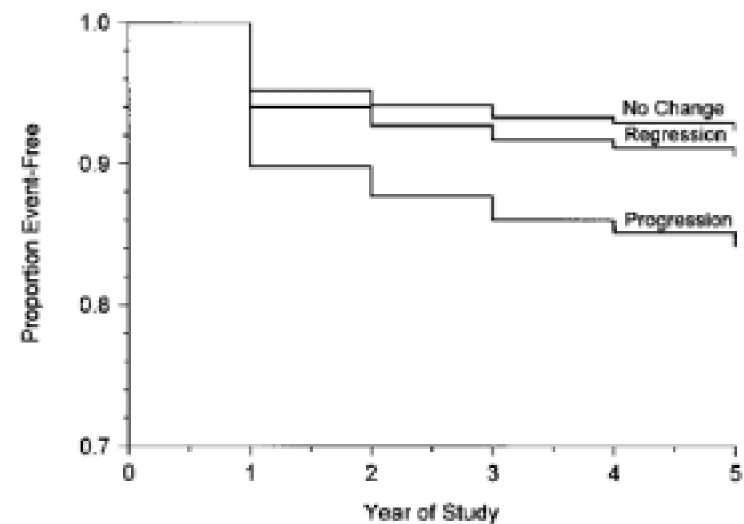


Figure 4. Risk-factor–adjusted event-free survival from stroke, myocardial infarction, and vascular death by quartiles of carotid plaque area (top; cm^2) and by status of carotid plaque area progression or regression during follow-up (bottom). Plaque area regression was defined as a decrease of ≥ 0.05 cm^2 from baseline; progression was defined as an increase of ≥ 0.05 cm^2 from baseline; and no change was defined as either an increase or decrease of no more than 0.049 cm^2. Survival was adjusted for all baseline patient characteristics listed in Table 1.

kardiolab

Atherosclerosis Tracking – Test Performances for Coronary Volume Score and TPA from the Spence Cohort

	TP	TN	FP	FN	SENS	SPEZ	PPV	NPV	ACC	ALL	pLR	nLR	INC%
CVS >15%	39	244	210	2	95	54	16	99	57	495	2.06	0.09	8
TPA>0.05	108	440	577	42	72	43	16	91	47	1167	1.27	0.65	13

Atherosclerosis tracking:
Since the incidence of events is usually rather low in subjects treated medically for their vascular risk, a sensitive test like CVS and TPA progression is able to assess whether a subject is at low risk or not.
Based on a limited evidence from the literature, coronary calcium outperforms carotid plaque imaging for risk tracking.

What may replace calcium scoring ?

Risk Assessment in Primary Care

What might replace coronary calcium measurements in the future ?

- Coronary calcium is simply the best measure we have to date !
  - But there is radiation burden
  - It is a relatively costly method
- TPA > 1.0 cm2: ability to detect a coronary calcium percentile > 75%
  - Data on file: Sensitivity 36%, Specificity 85%, AUC 0.58, p=0.02
- Aortic Pulse Wave Velocity (personal communication, Prof. Kullo, Mayo Clinic, 05.03.2006

What may replace calcium scoring ?

Kullo Hypertension 2006;47:174-179

PWV	CAC	TP	TN	FP	FN	SENS	SPEZ	PPV	NPV	ACC	ALL	pLR	nLR	ROC	PREV%
9.4	0	129	116	27	129	50	81	83	47	61	401	2.6	0.6	0.68	64
9.4	>100	80	200	76	45	64	72	51	82	70	401	2.3	0.5	0.73	31
10.2	>400	31	265	88	17	65	75	26	94	74	401	2.6	0.5	0.73	12

Romanens data on file

TPA	CAC	TP	TN	FP	FN	SENS	SPEZ	PPV	NPV	ACC	ALL	pLR	nLR	ROC	PREV%
>0.5	0	40	42	7	60	40	86	85	41	55	149	2.8	0.7	0.64	67
>0.5	>100	27	72	19	31	47	79	59	70	66	149	2.2	0.7	0.67	39
>0.5	>400	14	90	33	12	54	73	30	88	70	149	2.0	0.6	0.67	17

Romanens data on file

TPA	CAC	TP	TN	FP	FN	SENS	SPEZ	PPV	NPV	ACC	ALL	pLR	nLR	ROC	PREV%
>1.0	0	14	48	1	86	14	98	93	36	42	149	6.9	0.9	0.64	67
>1.0	>100	10	87	4	48	17	96	71	64	65	149	3.9	0.9	0.67	39
>1.0	>400	7	115	8	19	27	93	47	86	82	149	4.1	0.8	0.67	17

VCT in Cardiology

kardiolab

Overview

Who should do the test
- cardioradiology versus radiocardiology
- be cautious with the baby

Just another test
- how to judge, how good it is in
  - vascular risk prediction
  - coronary obstructive disease

Coronary Calcium Scoring
- state-of-the art

Coronary Obstruction
- ischemia versus obstruction

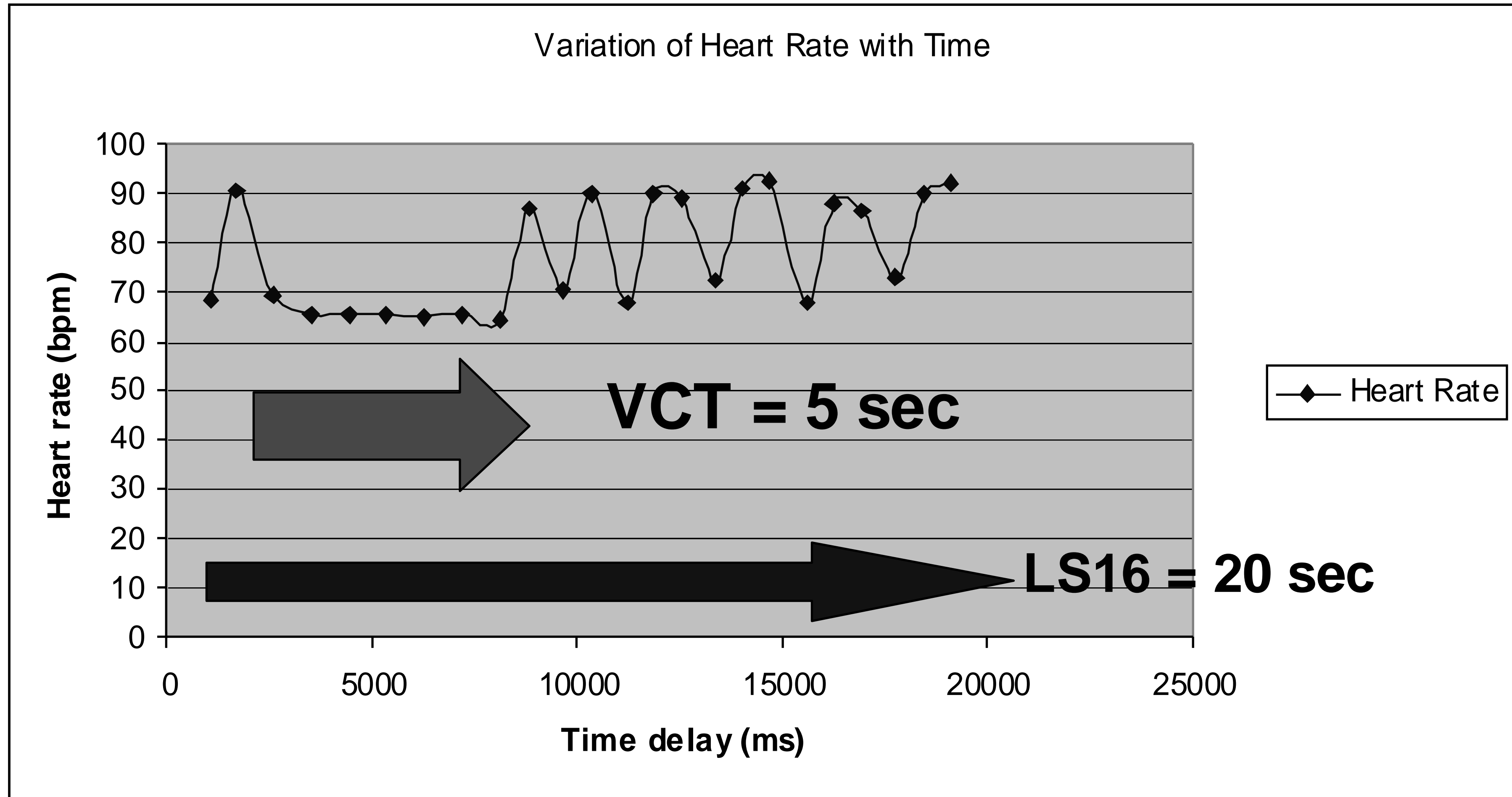
Conclusion and a Glance at the Future

VCT – Advantages

	16	64
Short acquisition time	++	+++
Less motion artefacts	++	+++
Better s/n ratio	++	+++
Only arterial phase	++	+++
Distal vessel assessibilit	++	+++
Less ECG artefacts	++	+++
Less respirations artefacts	++	+++

kardiolab

VCT – Advantages



kardiolab

MSCT – diagnostic accuracy in comparison to coronary Angiography (QCA); coronary segment level

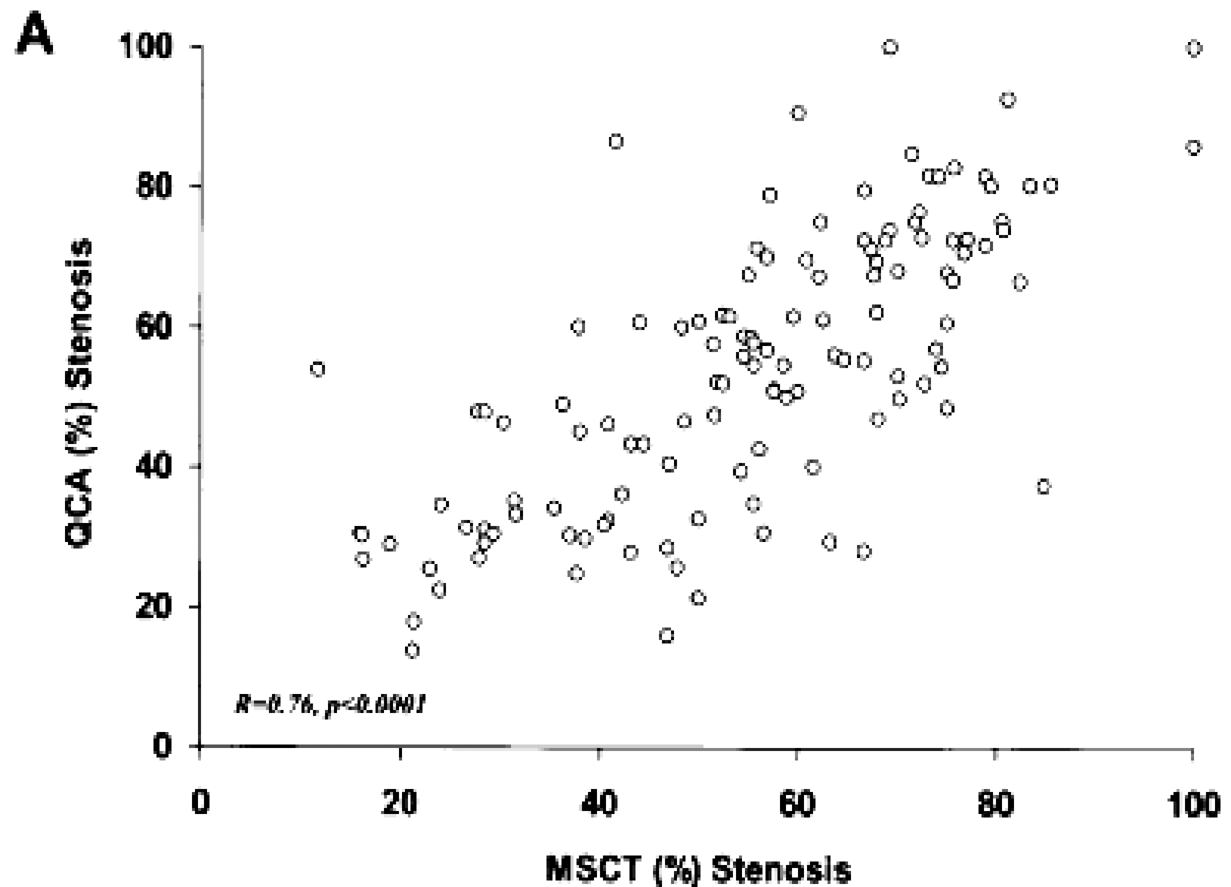
	Author	Publication	Patients	Sens	Spec	PPV	NPV	Excl
16 Slice	Achenbach	EHJ 2005	50	93	95	76	99	5%
	Hoffmann	JAMA 2005	103	95	98	79	99	6%
	Kuettner	JACC 2004	66	37	99	83	92	7%
	Martuscelli	EHJ 2004	64	89	98	90	98	16%
	Mollet	JACC 2005	51	95	98	87	99	9%
	Mollet	JACC 2004	128	92	95	79	98	7%
	Kaiser	EHJ 2005	149	30	91	47	83	23%
	Achenbach	CIRC 2004	33	63	96	64	96	6%
	Gewichteter Mittelwert		81	71	96	73	94	11
64 Slice	Leschka	EHJ 2005	70	86	95	66	98	12%
	Leber	JACC 2005	59	79	97	72	98	7%
	Raff	JACC 2005	70	86	95	66	98	12%
	Ropers	AJC in press	82	93	97	80	98	4%
	Gewichteter Mittelwert		70	87	96	71	98	9

kardiolab

Degree of stenosis: comparison made by MCT – QCA

Single case
Agreement low

Comparing the maximal percent diameter luminal stenosis by MSCT versus QCA, the Spearman correlation coefficient between the two modalities was 0.76 ($p < 0.0001$)



kardiolab

Degree of Stenosis: comparison MSCT, QCA und IVUS

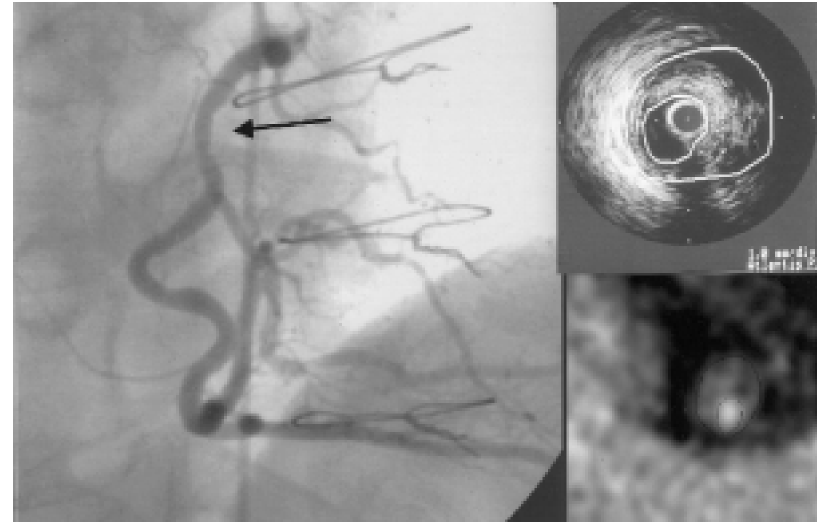
IVUS in 54 patients with Intermediate degree of stenosis:

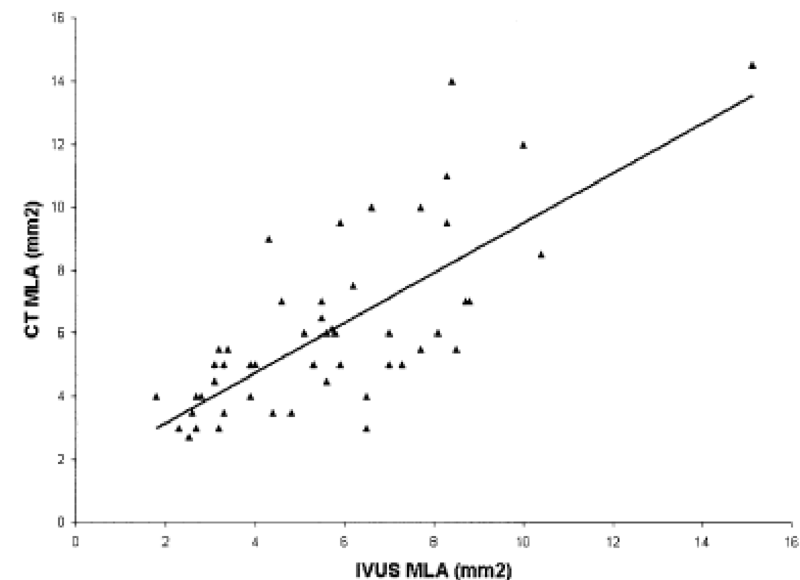
51 stenoses 30-60%

22 stenoses > 50%

Stenose > 50%

MSCT		**QCA**	
Sens	68%	Sens	10%
Spec	86%	Spec	96%
Acc	71%	Acc	59%
p<0.001		p NS	





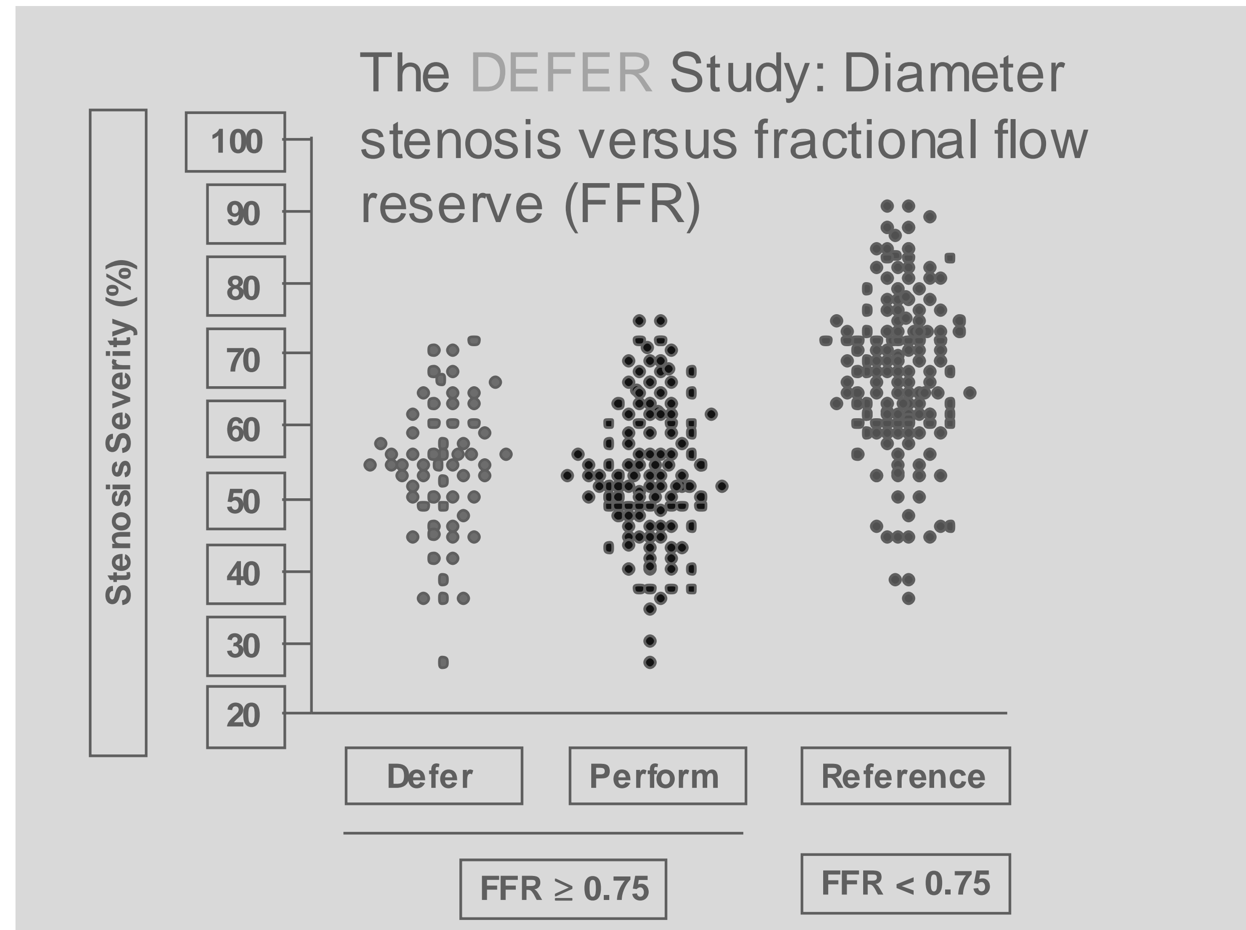
kardiolab

Luminology or Ischemia ?

Defer Group:
N=91
No ischemia (FFR>0.75)
No PCI

Perform Group:
N=90
No ischemia (FFR>0.75)
PCI done

Reference Gruppe:
N=144
Ischemia yes (FFR<0.75)
PCI performed



kardiolab

Luminology or Ischemia ?

Diagnostic Ability of Coronary Angiography to detect „ischemia“ The DEFER Study [1]

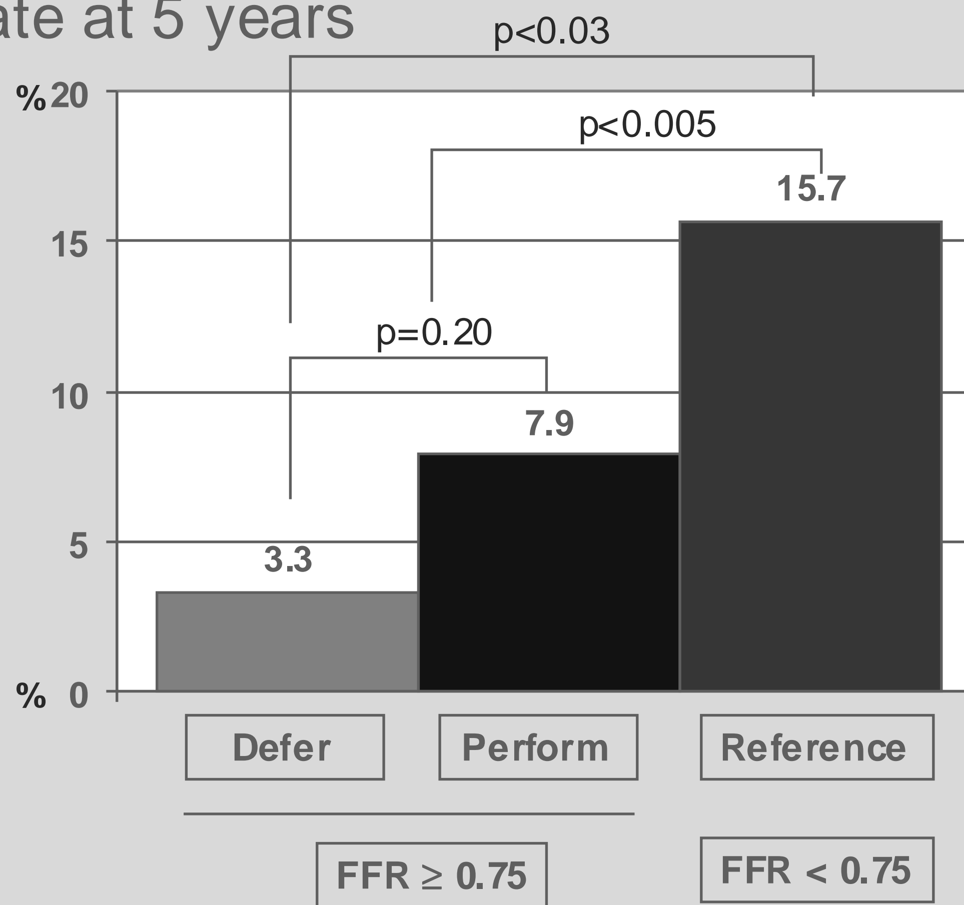
TP	TN	FP	FN
106	72	109	38

SENS	SPEZ	PPV	NPV	ACC	ALL
74	40	49	65	55	325

[1] Reference is coronary stenosis of at least 50%

kardiolab

Luminology or Ischemia ?



VCT – „clinical decision making“

		16		64
PPV	too low	73%	vs	71%
NPV	very good	94%	vs	98%

Problems with QCA Stenoses:

- not a good golden standard for stenoses that cause ischemia
- performing PCI in stenoses greater than 30-70% to relieve „ischemia“ is purely arbitrary without a coronary function test

VCT – „clinical decision making“: better NPV with 64 VCT ?

Higher NPV due to lower prevalence of coronary stenoses !

More important: with 64 higher pLR and nLR and Sensitivity

High Sensitivity of a test in a population with low prevalence of disease is ideal

	TP	TN	FP	FN	SENS	SPEZ	PPV	NPV	ACC	ALL	pLR	nLR	PRE%
16 Slices	**63**	**532**	**23**	**26**	**71**	**96**	**73**	**95**	**92**	**644**	**17.1**	**0.30**	**14**
64 Slices	**36**	**278**	**13**	**5**	**88**	**96**	**73**	**98**	**95**	**332**	**19.7**	**0.13**	**12**

Predictive Value of 16-Slice Multidetector Spiral Computed Tomography to Detect Significant Obstructive Coronary Artery Disease in Patients at High Risk for Coronary Artery Disease

Patient- Versus Segment-Based Analysis

Circulation October 26, 2004

TABLE 2. Diagnostic Accuracy and Predictive Value of MDCT for Detection of Significant Stenosis (>50% Luminal Narrowing) on Selective Angiography

	Sensitivity	Specificity	PPV	NPV	+LR	−LR	DOR
Segment-based analysis							
All segments	0.63 (0.50–0.76)	0.96 (0.94–0.98)	0.64	0.96	15.77	0.39	40.89
Evaluable only	0.70 (0.57–0.82)	0.94 (0.92–0.97)	0.58	0.97	12.46	0.32	38.92
Proximal segments	0.82 (0.70–0.94)	0.93 (0.90–0.97)	0.68	0.97	12.46	0.19	64.04
Patient-based analysis							
All segments	0.86 (0.72–1.01)	0.82 (0.60–1.04)	0.90	0.75	4.75	0.17	28.5
Proximal segments	0.86 (0.67–1.04)	0.89 (0.76–1.03)	0.86	0.89	8.14	0.16	51.00

For segment-based analysis for all segments, analysis of 530 segments according to modified AHA classification of coronary segments; evaluable only, 438 segments (92 segments were excluded because of impaired image quality); proximal segments, 1, 2, 5, 6, 7, 11, 13. For patient-based analysis, there were 33 consecutive patients. PPV indicates positive predictive value; NPV, negative predictive value; +LR, positive likelihood ratio; −LR, negative likelihood ratio; and DOR, diagnostic odds ratio. All other abbreviations are as defined in text. Values in parenthesis represent upper and lower bound for 95% confidence interval.

VCT in Cardiology

kardiolab

Eur Radiol (2006) 16: 575–582
DOI 10.1007/s00330-005-0041-0

CARDIAC

Francesca Pugliese
Nico R. A. Mollet
Giuseppe Runza
Carlos van Mieghem
Willem B. Meijboom
Patrizia Malagutti
Timo Baks
Gabriel P. Krestin
Pim J. deFeyter
Filippo Cademartiri

Diagnostic accuracy of non-invasive 64-slice CT coronary angiography in patients with stable angina pectoris

Table 4 Overall CT accuracy: all segments, per-vessel, per-patient

	Sensitivity	Specificity	Positive predictive value	Negative predictive value
All segments (total 494)	66/67=99% (92–100)	408/427=96% (93–97)	66/85=78% (68–85)	408/409=99% (99–100)
Per vessel				
RCA, PDA, PL (available 138)	20/20=100% (84–100)	113/118=96% (90–98)	20/25=80% (61–91)	113/113=100% (97–100)
LM (available 35)	–	35/35=100% (90–100)	–	35/35=100% (90–100)
LAD, diagonal branches (available 156)	25/26=96% (81–99)	121/130=93% (87–96)	25/34=74% (57–85)	121/122=99% (96–100)
LCX, MO branches, IB (available 165)	21/21=100% (85–100)	139/144=97% (92–98)	21/26=81% (62–91)	139/139=100% (97–100)
Per-patient (total 35)	25/25=100% (87–100)	9/10=90% (59–98)	25/26=96% (81–99)	9/9=100% (69–100)

Values are reported in ratios and percentages, with 95% central confidence intervals in brackets
RCA right coronary artery; *PDA* posterior descending artery; *PL* posterolateral artery; *LM* left main coronary artery; *LAD* left anterior descending artery; *LCX* left circumflex artery; *MO* marginal obtuse branches; *IB* intermediate branch. The left main coronary artery was normal in all patients

High-Resolution Spiral Computed Tomography Coronary Angiography in Patients Referred for Diagnostic Conventional Coronary Angiography

Nico R. Mollet, MD; Filippo Cademartiri, MD; Carlos A.G. van Mieghem, MD; Giuseppe Runza, MD; Eugène P. McFadden, MB, FRCP; Timo Baks, MD; Patrick W. Serruys, MD; Gabriel P. Krestin, MD; Pim J. de Feyter, MD

Background—The diagnostic performance of the latest 64-slice CT scanner, with increased temporal (165 ms) and spatial (0.4 mm^3) resolution, to detect significant stenoses in the clinically relevant coronary tree is unknown.

VCT in Cardiology

kardiolab

TABLE 2. Diagnostic Performance and Predictive Value of 64-Slice CT Coronary Angiography for the Detection of ≥50% Stenoses on QCA

	n	Sensitivity, %	Specificity, %	PPV, %	NPV, %	+LR	−LR
Segment-based analysis							
All segments	725	99 (94–98)	95 (93–96)	76 (67–89)	100 (99–100)	20.31	0.01
Proximal segments	204	100 (89–100)	97 (93–98)	83 (67–97)	100 (97–100)	29.00	0.00
Mid segments	142	97 (83–99)	94 (88–97)	81 (63–96)	99 (94–99)	15.47	0.04
Distal segments	121	100 (68–100)	97 (92–99)	73 (39–98)	100 (96–100)	37.67	0.00
Side branches	253	100 (87–100)	94 (90–96)	65 (48–85)	100 (98–100)	16.57	0.00
LM	51	100 (21–100)	100 (93–100)	100 (92–100)	100 (2–100)	∞	0.00
LAD	230	97 (85–100)	92 (88–95)	69 (53–86)	99 (96–99)	12.68	0.03
LCx	235	100 (88–100)	97 (94–99)	83 (66–97)	100 (98–100)	34.33	0.00
RCA	209	100 (89–100)	95 (91–97)	77 (60–95)	100 (97–100)	19.39	0.00
Patient-based analysis							
All segments	51	100 (91–100)	92 (67–99)	97 (86–99)	100 (73–100)	13.00	0.00

PPV indicates positive predictive value; NPV, negative predictive value; +LR, positive likelihood ratio; −LR, negative likelihood ratio; LM, left main coronary artery; LCx, circumflex coronary artery; and RCA, right coronary artery. For segment-based analysis, analysis of 725 segments visualized on the conventional angiogram and classified according to a 17-segment modified AHA classification was performed. Segments were further classified on the basis of their location within the coronary tree (proximal, mid, or distal segments of the main coronary artery arteries or side branches) and their location within a single vessel (LM, LAD, LCx, or RCA). For patient-based analysis, analysis of 51 patients was performed. Values in parentheses represent 95% CIs.

Study Population

During a period of 6 weeks, we studied 70 consecutive patients scheduled for diagnostic conventional coronary angiography who fulfilled the following criteria: sinus heart rhythm, able to hold breath for 15 seconds, and no previous percutaneous coronary intervention or coronary bypass surgery. Eighteen patients were excluded because of the logistical inability to perform a CT scan before the conventional angiogram (n=9), presence of arrhythmia (n=4), impaired renal function (serum creatinine >120 mmol/L) (n=4), and known contrast allergy (n=1). Thus, the study population comprised 52 patients (34 men; mean age, 59.6±12.1 years). Our institutional review board approved the study protocol, and all patients gave informed consent.

kardiolab

VCT – „clinical decision making“

For EBCT, sensitivity and specificity are given as 74% to 92% and 63% to 94% respectively. The corresponding values for MSCT are 75% to 83% and 76% to 99% respectively, and for 3D MR angiography 68% to 86% and 91% to 97% respectively.[1] However, it must be taken into consideration that evaluation is not possible in all cases. Thus, for EBCT an exclusion of 10-28% is given, for MSCT 6% to 32% and for 3D MR angiography 23% to 31%. Sensitivity and specificity values were obtained from a selected group, the selection criteria being based on subjective evaluation.
An average exclusion rate of >20% makes the data on which diagnostic exactness and believability is based relative. With an average sensitivity of about 80%, taking the exclusion rate into consideration, a diagnostically useful result would be expected in <60% of cases.
Technical progress in procedures for noninvasive detection of coronary arteriosclerotic changes is impressive. However, for an evidence-based clinical application considerable basis material is still lacking.

W. Kübler, Heidelberg, Germany, Eur Cardiologist J by Fax, March 2006

kardiolab

VCT – „clinical decision making“: Take home messages ...

In selected patients, test performance is excellent on a segment by segment analysis
The true value of a test is however within a more unselected setting
Coronary angiography performance in a more unselected setting is virtually unknown
Therefore:

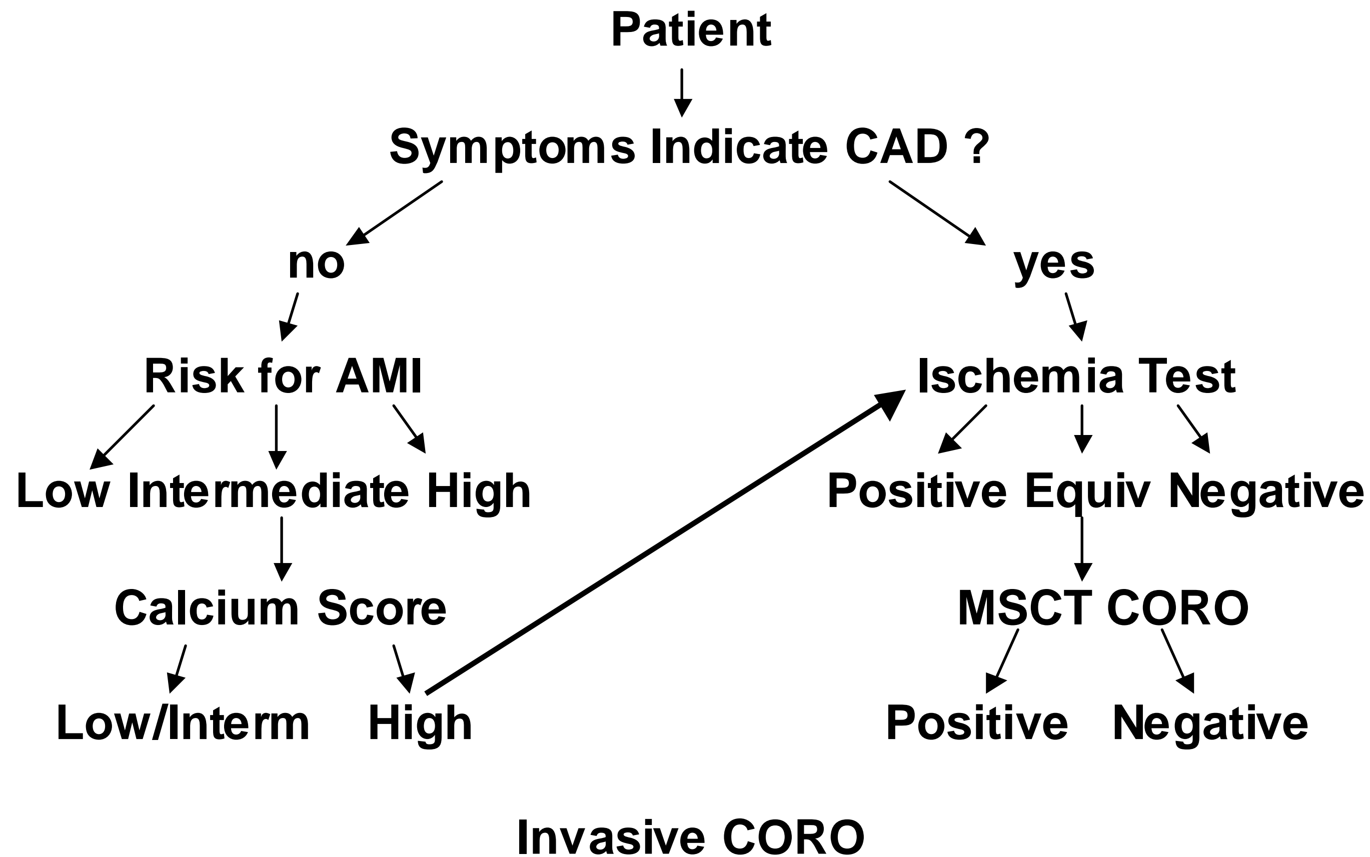
Careful patient selection and strict adherence to exclusion criteria is mandatory:

Do not use the test in whom

- there are no symptoms or ischemia
- arrhythmia is present (sinus arrhythmia, extrasystoles, atr fib)
- severe coronary calcification is present
- pacemakers are in use
- bypass grafting had been performed

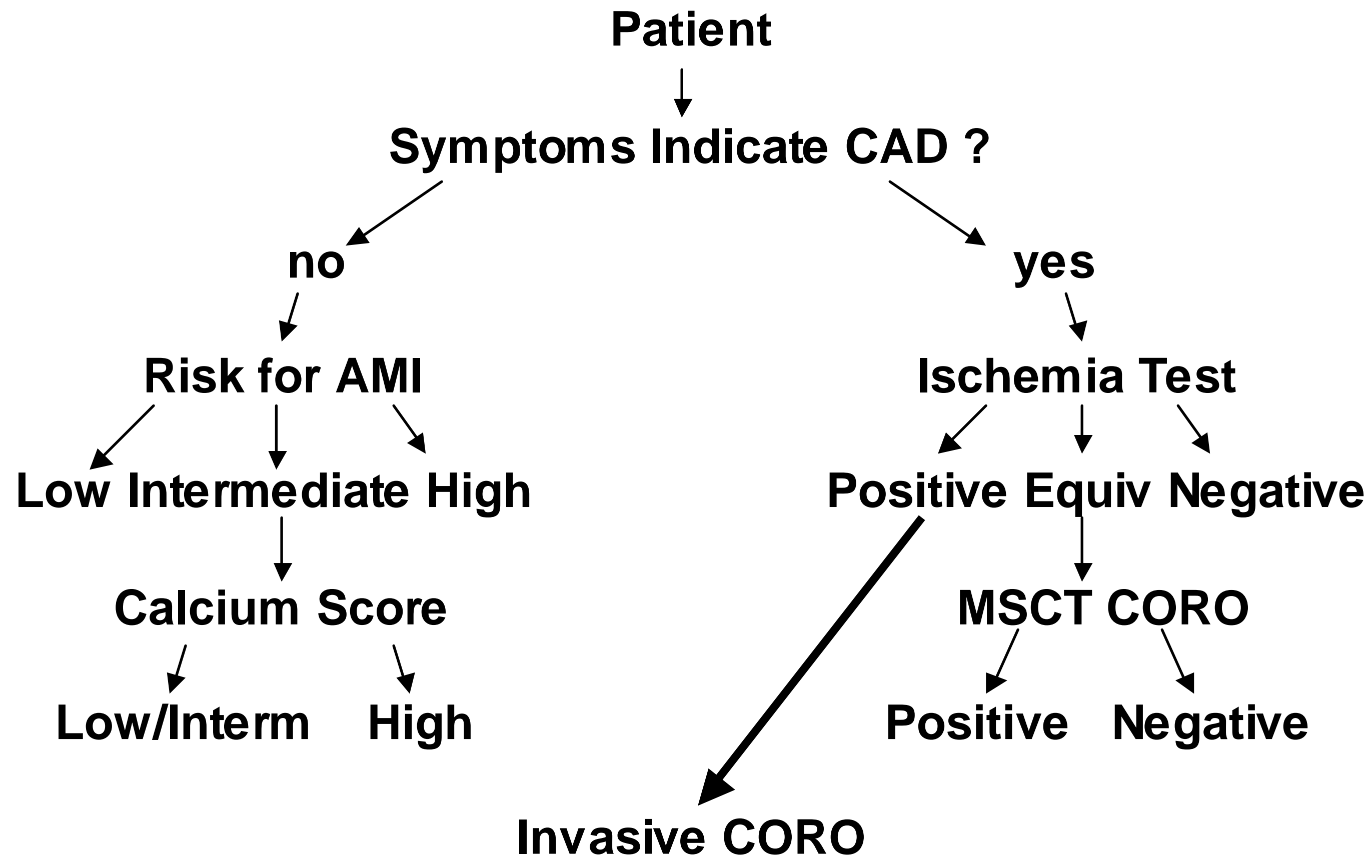
Non-Invasive Coronary Angiography
Indications and Guidelines

kardiolab



Non-Invasive Coronary Angiography
Indications and Guidelines

kardiolab



MPS study in 519 subjects with 6 year FU

Myocardial Perfusion SPECT:

as a gate keeper for a coronary angiogram

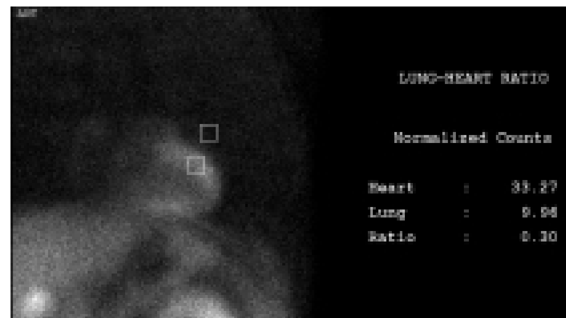
MPS
MR 04

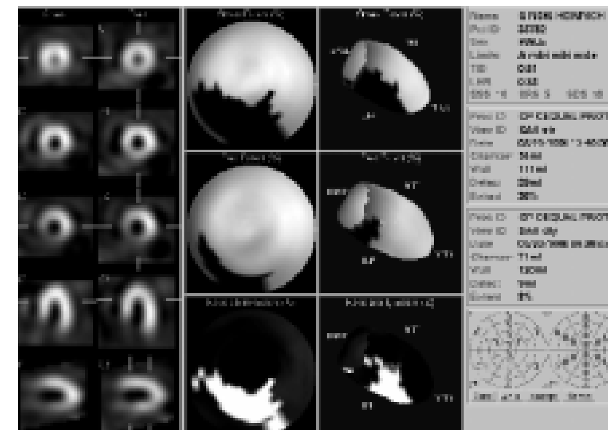
Study Protocol

Morning: rest SPECT (untriggered), 8 mCi

Afternoon: Exercise test
Peak exercise tracer injection, 22 mCi
> 4 min post exercise: LHR (anterior planar image)
followed by stressSPECT (untriggered)

injection to injection time: > 4 hours





MPS study in 519 subjects with 6 year FU

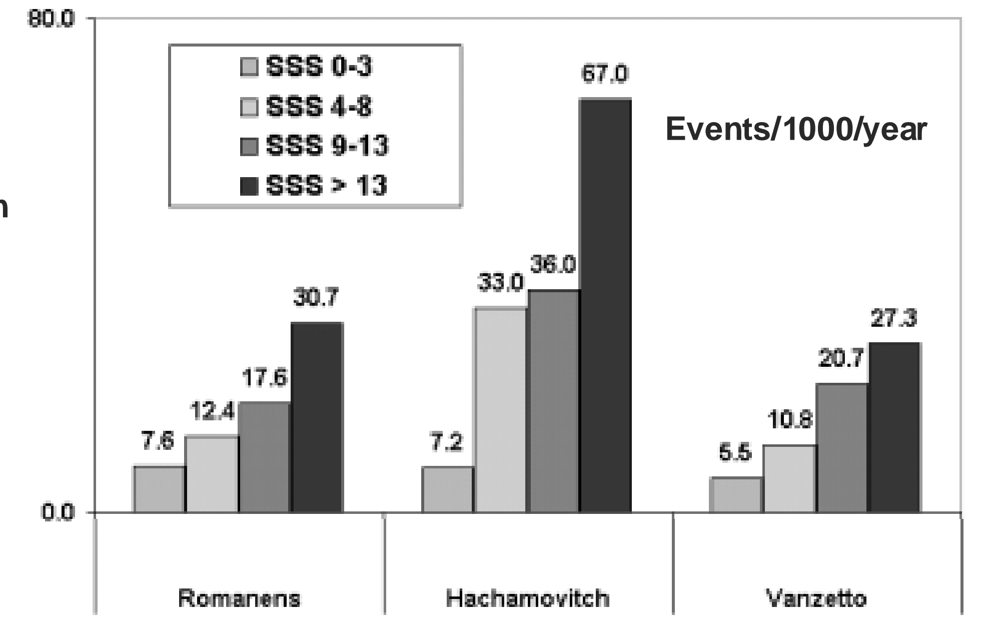
Myocardial Perfusion SPECT

if normal, any intervention may worsen the prognosis

MPS
MR 04

SSS in Relation to MACE: comparisons

Fewer MACE in mediterranean risk population assessed by SSS when compared to US



Hachamovitch	Circulation 1998;97:535-543	US high risk population
Vanzetto	Circulation 1999;100:1521-1527	French Mediterranean risk population

MPS study in 519 subjects with 6 year FU

Myocardial Perfusion SPECT

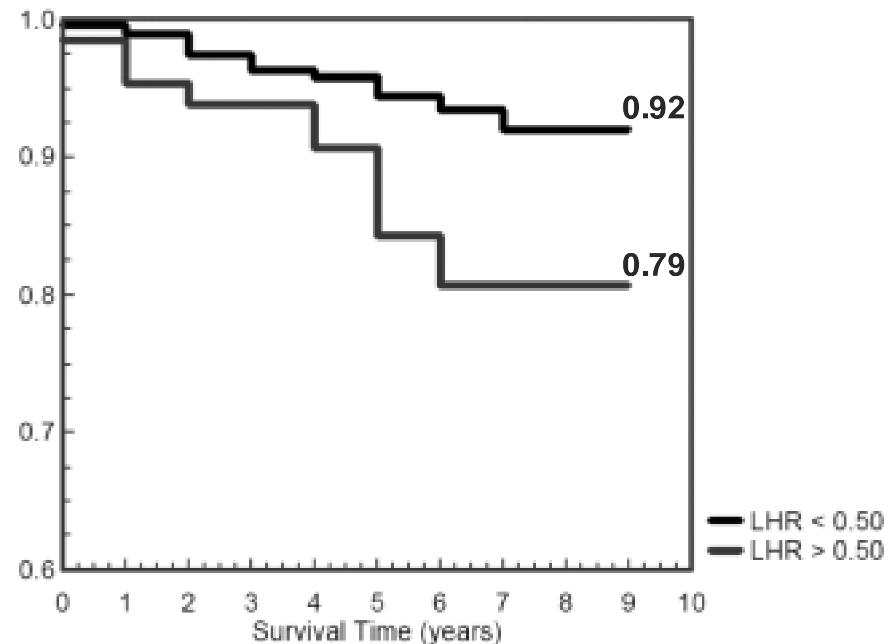
if equivocal
(e.g. normal perfusion, but increased lung uptake in a MIBI scan)
additional testing is warranted
(e.g. non-invasive coronary angiogram)

MPS
MR 04

LHR and Prediction of MACE

Cox Hazard Regression Model:

p=0.0002



VCT in Cardiology

The Prognostic Philosophy	
No ischemia	no intervention
Lot of plaques	treat medically
Equivocal test	non invasive CORO
invasive CORO	in cases of definite abnormality by non-invasive testing

Non-invasive Assessment as a Gate-Keeper for invasive CORO

The Interventionalists Philosophy	
Suspicion of CAD	invasive CORO Luminogram
Stenosis >70%	Stent
Stenosis 40-70%	Plaque Sealing = Stent
Stentomania Stentistry	

The prognostic impact of Stenting in subjects with normal left ventricular function is inexistent.

Pretest Probability for Coronary Artery Disease

	Nonanginal Chest Pain		Atypical Angina		Typical Angina	
Age, y	Men	Women	Men	Women	Men	Women
30–39	4	2	34	12	76	26
40–49	13	3	51	22	87	55
50–59	20	7	65	31	93	73
60–69	27	14	72	51	94	86

*Each value represents percent with significant CAD on catheterization.

Data from (1) Diamond GA, Forester JS. Analysis of probability as an aid in the clinical diagnosis of coronary-artery disease. *N Engl J Med.* 1979;300:1350–1358. (2) Chaitman BR, Bourassa MG, Davis K, Rogers WJ, Tyras DH, Berger R, Kennedy JW, Fisher L, Judkins MP, Mock MB, Killip T. Angiographic prevalence of high-risk coronary artery disease in patient subsets (CASS). *Circulation.* 1981;64:360–367.

Pretest Probability for Coronary Artery Disease

Definitions:

Low Risk	**00%-15%**
Intermediate Risk	**16%-85%**
High Risk	**86%-99%**

 Mieres, Circulation 2005;111:682– 96

VCT in Cardiology

kardiolab

Class I:

Conditions for which there is evidence and/or general agreement that a given procedure or treatment is useful and effective

a) **from several randomized trials**

b) **from one randomized trial**

Class II:

Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment

a) **Weight of evidence / opinion is in favor of usefulness / efficacy**

b) **Usefulness / Efficacy is less well established by evidence / opinion**

Class III:

Conditions for which there is evidence and/or general agreement that the procedure / treatment is not useful/effective and in some cases may be harmful

Class Ia Indications

no data

Class Ib Indications

no data

Class IIa Indications

patients with suspected coronary obstruction
with a regular heart beat
with intermediate pretest likelihood for
coronary obstruction

and equivocal results from ischemia testing
(ECHO, NUCLEAR, CMR)

Class IIb Indications

patients
with suspected coronary obstruction
with a regular heart beat
with high pretest likelihood for coronary obstruction
with stents > 3 mm in diameter
with previous bypass grafting

and equivocal results from ischemia testing
(ECHO, NUCLEAR, CMR)

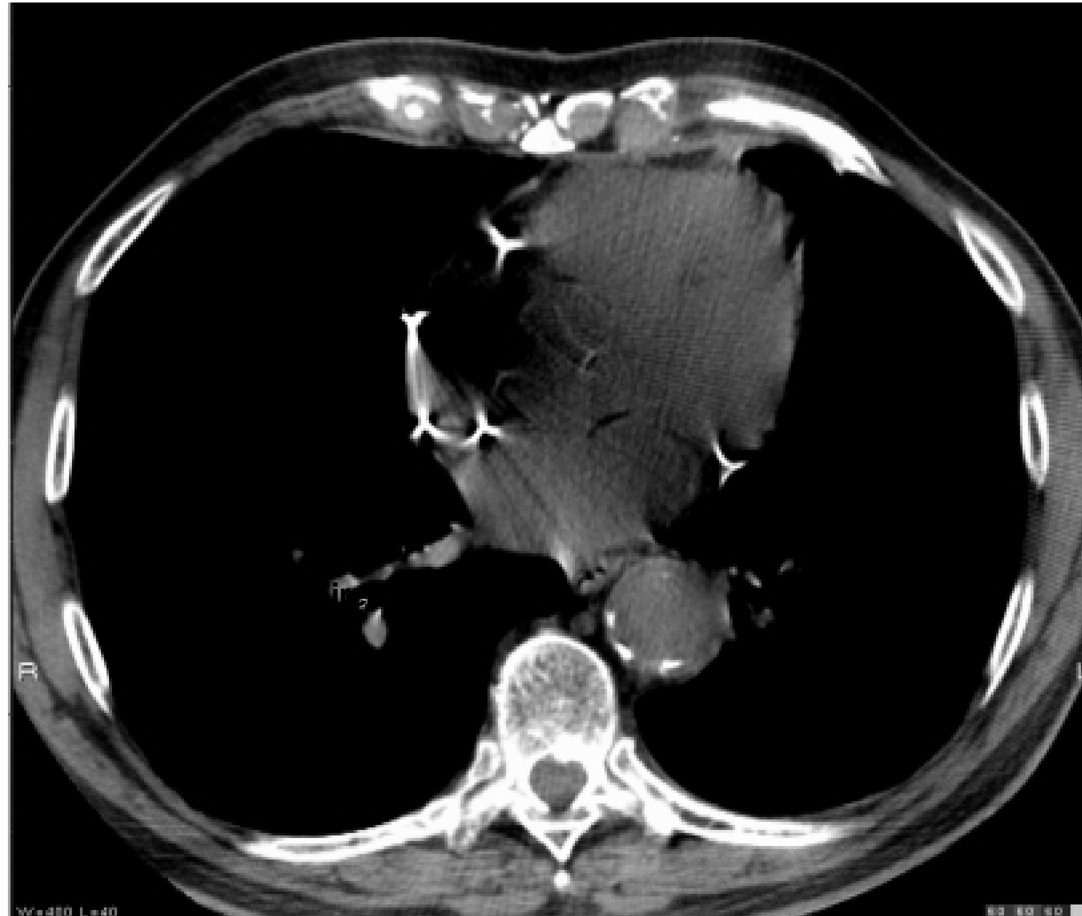
Class III Indications

patients

- **with a non regular heart beat (arrhythmia)**
- **with coronary calcifications (Agatston Score > 400)**
- **with severe single plaque calcification (Agatston Score > 80, either proximal or mid-portion)**
- **with contraindications to contrast media injection**
- **with calcified bypass graft connections**
- **with severe bypass graft calcifications**
- **with stents < 3 mm in diameter**
- **with pacemakers**
- **with internal defibrillators (intracardiac devices, ICD)**
- **with problems to perform breatholds up to 20 seconds**

Difficult patients that you should avoid

Pacemaker
ICD (intracardiac devices)



Difficult patients that you should avoid

Severe coronary calcifications (Agatston Score > 400)

Plaque Details

No.	Loc.	mm3	Score	Mean
1	LM	124.3	162.6	306
2	RCA	39.3	44.9	208
3	CIRC	118.8	183.2	226
4	RCA	115.6	144.4	226
5	RCA	45.7	64.5	185
6	RCA	100.6	107.0	214
7	RCA	13.4	8.4	192
8	RCA	9.6	4.7	189
9	RCA	7.0	6.5	170

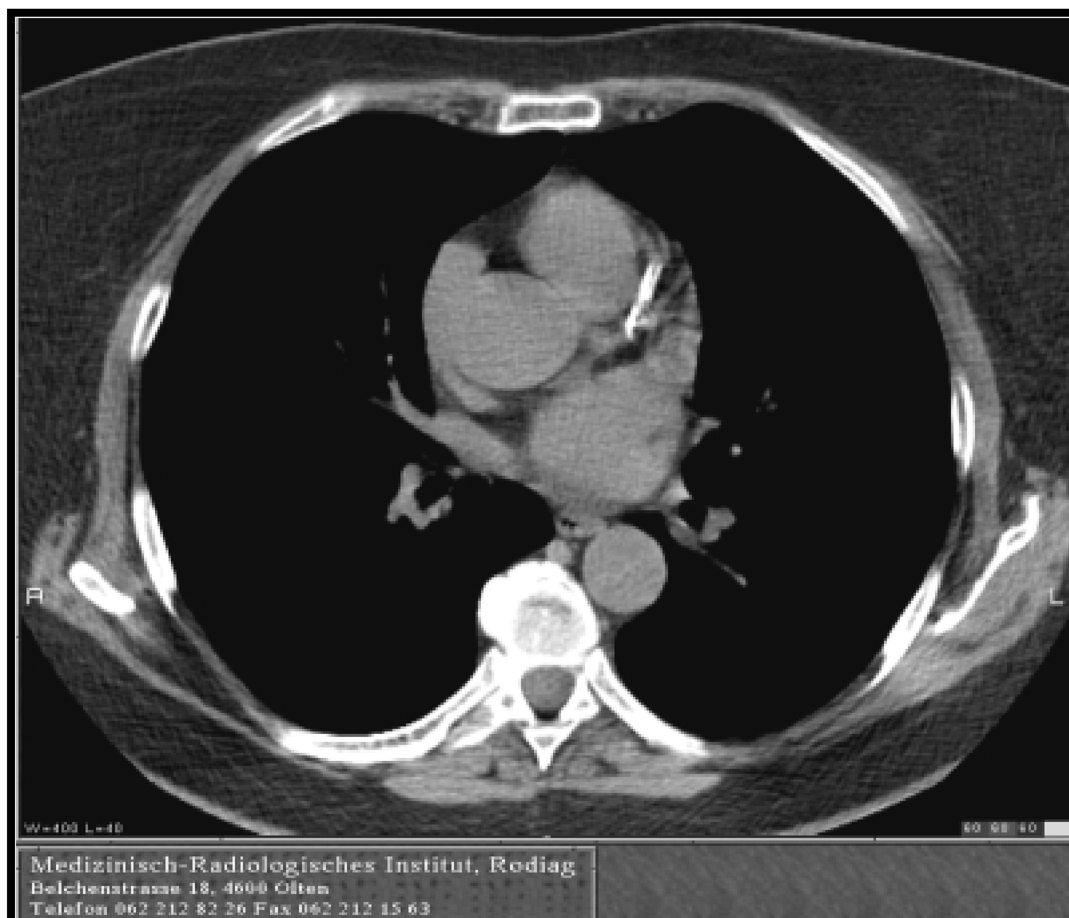
Art.	#	mm3	Score	Mean
LM	1	124.3	162.6	306
RCA	7	331.2	380.4	210
CIRC	1	118.8	183.2	226

Total Volume = 574.3 mm3
Total Score = 726.2
Total Mean = 234
Percentile = 73

kardiolab

Difficult patients that you should avoid

Severe local calcification (Agatston Score > 80)



Plaque Details

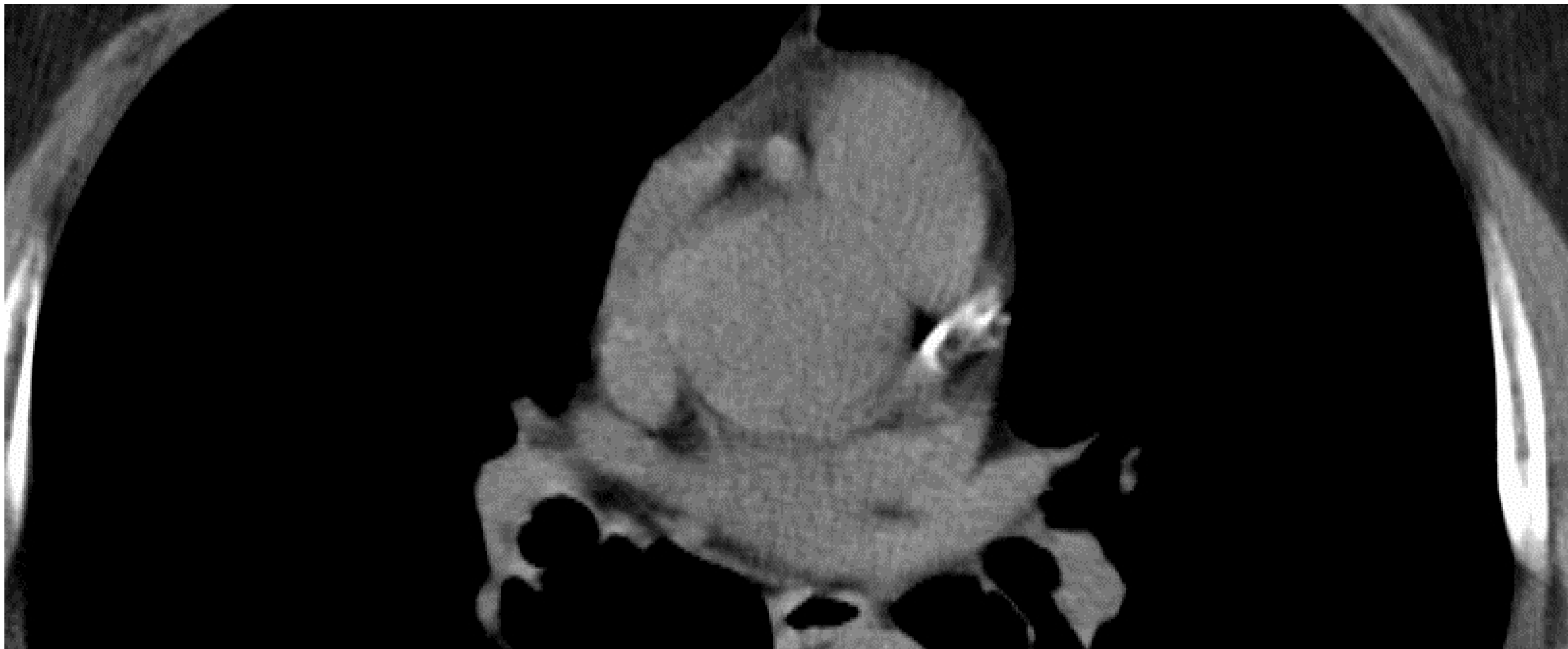
No.	Loc.	mm3	Score	Mean
1	LAD	241.8	321.0	241
2	RCA	10.2	5.6	177

Art.	#	mm3	Score	Mean
LAD	1	241.8	321.0	241
RCA	1	10.2	5.6	177

Total Volume = 252.0 mm3
Total Score = 326.6
Total Mean = 238
Percentile = 94

Difficult patients that you should avoid

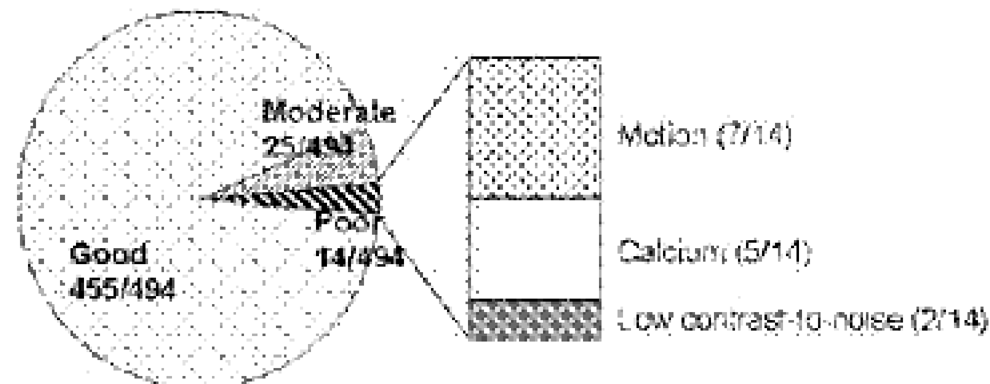
Severe local calcification (Agatston Score 349 in a 40 year old smoking tetraplegic subject): subsequent Perfusion scan was normal ! Therefore, an invasive coronary angiogram could be avoided



kardiolab

Be aware of coronary calcium !

Causes of poor image quality



Causes of false positives + false negatives

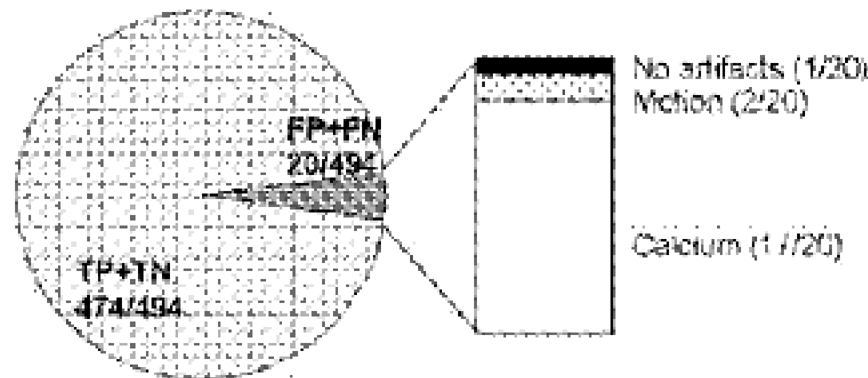
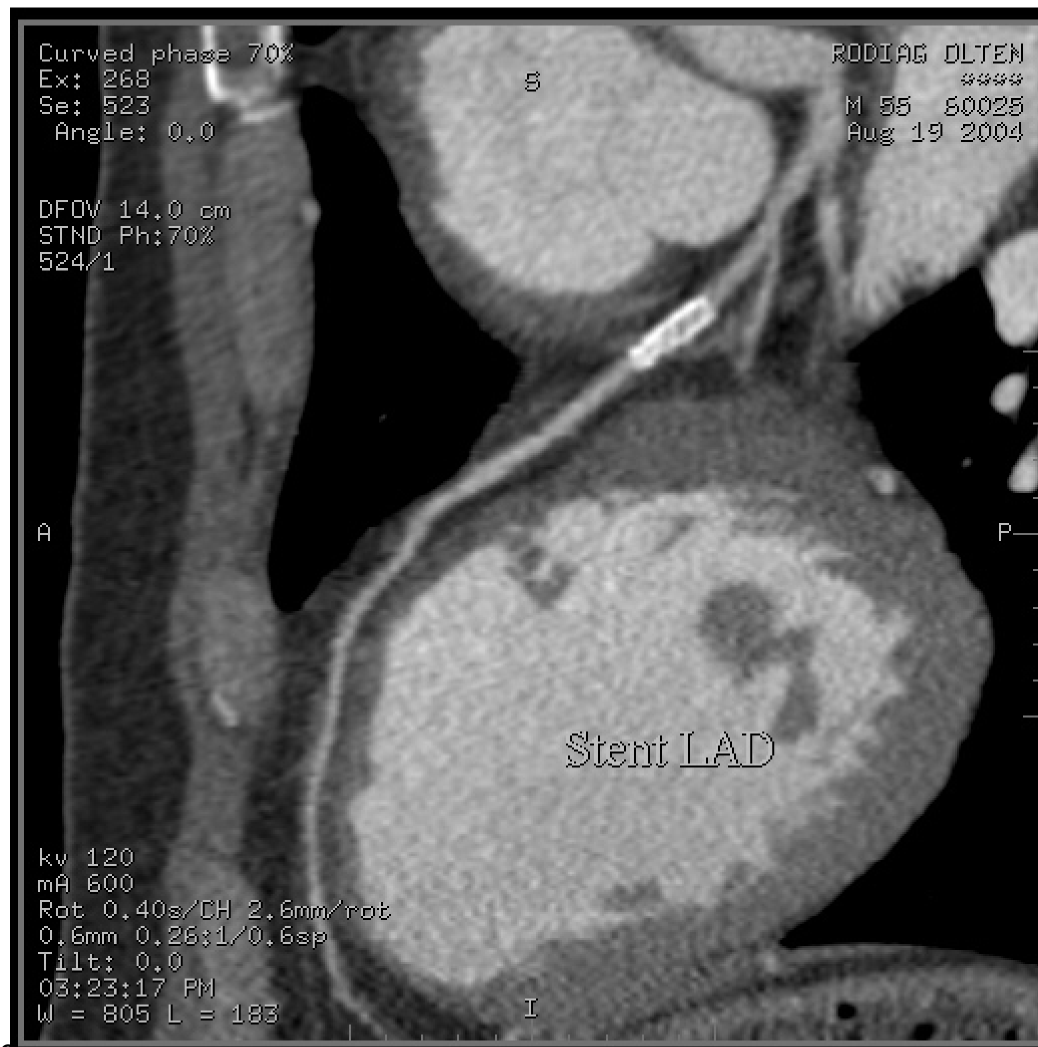


Fig. 1 Image quality, artefacts and incorrect CT results. Motion artefacts account for half of the cases rated as being of poor image quality, but only for 2/20 cases of incorrect CT findings. Calcification of the vessel wall, either bulky, eccentric or isolated, is associated to 17/20 falsely positive and falsely negative CT results

kardiolab

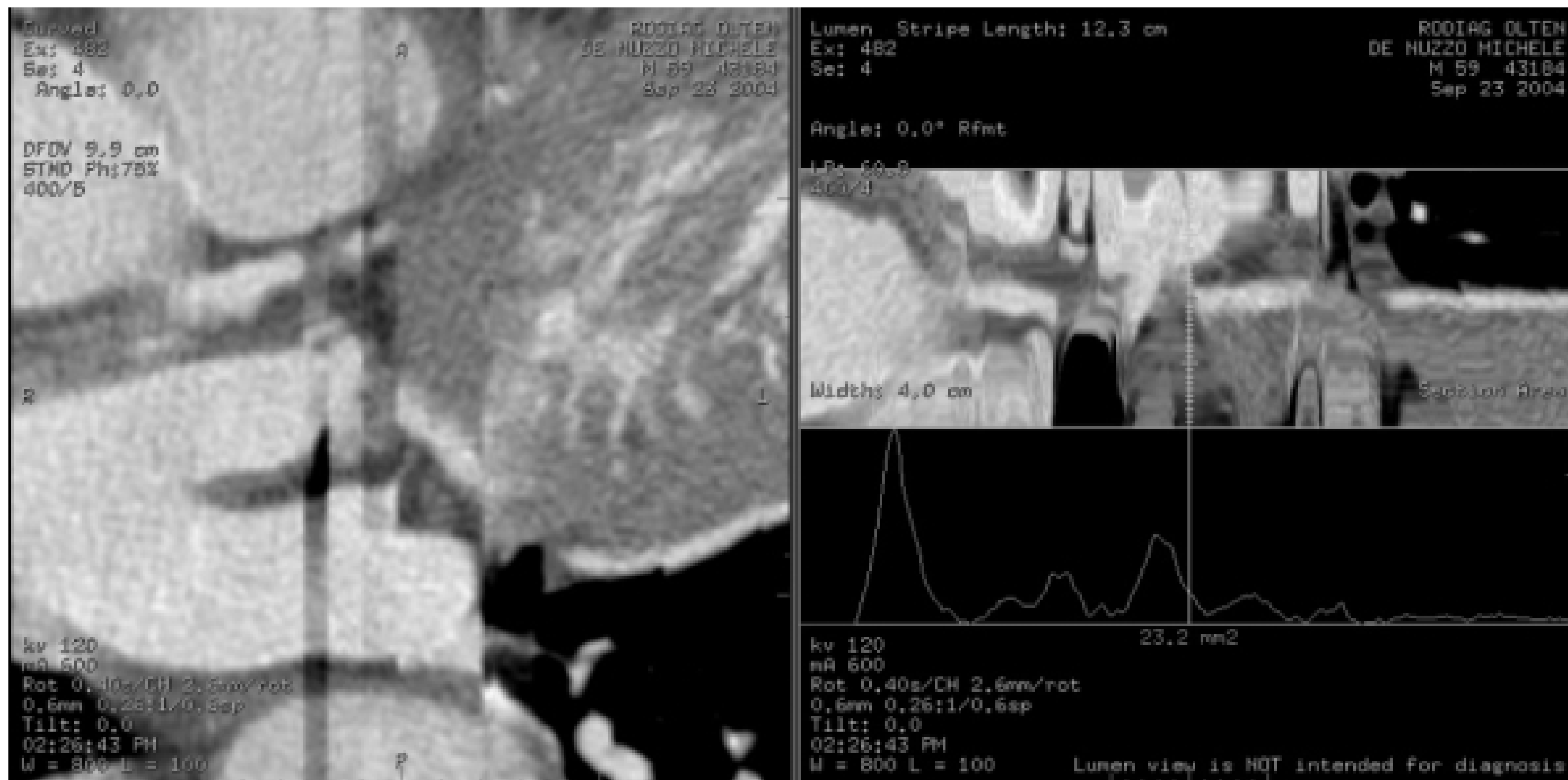
Difficult patients that you should avoid

Small stents < 3 mm



Difficult patients that you should avoid

ECG registration Artefact



kardiolab

Summary and Conclusions

MSCT has a definite role in contemporary Cardiology, however ...

be careful with the baby (chose appropriate indications and perform studies with a 100% success or feasibility rate)

never view the results of imaging in isolation
always integrate results of imaging with the patients background

integrate coronary calcium into a posttest probability
integrate a coronary stenosis into symptoms and ischemia testing
avoid referring patients invasive procedures without proof of ischemia

collaboration between the cardiologist and radiologist part in your brain
if you do not have a cardiologist or radiologist brain, seek for collaboration