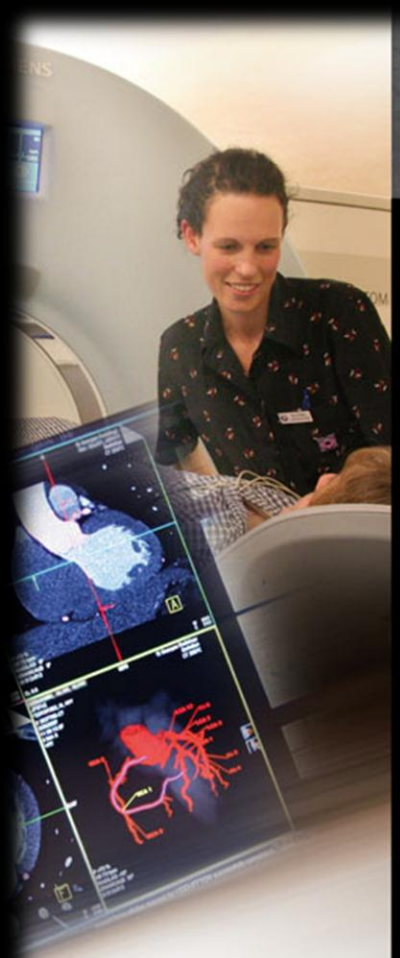


Heart Vision

A joint venture between Christchurch Radiology Group and Heart Centre 2003 Ltd.

Heart Vision

GP CME, Dunedin 16 - 19 August 2012

Workshop 72 Saturday 4.30pm Edgar Centre

Disclosures:

1. Pacific Radiology Group (PRG) - partner
2. Heart Vision - MD
3. General Electric - R&D partner

UNIVERSITY of OTAGO

Te Whare Wānanga o Otāgo
NEW ZEALAND

Canterbury District Health Board
Te Poari Hauora o Waitaha

Heart Vision

Clinical

- MB. ChB. (Otago), FRANZCR (1991)
- Paediatric Imaging Fellowship (1992)
- Neuroimaging Fellowship (1993-1994)
- Cardiac MR Adelaide (ACI) (2000)
- Cardiac CT Adelaide (ACI) (2002)
- CRG Partner - CHC Hospital Appt. (2004)
- Heart Vision CHC (2007)
- Cardiac CTA Specialist (2010)
- CT-PET Specialist application (2012)

"Mr. Osborne, may I be excused? My brain is full."

Heart Vision

www.heartvision.co.nz

HEART VISION Ltd.

joint venture

CHRISTCHURCH RADIOLOGY GROUP
&
HEART CENTRE (2003)

www.heartvision.co.nz

Cardiac Imaging Team

Right to Left: Amanda, Jo, Dr Latham Berry, Dr Sharyn Macdonald, Dr Ross Keenan, Jenny, Clare, Rachel

Cardiac Imaging Team

Heart Vision : Heart Vision reception, St Georges Radiology, Christchurch

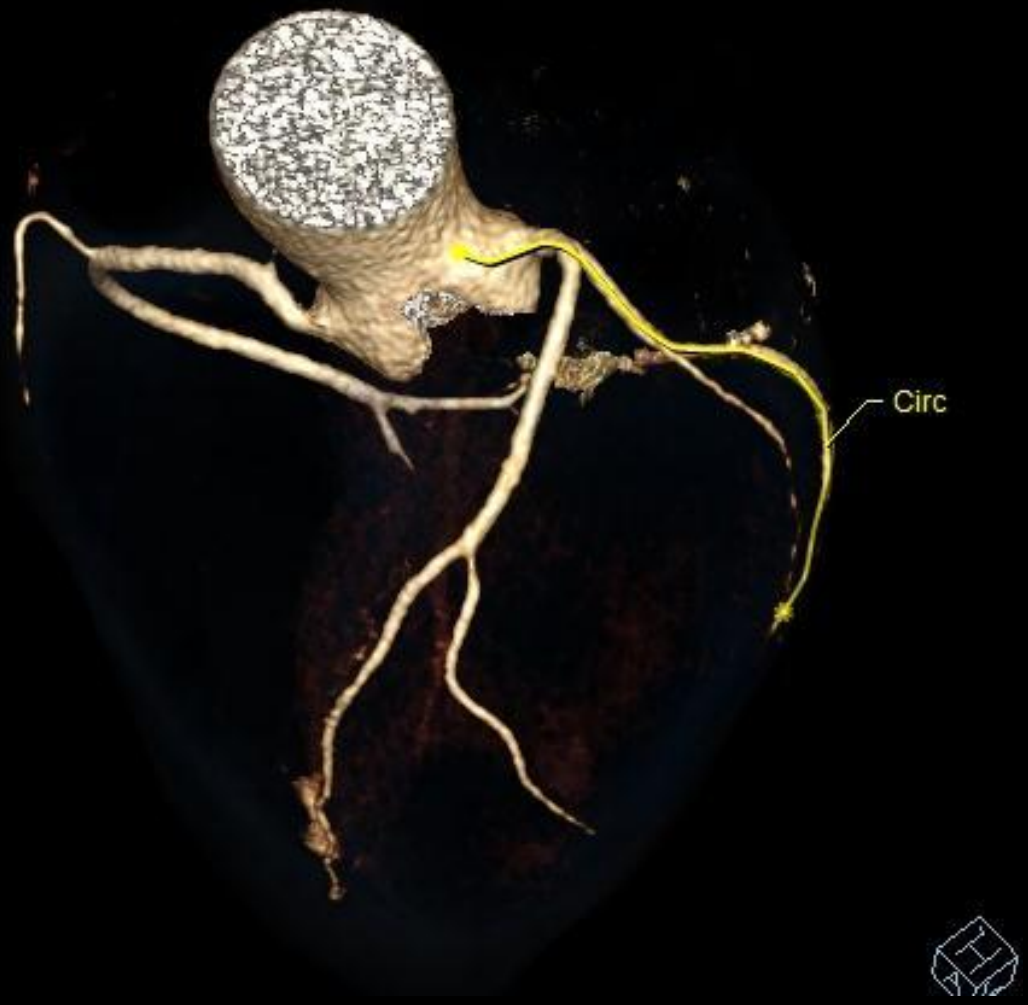
Cardiac Imaging Team

Heart Vision : Dr Latham Berry, Cardiac Radiologist, Jane Turner Cardiac CT technologist

Cardiac CT Imaging Systems

Siemens Dual Source CT: **Left:** Definition 2007 (St Georges), **Right:** Definition FLASH 2012 (Christchurch Hospital)

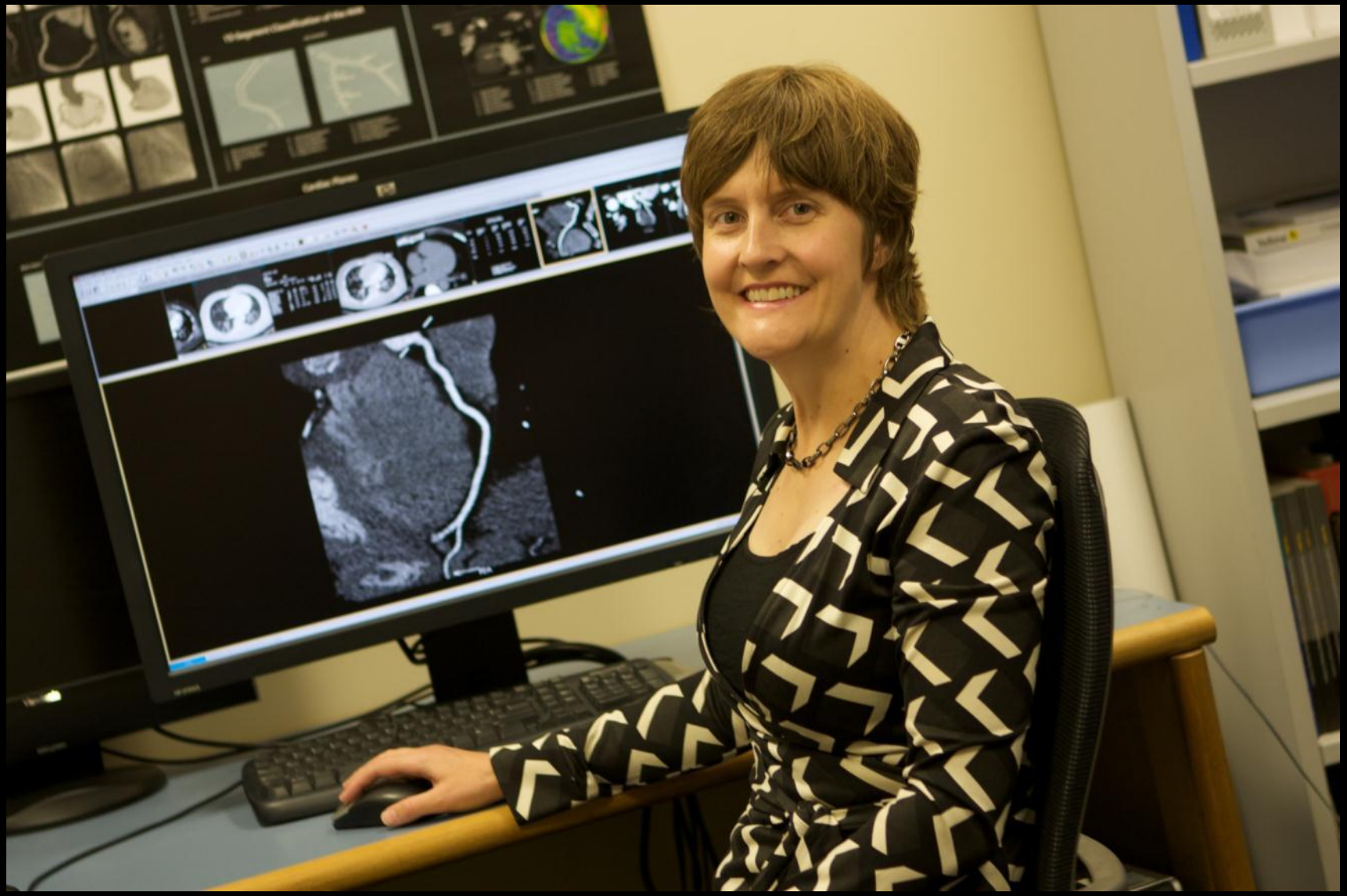
Cardiac CT Imaging Systems



Left: CCTA Syngo via VR

Right: Syngo via curved MIP, normal LAD

Cardiac CT Imaging Systems



Heart Vision : Dr Sharyn Macdonald, Cardiac Radiologist: Siemens Dual Source Definition CT_Circulation analysis

Cardiac CT : Heart Vision

- based in St Georges Radiology CHC

- total CCTA patients ~ 1900pts

- CCTA v catheter ongoing audit

- continuous radiation dose audit

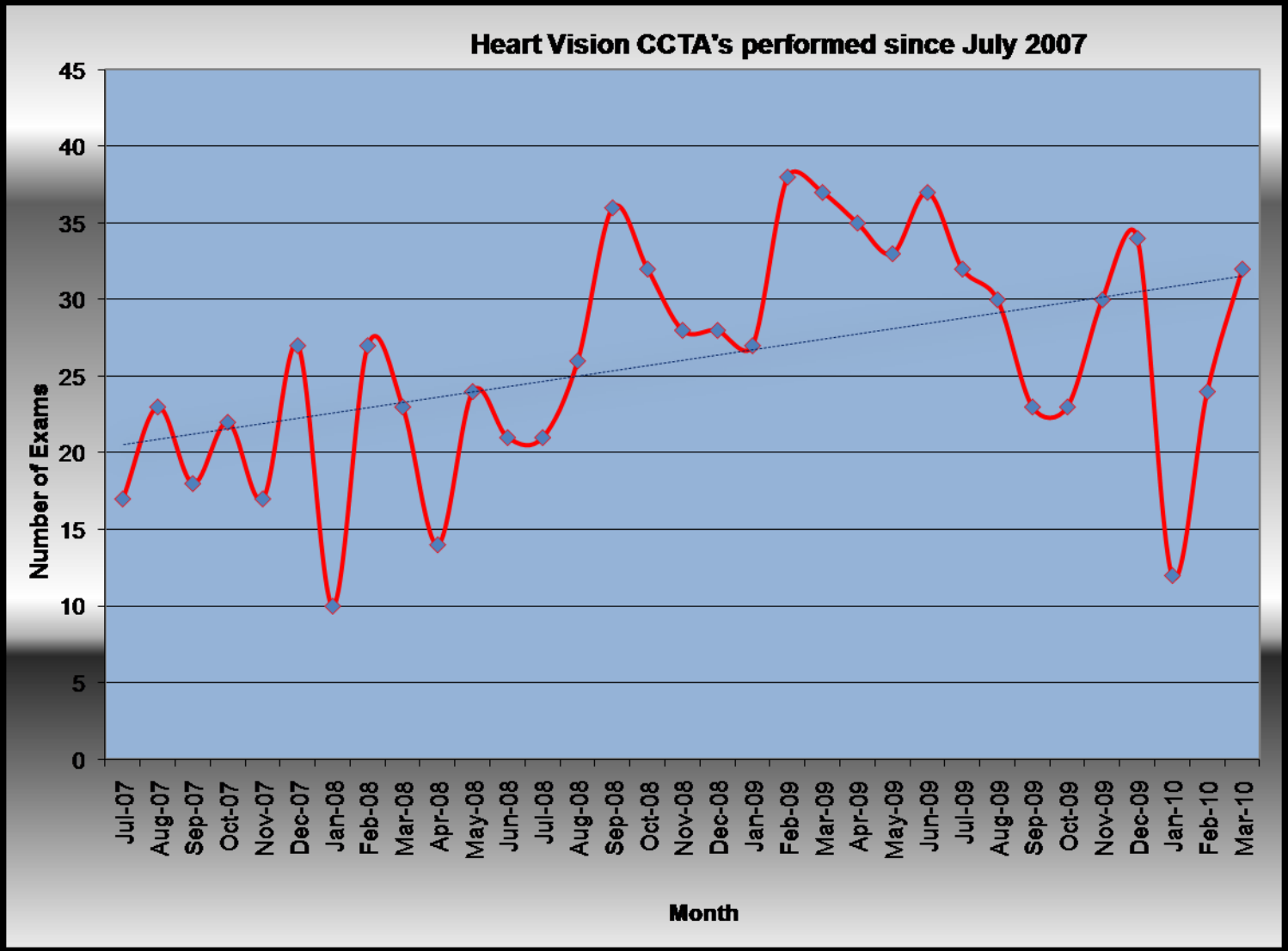
- health insurance coverage

  CACS “screening” not covered

  CCTA - SXHI criteria v others

Heart Vision

HEART VISION



Outline

- CT radiation dose
- CACS - CT coronary calcium scoring
- CCTA - coronary CTA
- CMRI - cardiac MRI
- summary points

'5' learning points

- CT dose = low and decreasing to < 1mSv
- CACS = CVD risk stratification - adjuvant
- CCTA = coronary stenosis imaging - exclude CAD
- cardiac MRI = function, myocardial, valvular disease
- **ROUTINE!**

Cardiac CT Radiation Dose


RADIATION
AREA

Cardiac CT System

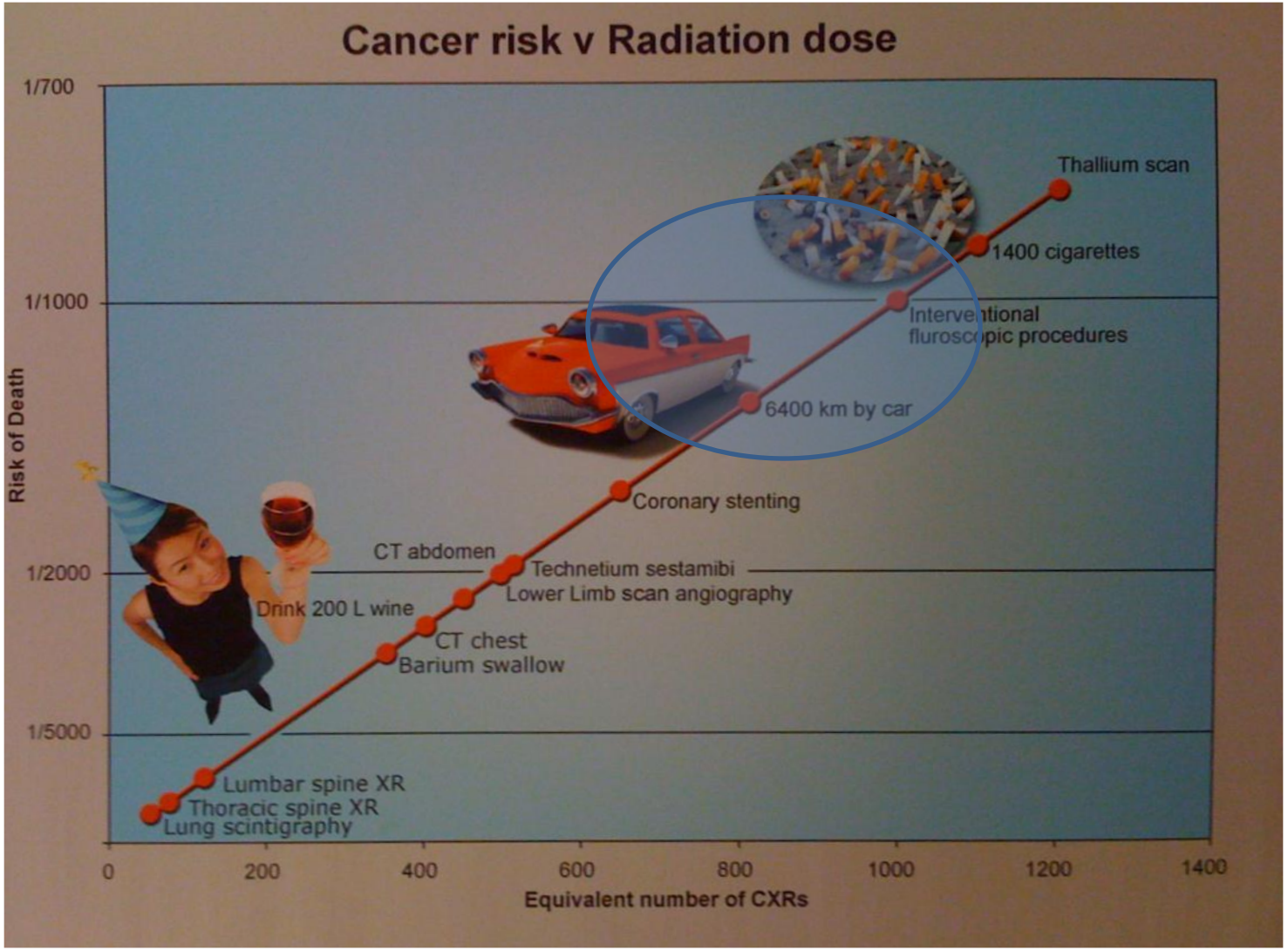
Siemens Dual Source CT

- dedicated cardiac CT system
- dual source (2 XR tubes 1.5 tonne)
- rotation time = 280msec
- temporal resolution = 70msec
- detector = 40mm
- “FLASH” scanning, high pitch ~ 3.4
- dual energy = 80 - 140kvp

NY Times article June 2008

"the radiation dose from cardiac CTA is several fold higher than nuclear scans or cardiac catheterisation and this dose is correlated with a 2% lifetime risk attributable cancer risk"

Journalists: Alex Berenson & Reed Abelson


Cancer risk v Radiation dose
1/700
1/1000
1/2000
1/5000
Risk of Death
Thallium scan
1400 cigarettes
Interventional
fluroscopic procedures
6400 km by car
Coronary stenting
CT abdomen
Technetium sestamibi
Lower Limb scan angiography
Drink 200 L wine
CT chest
Barium swallow
Lumbar spine XR
Thoracic spine XR
Lung scintigraphy
0
200
400
600
800
1000
1200
1400
Equivalent number of CXRs

COUNTERTHINK

Cardiac CT Dose

- ALARA – As Low As Reasonably Achievable
- huge CT advances dose savings since 2006
- aggressive dose reduction
- CCTA dose highly acceptable in 2012
- referral pattern change, ↓ patient age
- ? next generation = CT dose ~ Xray

CCTA - Radiation dose

Dose metrics

1. **$CTDI_{vol}$ (CT Dose Index, mGy)**

- estimates the average radiation dose in all 3 directions (x,y,z)

2. **DLP (Dose Length Product)**

- reflects the total energy absorbed by the patient
- recorded from CT scanner

3. **Effective Dose ($Dose_{eff}$, mSv)**

- weighted sum of dose applied to all organs in a CT examination
- weighting factors for biological sensitivities of different organs (chest ~ 0.017)
- best classifies risk of biological injury

CCTA Radiation Dose - 2009

Technique	Effective Dose pa
SPECT Thallium stress	**25mSv**
SPECT Sestamibi stress	**12-18mSv**
CT chest ungated helical	**5-7mSv**
Retrospective mode CCTA	**14 mSv**, (4.5-19) **< 5-6mSv**
Prospective mode CCTA	**5 mSv**,(1.7-7.3) **< 3-4mSv**
FLASH mode CCTA	**</= 1mSv**
Diagnostic catheter angiogram	**3-6 mSv**, (3-30)
CXR (PA/Lat)	**0.05 mSv**
Annual background radiation	**2-5mSv (~ 3mSv)**
Additional background radiation at altitude	**+ 1.5mSv**
USA East-West round trip flight	**+ 0.03mSv**

Reference:

Stolzmann P et al. Eur Radiol 2008; 18: 592-599

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“Protection 1” Trial:

- prospective trial CCTA radiation dose
- multicenter, multivendor observational trial
    - mean dose ~ 12mSv
    - marked multicenter variability
    - up to 6x dose variation

JAMA February 2009

Heart Vision

A joint venture between Christchurch Radiology Group and Heart Centre 2003 Ltd.

"Protection 1" Trial:

- independent modifiable CCTA factors to maintain IQ
- prospective gating technique (- 78%)
- low kVp technique (↓80/100kVp) (- 46%)
- ↑ dose modulation (pulsing) (- 25%)
- non sinus rhythm (+10%)
- ↑ patient weight (+ 5%)
- ↑ experience/exam numbers (~ 0%)

JAMA February 2009

CCTA Radiation Dose - 2009

Technique 2008-2009	Mean DLP Dose Length Product	Mean Dose (mSv)	Patient Number
Retrospective gated	871	**14.6mSv**	74
		(4.5 - 19)	
Prospective gated	290	**5mSv**	90
		(1.7 - 7.3)	

Reference:

Heart Vision Audit 2009: Tiffen sample June 2008 – May 2009

Heart Vision
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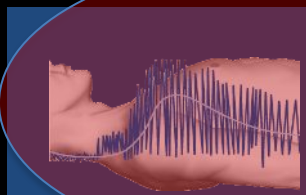
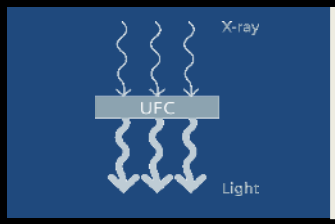
R J Keenan CRG 200

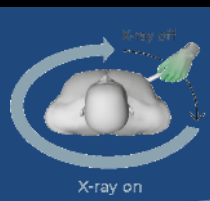
CT Dose Reduction



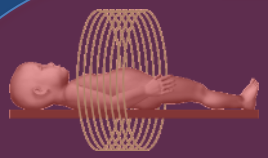
CARE Dose 4D



UFC

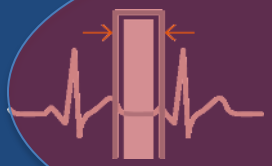


Hand CARE

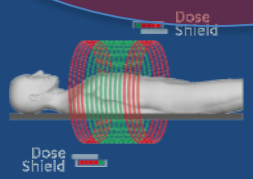


Pediatric 80 kV Protocols

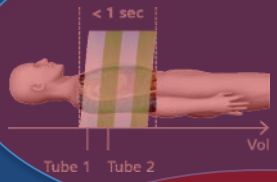
DSCT



Adaptive ECG-Pulsing /Sequence

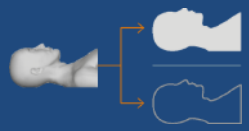


Adaptive Dose Shield

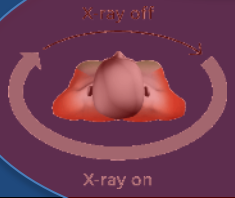


Flash Spiral

Selective Photon Shield



4D Noise Reduction



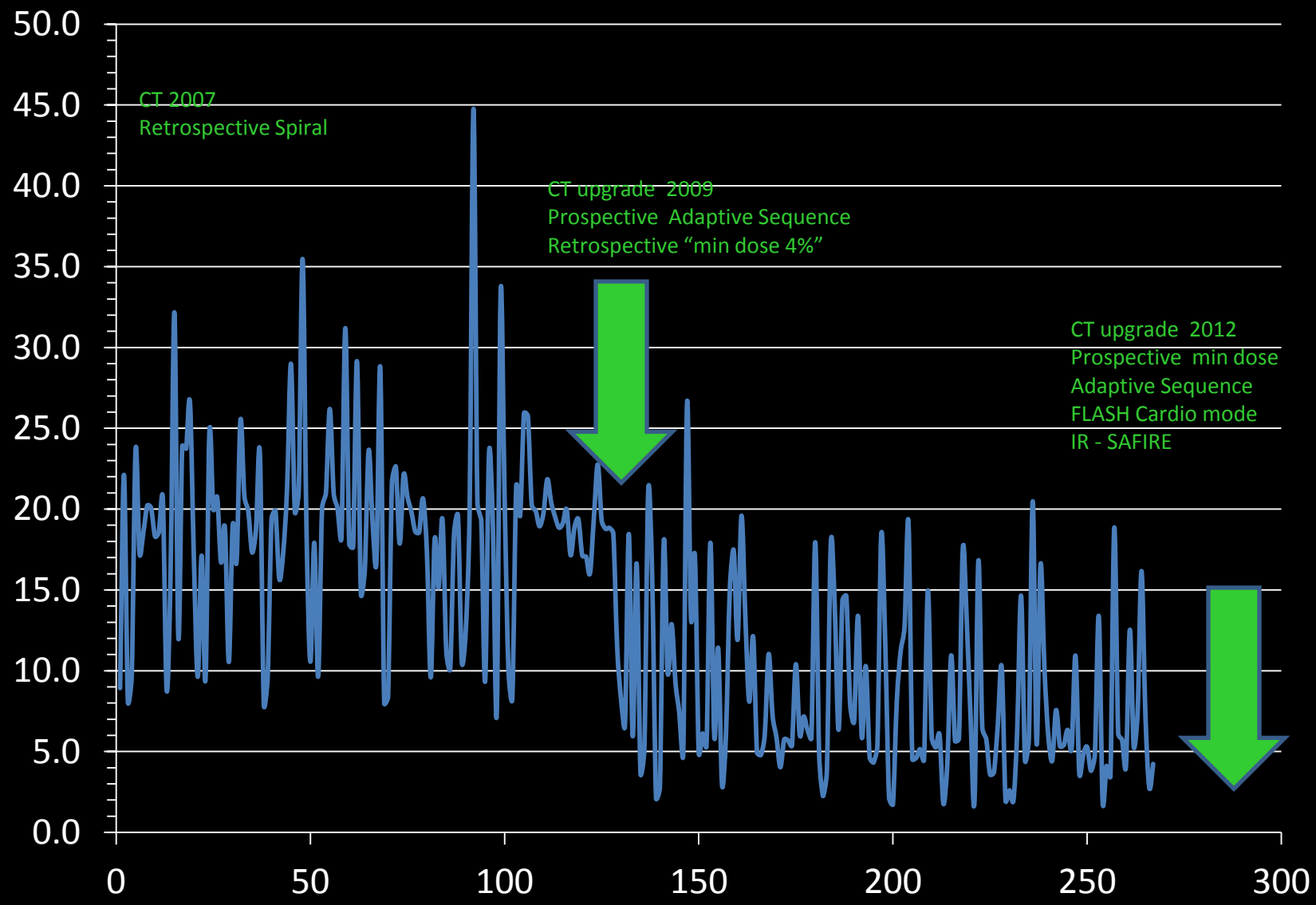
X-CARE

IRIS

Reference:

Siemens AG Erlangen Germany:

CCTA Radiation Dose - 2009



CCTA Radiation Dose - 2012

Technique	Mean Dose (mSv)
Retrospective gated	< 6mSv
Prospective gated	0.8 - 4mSv
Siemens FLASH mode	<< 2mSv
CACS	< 0.5mSv

Reference:

Heart Vision Audit 2011:

Heart Vision
A joint venture between Christchurch Radiology Group and Heart Centre 2003 Ltd.

R J Keenan CRG 200

Iterative Reconstruction (IR)

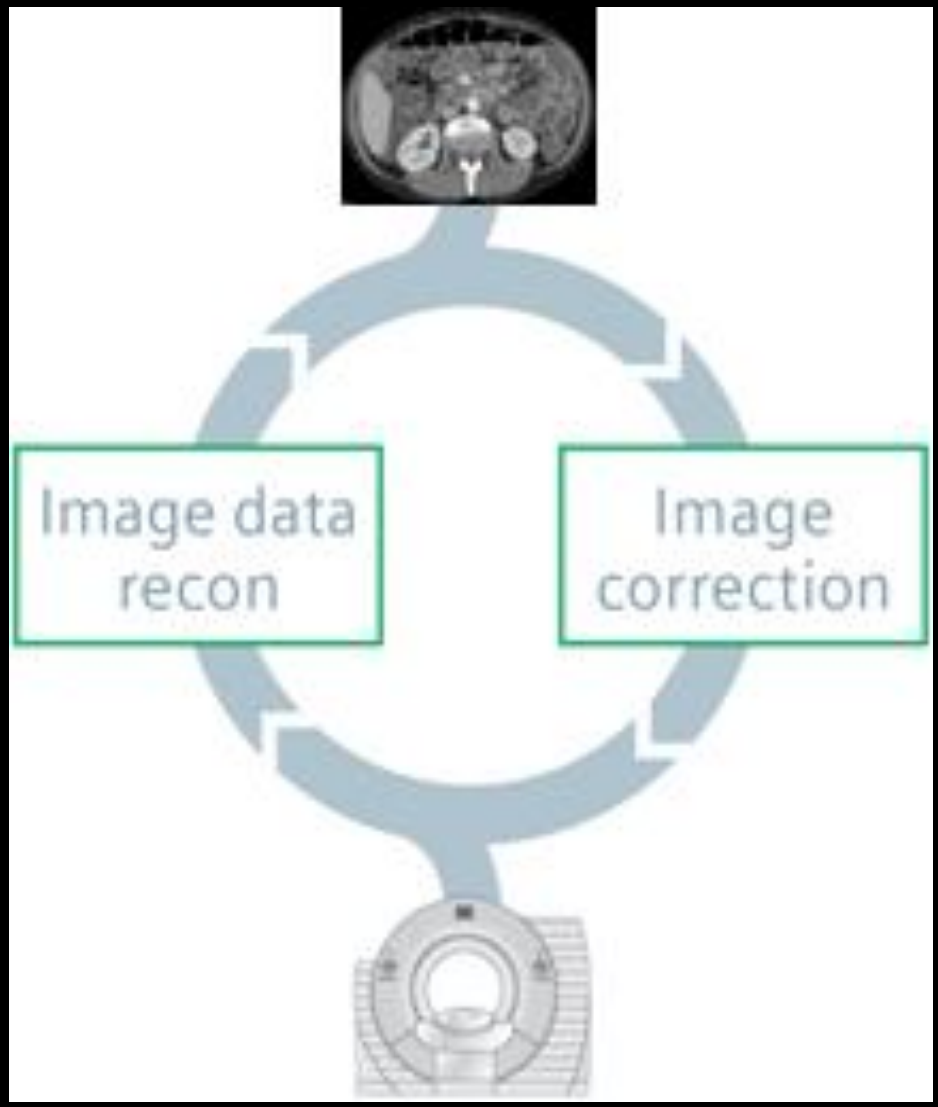
- IR new technique ~ 2011
- IR installed on new systems
- ↑↑ computing power
- dose reduction ↓30-60%
- IQ changes = compromise

  Siemens IRIS-SAFIRE

  GE ASIR

  Philips iDose

  Toshiba AIDR
- future advances = GE “Veo”



CT Reconstruction

- Generation 1

  Filtered back projection (FBP)

- Generation 2

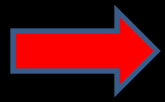
  Image filters & kernels

- Generation 3

  Image domain algorithm, statistical IR loop

- Generation 4

  Raw data domain algorithm, data reprojection IR loop



future

GE “Veo” system - ultralow dose **?? CT = XR** dose

"C'mon, c'mon — it's either one or the other."

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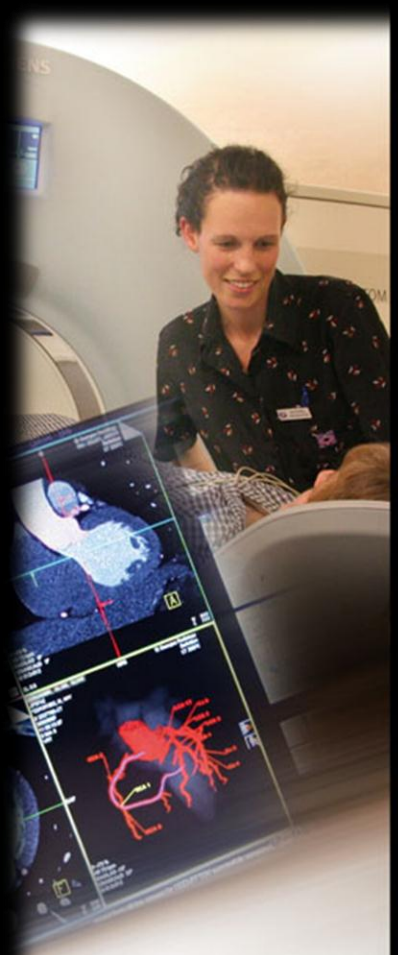
CACS

Coronary Artery Calcium Scoring

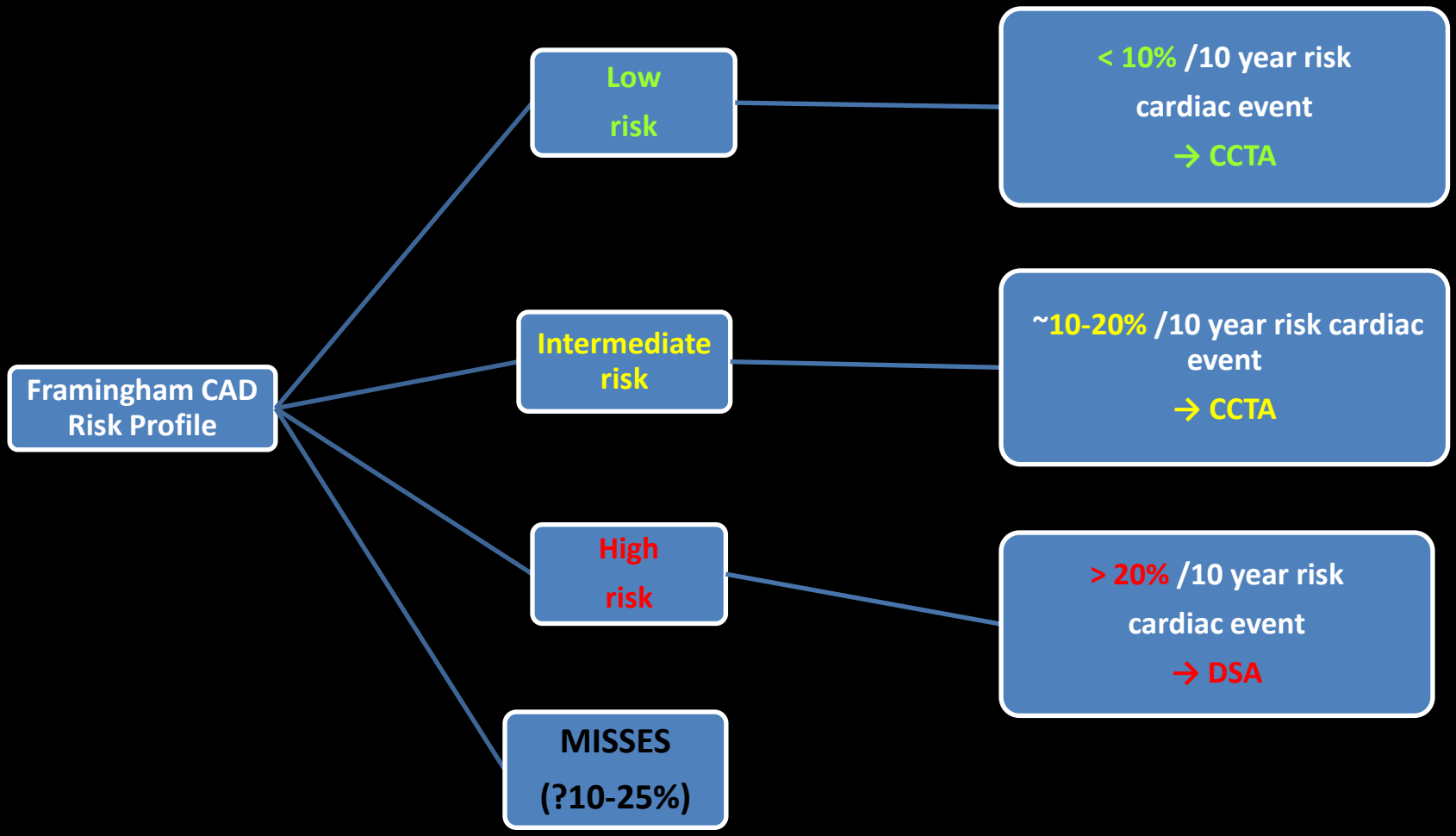
"I'm afraid it's stupidity. And it appears to be spreading."



CACS

- CT scan - ECG gated prospective low dose (< 0.5mSv)
- CVD risk stratification tool (Agatston 1990)
- CACS quantifies calcified plaque
- CACS scores plaques with peak density >130HU
- Total CACS score ranked against population standards
- MESA = Multiethnic Study in Atheroslerosis

CAD Risk Stratification: definitions



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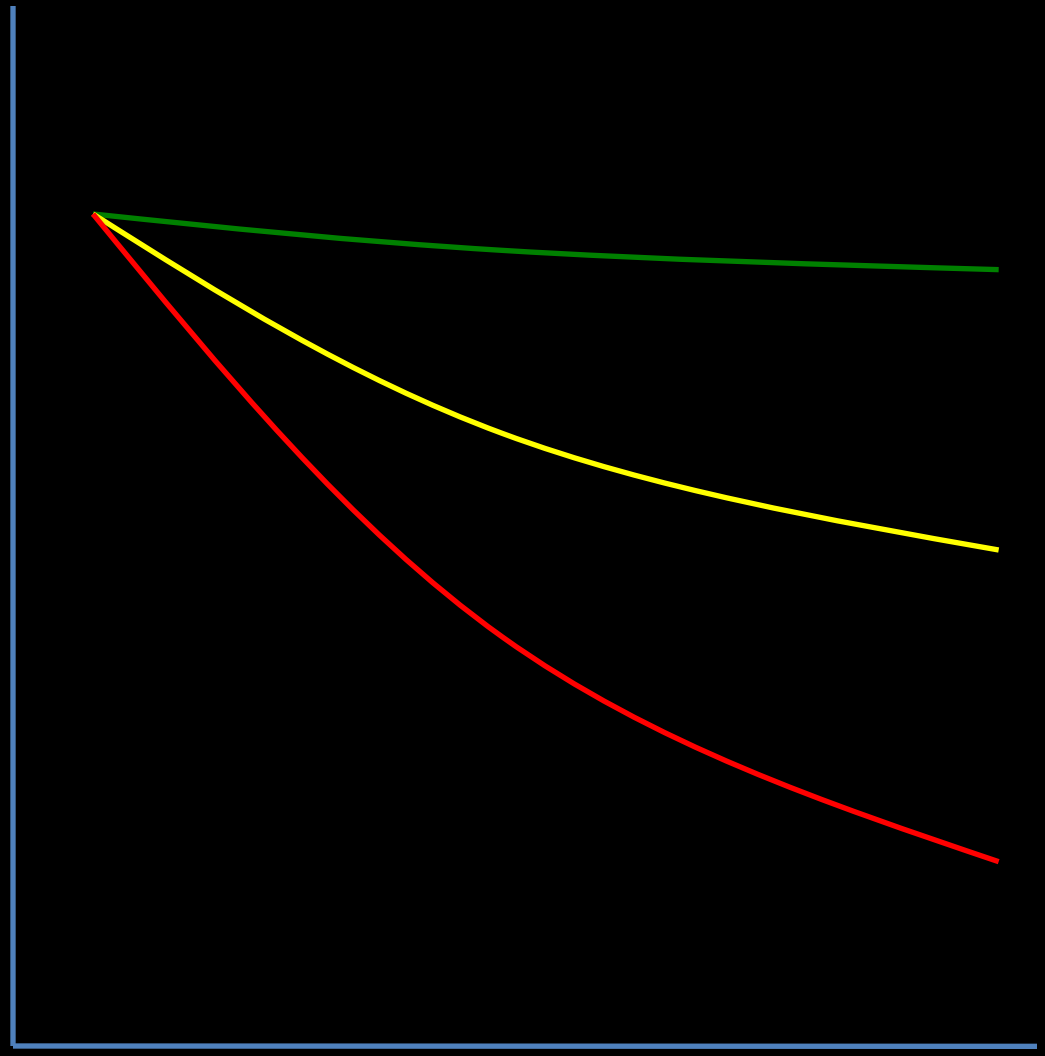
R J Keenan CRG 2009

CVD Risk Stratification



1.7% Normal

2.7% 1V NOD

4.6% 2V NOD

6.9% 3V NOD

7.1% 1V OD

CACS

CCTA

11.3% 2V OD

20% 3V OD

NOD = non obstructive disease
OD = obstructive disease

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CACS References

● High calcium scores in patients with low Framingham risk of CVS disease: implications for more accurate CVS risk assessment in NZ.
NZMJ (2011): 124; 1335

● The detection of any coronary calcium outperforms Framingham risk score as a first step n screening for coronary atherosclerosis.
AJR (2010) 194; 1235-1243

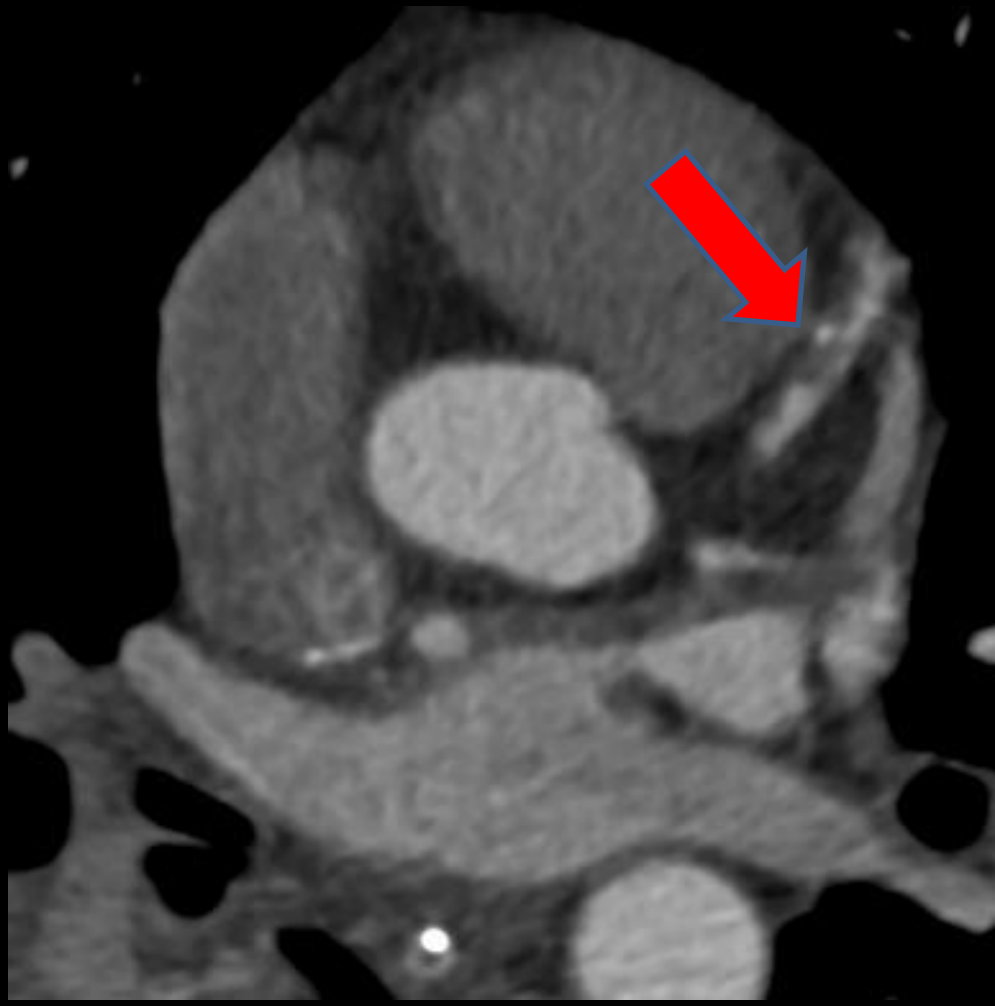
● Relationship between baseline coronary calcium score and demonstration of coronary stenoses during follow-up: MESA
J Am Coll Cardiol (2009) 2; 1175-1183

● Coronary artery calcium score and risk classification for coronary heart disease prediction.
JAMA (2010) 303:16; 1610-1616

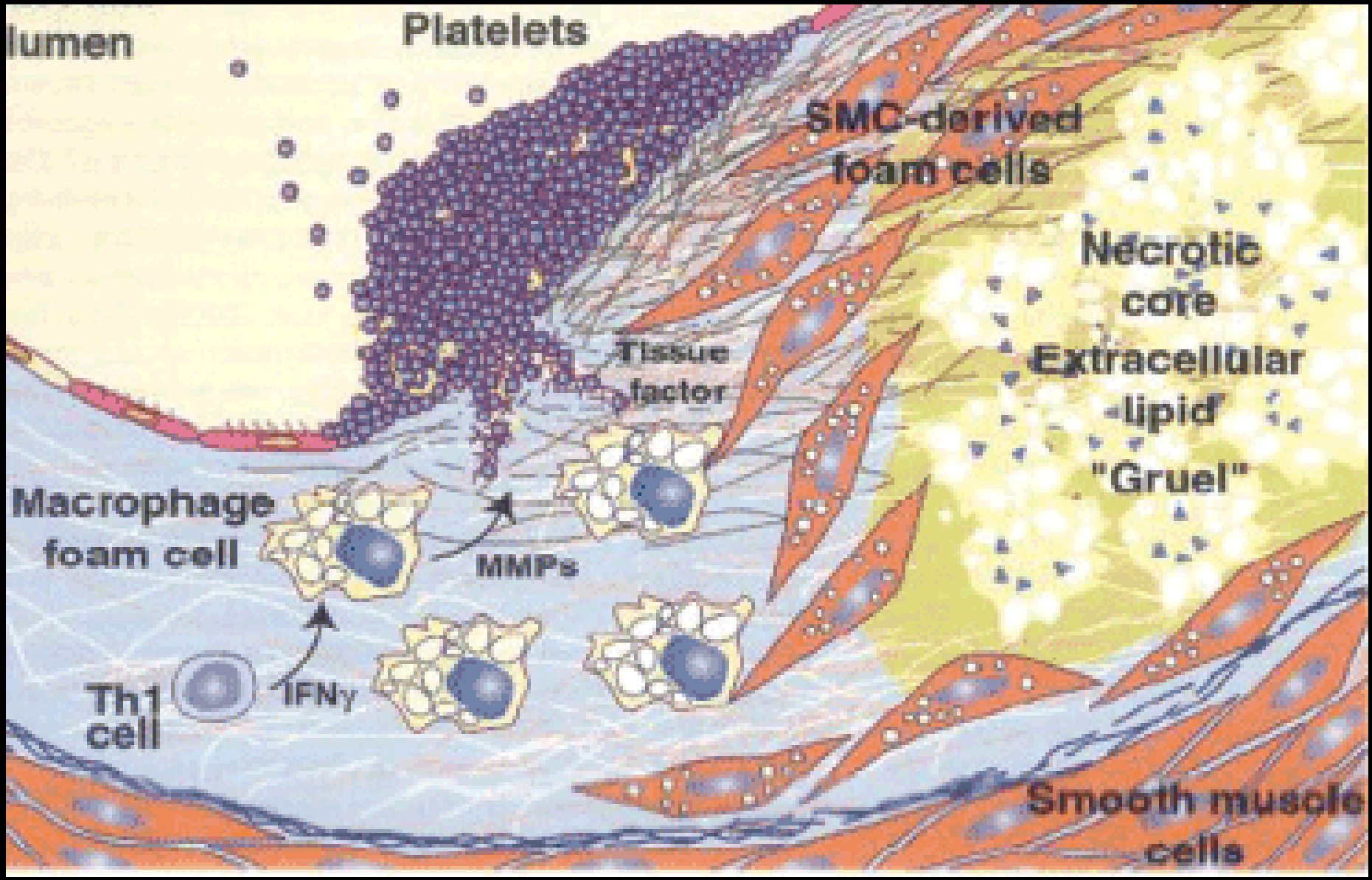
● MESA CACS calculator online
http://www.mesa-nhlbi.org/Calcium/input.aspx

CACS

Non-contrast CACS



Contrast CCTA


lumen
Platelets
SMC-derived
foam cells
Necrotic
core
Extracellular
lipid
"Gruel"
Tissue
factor
Macrophage
foam cell
MMPs
Th1
cell
IFNγ
Smooth muscle
cells

Heart Vision at St George's Radiology
137 Leinster Rd, Christchurch
p • 03 355 6073 f • 03 355 2173
www.heartvision.co.nz

Patients Name	D.O.B	Referrer Name / Signature
Address	NHI	
	Phone	Date
Clinical Details		Copy to
		Scan Urgency

CLINICIAN CHECKLIST (COMPLETE FOR ALL PATIENTS)

☐ Pacemaker or ICD

☐ AF or arrhythmia

☐ Coronary stents or CABG

Details:

Resting heart rate:

Contraindication to GTN spray? ☐ Yes ☐ No

Contraindication to B-Blocker? ☐ Yes ☐ No

Height cm:

Weight kg:

GFR:

Date of GFR:

APPROPRIATENESS CRITERIA/RISK STRATIFICATION (ONLY REQUIRED FOR SOUTHERN CROSS HEALTH INSURANCE)

STEP 1 APPROPRIATENESS CRITERIA

☐ Chest pain or other cardiac symptoms suggesting CAD, with a low or intermediate pre-test probability of CAD when exercise or pharmacologic stress testing is not possible or contraindicated.
Complete STEP 2 CVD Risk Stratification

☐ Intermediate pre-test probability of CAD (based on NZ Guidelines Group 5 year CVD risk 10-15%) with a non-interpretable or equivocal recent stress test for suspected CAD symptoms.
Complete STEP 2 CVD Risk Stratification

☐ Postoperative CABG with atypical chest pain.

☐ Preoperative assessment of coronary arteries prior to elective cardiac valve or aortic aneurysm surgery.

☐ Suspected mass or other morphologic abnormality of the heart, pericardium or great vessels on echo.

☐ New onset heart failure or dilated cardiomyopathy previously evaluated by echo, where ischemia is suspected aetiology.

STEP 2 CVD RISK STRATIFICATION

Age:

Sex: ☐ Male ☐ Female

Ever Smoked ☐ Yes ☐ No

Diabetic ☐ Yes ☐ No

Maximum recorded BP:

Lipids untreated/pre-treatment
Total cholesterol:

HDL:

Lipids post-treatment
Total cholesterol:

HDL:

USE NZ GUIDELINES TO CALCULATE 5 YEAR CVD RISK

☐ Mild 5-10%:
Complete step 3 risk modifiers.

☐ Moderate 10-15%: CCTA appropriate.

☐ High – very high >15%:
Consider alternative investigations.

STEP 3 RISK MODIFIERS

☐ Maori, Pacific Island or Indian

☐ Family history of premature CAD

☐ Family history of premature stroke

☐ BMI ≥ 30kg/m2

☐ Pre-treatment total cholesterol > 8.5mmol/L

☐ Maximum recorded BP > 170/100

Metabolic/insulin resistance syndrome

Abdominal obesity

☐ Waist M ≥ 100cm or F ≥ 90cm

Fasting triglycerides

☐ ≥1.7mmol/L

HDL cholesterol

☐ M < 1.0mmol/L or F < 1.3mmol/L

BP

☐ Systolic ≥ 130 or Diastolic ≥ 85

Fasting glucose

☐ ≥ 6.1

CACS - Case 1

- 57yr Chinese female
- strong family history premature CVD
- ↑ cholesterol
- ↓ HDL
- ↑ severe hypertension
- ? HDL functionality

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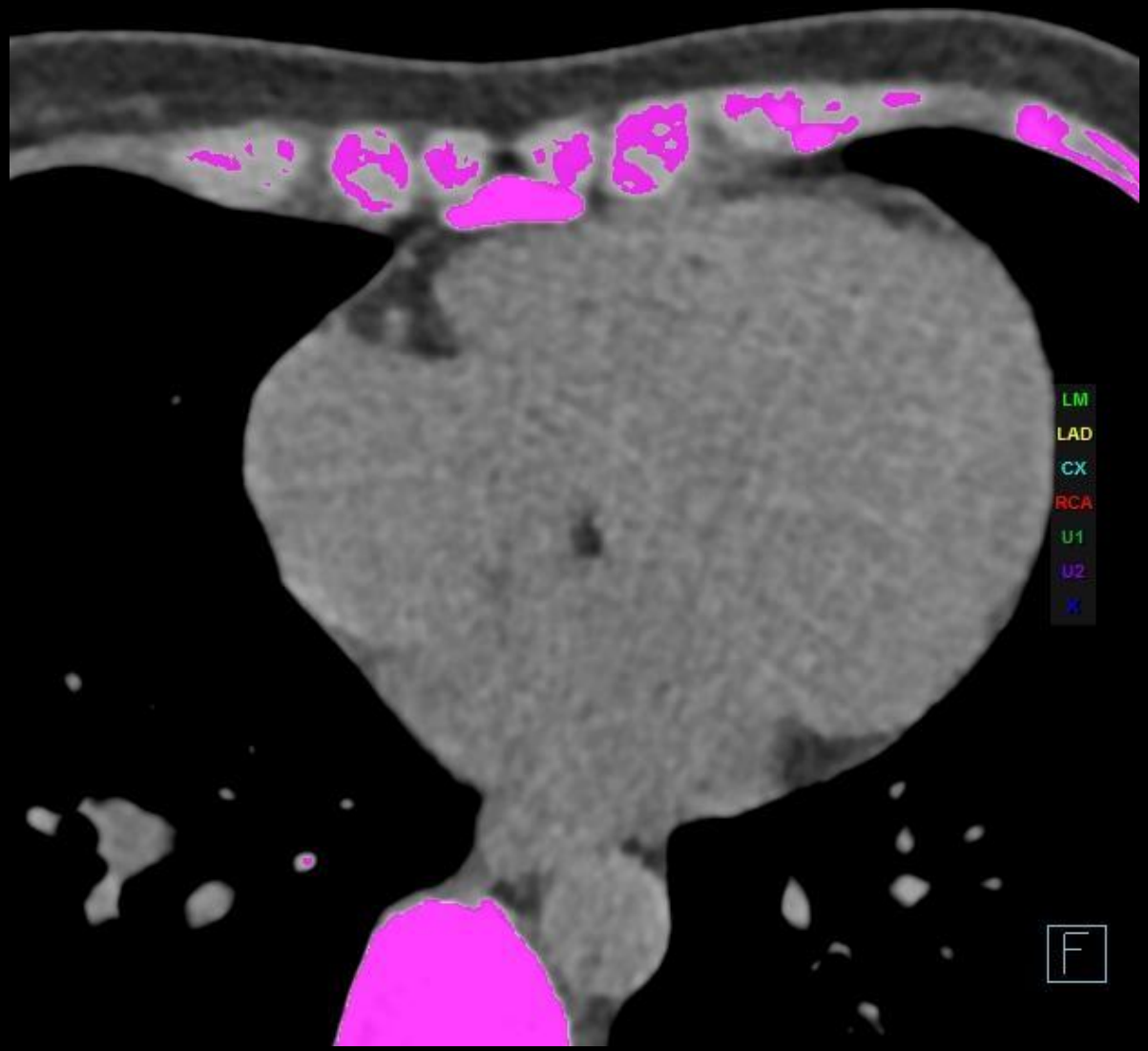
CACS



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CACS

Artery	Lesions	Volume [mm³]	Equiv. Mass [mg]	Score
LM	0	0.0	0.00	0.0
LAD	0	0.0	0.00	0.0
CX	0	0.0	0.00	0.0
RCA	0	0.0	0.00	0.0
TOTAL	**0**	**0.0**	**0.00**	**0.0**
U1	0	0.0	0.00	0.0
U2	0	0.0	0.00	0.0

- **Total CACS = 0**

Settings

Score Type: Agatston equivalent, Threshold: 130 HU (96.5 mg/cm³ CaHA)

Mass calibration factor: 0.743


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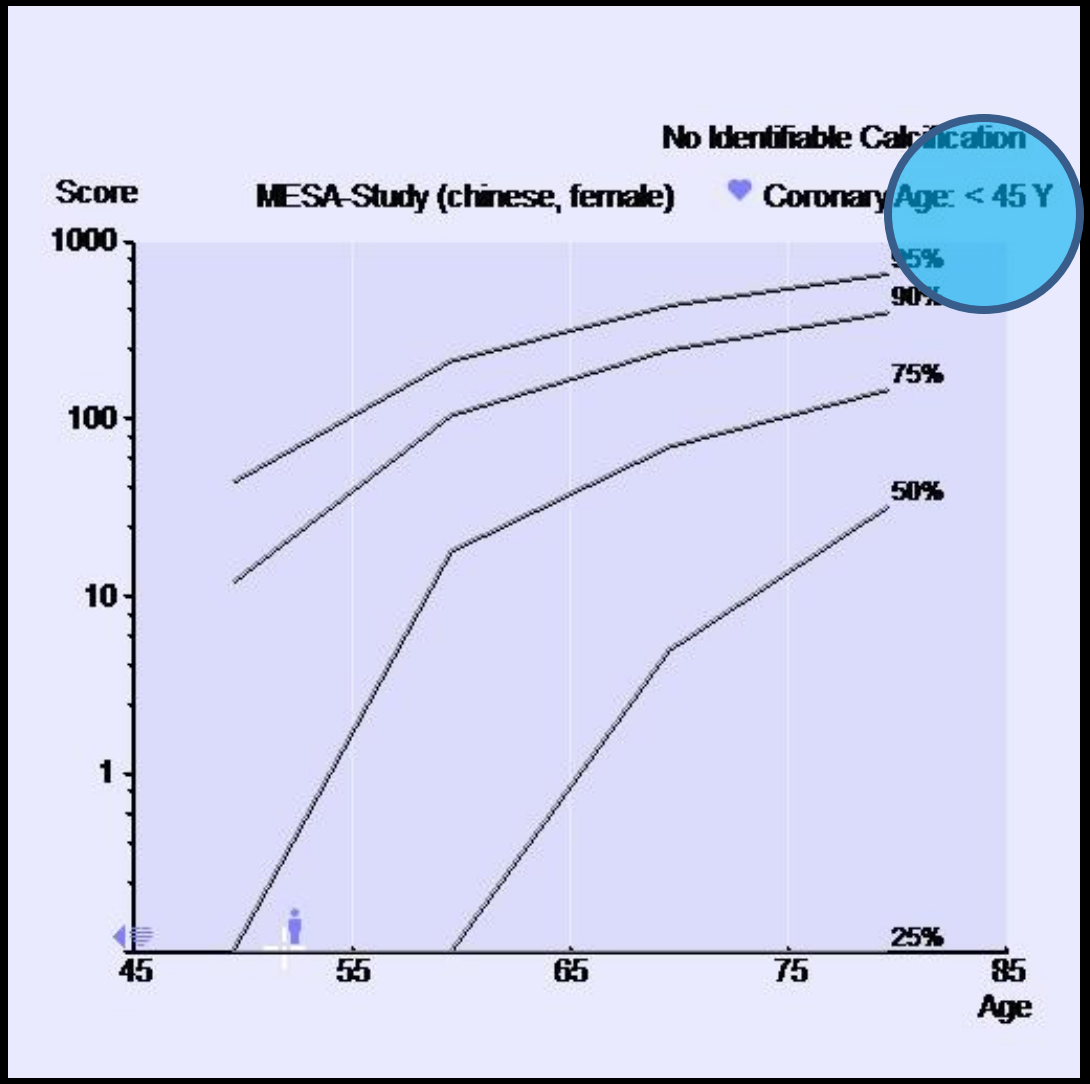
CACS


No Identifiable Calcification
Score
MESA-Study (chinese, female)
Coronary
Age: < 45 Y
1000
100
10
1
95%
90%
75%
50%
25%
45
55
65
75
85
Age

CACS - Case 2

- 72yr white female, ex smoker
- familial dyslipidemia
- moderate family history premature CVD
- ↑↑ cholesterol, ↓ HDL
- statin intolerant
- ? significant plaque burden

CACS


Heart
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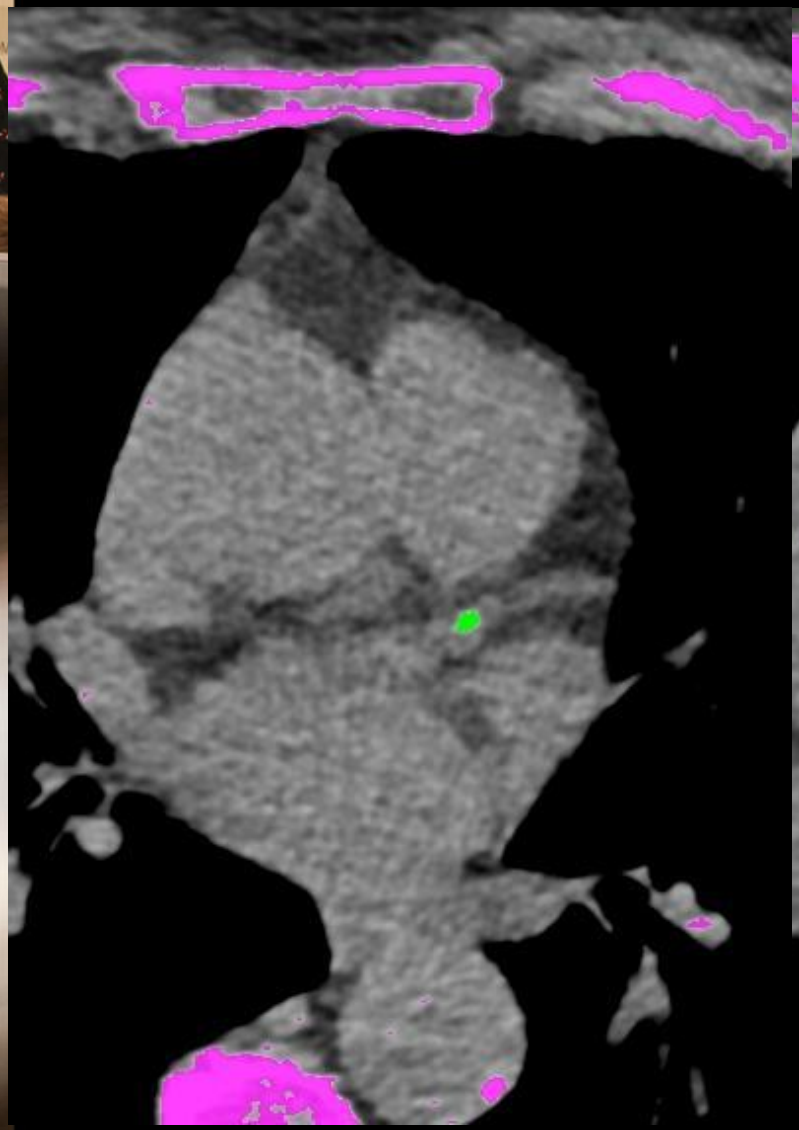
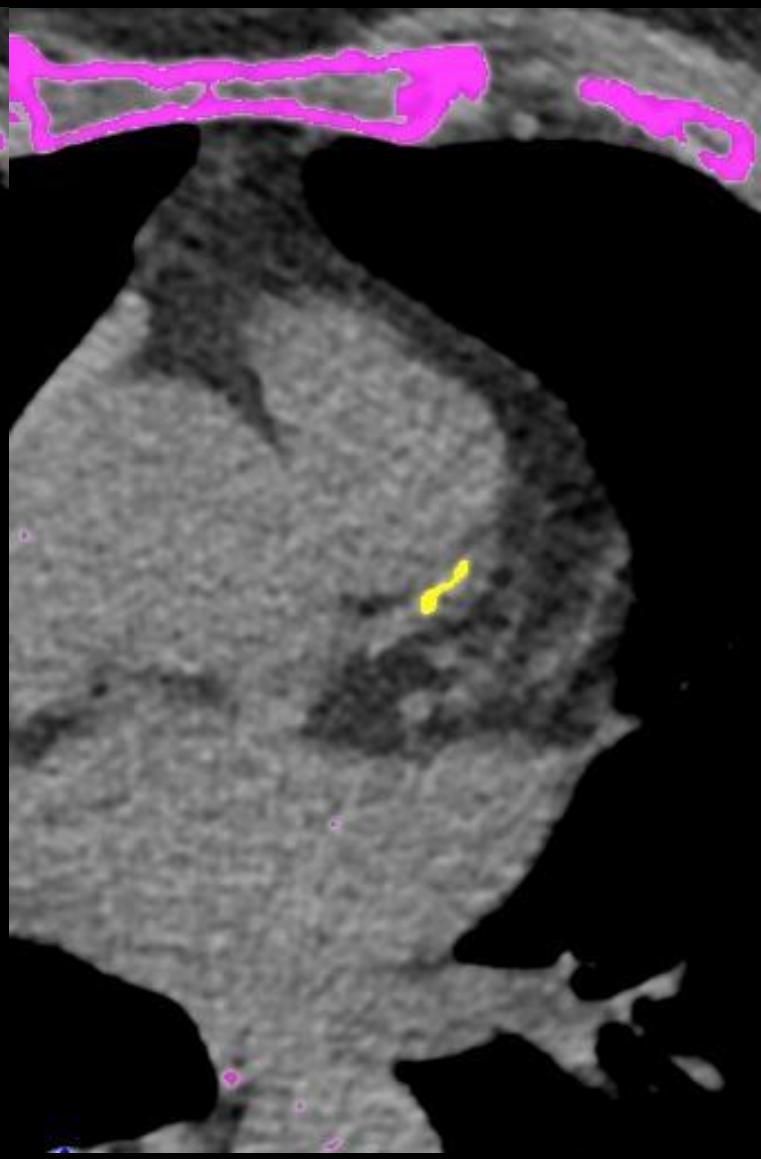
Group and Heart Centre 2003 Ltd.





Heart Vision

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CACS

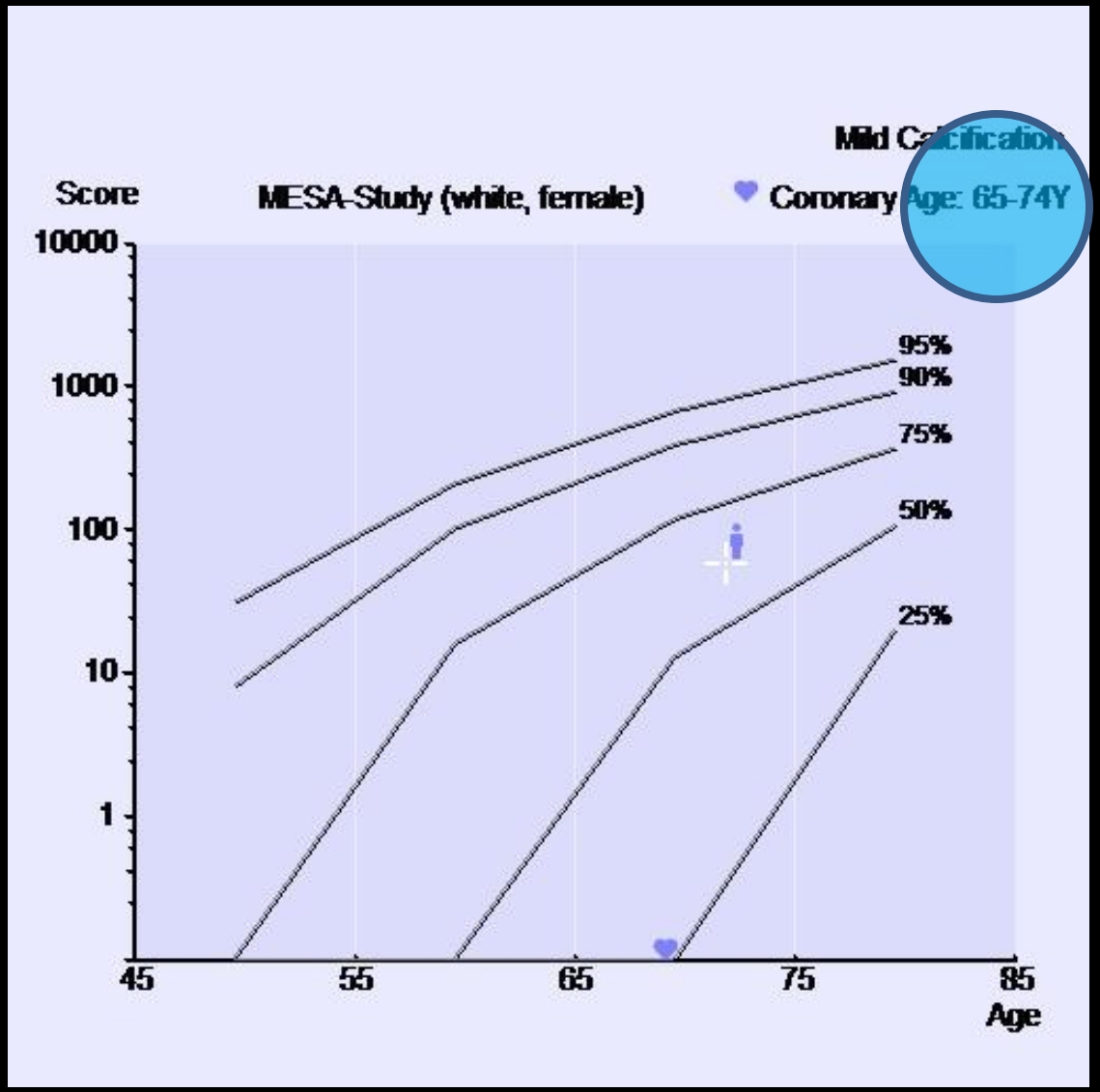
Artery	Lesions	Volume [mm³]	Equiv. Mass [mg]	Score
LM	1	21.8	3.54	21.1
LAD	2	37.3	5.69	27.4
CX	0	0.0	0.00	0.0
RCA	4	13.2	2.02	7.9
TOTAL				
U1	2	18.9	3.76	24.2
U2	0	0.0	0.00	0.0

- **Total CACS = 81**

Settings
Score Type: Agatston equivalent, Threshold: 130 HU (96.5 mg/cm³ CaHA)
Mass calibration factor: 0.743


Heart
Vision
A joint venture between Christchurch Radiology
Group and Heart Centre 2003 Ltd.

CACS


Score
MESA-Study (white, female)
Coronary
Age: 65-74Y
10000
1000
100
10
1
95%
90%
75%
50%
25%
45
55
65
75
85
Age

CACS - Interpretation

CACS Score (Agatston)	Plaque burden	Obstructive CAD Risk	CVD Risk	Guidelines
0	none	< 5%	very low	• reassuring
1-10	minimal	< 10%	low	• discuss 1^0 prevention
10-100	mild	mild stenoses	moderate	• 1^0 risk modification
100-400	moderate	NOCAD highly likely	moderately high	• $1^0 + 2^0$ risk modification • aspirin • consider stress test
> 400	severe	> 90% risk of OCAD >/= 1 stenosis	high	• aggressive risk modification • aspirin • stress test

Reference: **Rumberger 1999**

CACS

- result = ranked Agatston score
- calcification = biomarker of CAD burden
- CVD risk assessment in low-medium risk patients
- ↑score = ↑ CVD risk
- extensive evidence base
- routinely incorporated in CCTA studies (2012)

CACS

- not included in 2009 NZ CVS Risk Guidelines
- independent CVD risk cf Framingham risk (Shaw 2003, n = 10,000)
- 10-25% Framingham low risk → CACS high risk (NZMJ 2011)
- identifies a group with falsely low Framingham CVD risk

- -ve test = 96% NPV for significant CAD
- CACS > 1000 = 20% 1yr probability severe/fatal CVD event
- CACS > 75th centile, odds ratio 21.5 of MI or CVD (Raggi 2000)
- good CACS v cath correlation > 6800 pts = 174 caths (MESA 2009)

CACS - Selection

- asymptomatic intermediate risk where clinical decision making difficult
- ethnic groups Indian, Maori, Pacific Islanders risk understaged
- FHx premature stroke or CAD - IHD
- dyslipidaemias for HDL functionality
- metabolic syndrome

"I'm afraid the brain scan results confirm your worst fears, Mrs. Taylor."

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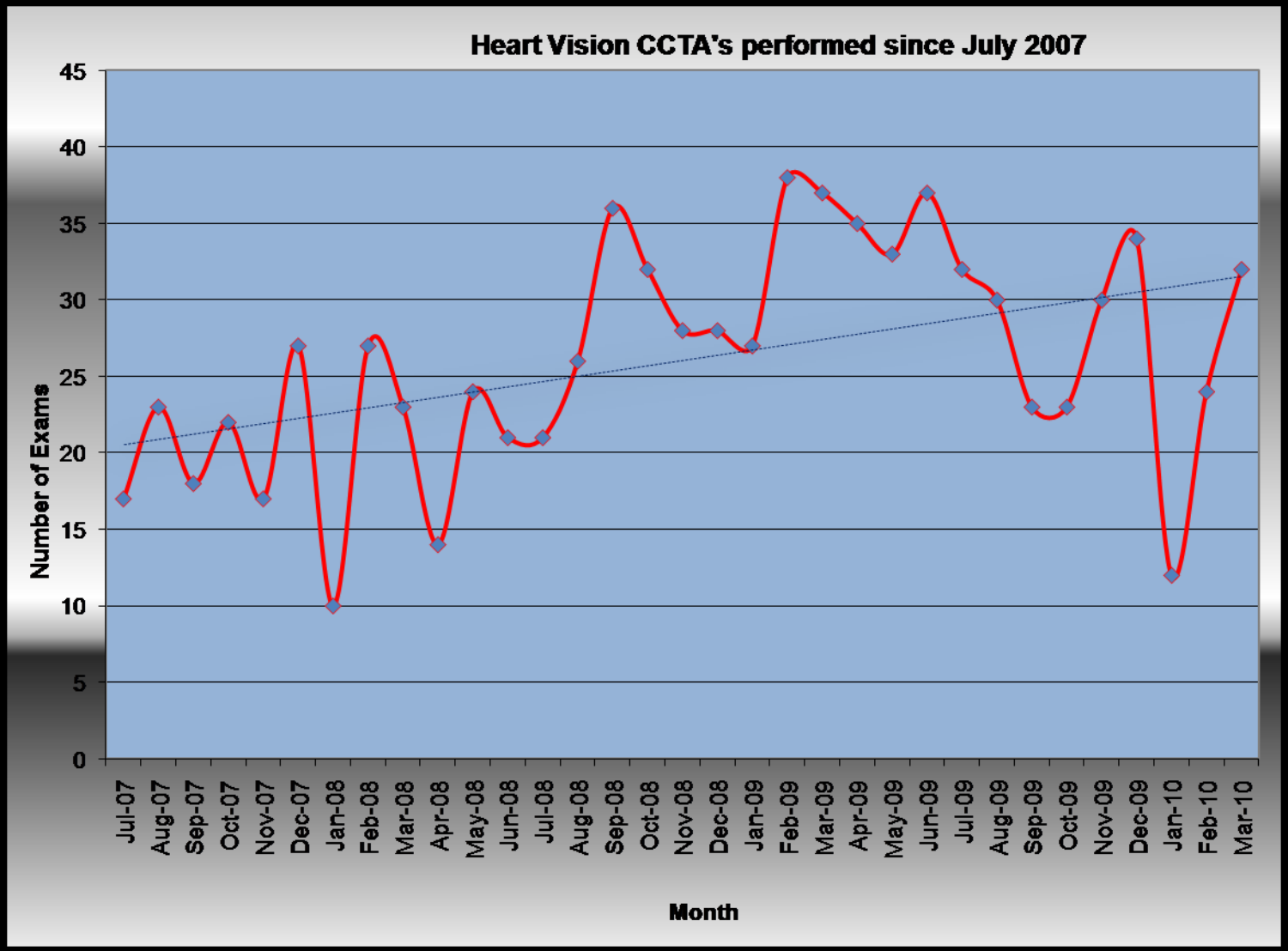
CCTA

Coronary CT Angiography

CCTA


Heart Vision CCTA's performed since July 2007
Number of Exams
0
5
10
15
20
25
30
35
40
45
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Jan-08
Feb-08
Mar-08
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Jun-09
Jul-09
Aug-09
Sep-09
Oct-09
Nov-09
Dec-09
Jan-10
Feb-10
Mar-10
Month

Heart Vision at St George's Radiology
137 Leinster Rd, Christchurch
p • 03 355 6073 f • 03 355 2173
www.heartvision.co.nz

Patients Name	D.O.B	Referrer Name / Signature
Address	NHI	
	Phone	Date
Clinical Details		Copy to
		Scan Urgency

CLINICIAN CHECKLIST (COMPLETE FOR ALL PATIENTS)

☐ Pacemaker or ICD

☐ AF or arrhythmia

☐ Coronary stents or CABG

Details:

Resting heart rate:

Contraindication to GTN spray? ☐ Yes ☐ No

Contraindication to B-Blocker? ☐ Yes ☐ No

Height cm:

Weight kg:

GFR:

Date of GFR:

APPROPRIATENESS CRITERIA/RISK STRATIFICATION (ONLY REQUIRED FOR SOUTHERN CROSS HEALTH INSURANCE)

STEP 1 APPROPRIATENESS CRITERIA

☐ Chest pain or other cardiac symptoms suggesting CAD, with a low or intermediate pre-test probability of CAD when exercise or pharmacologic stress testing is not possible or contraindicated.
Complete STEP 2 CVD Risk Stratification

☐ Intermediate pre-test probability of CAD (based on NZ Guidelines Group 5 year CVD risk 10-15%) with a non-interpretable or equivocal recent stress test for suspected CAD symptoms.
Complete STEP 2 CVD Risk Stratification

☐ Postoperative CABG with atypical chest pain.

☐ Preoperative assessment of coronary arteries prior to elective cardiac valve or aortic aneurysm surgery.

☐ Suspected mass or other morphologic abnormality of the heart, pericardium or great vessels on echo.

☐ New onset heart failure or dilated cardiomyopathy previously evaluated by echo, where ischemia is suspected aetiology.

STEP 2 CVD RISK STRATIFICATION

Age:

Sex: ☐ Male ☐ Female

Ever Smoked ☐ Yes ☐ No

Diabetic ☐ Yes ☐ No

Maximum recorded BP:

Lipids untreated/pre-treatment
Total cholesterol:

HDL:

Lipids post-treatment
Total cholesterol:

HDL:

USE NZ GUIDELINES TO CALCULATE 5 YEAR CVD RISK

☐ Mild 5-10%:
Complete step 3 risk modifiers.

☐ Moderate 10-15%: CCTA appropriate.

☐ High – very high >15%:
Consider alternative investigations.

STEP 3 RISK MODIFIERS

☐ Maori, Pacific Island or Indian

☐ Family history of premature CAD

☐ Family history of premature stroke

☐ BMI ≥ 30kg/m2

☐ Pre-treatment total cholesterol > 8.5mmol/L

☐ Maximum recorded BP > 170/100

Metabolic/insulin resistance syndrome

Abdominal obesity

☐ Waist M ≥ 100cm or F ≥ 90cm

Fasting triglycerides

☐ ≥1.7mmol/L

HDL cholesterol

☐ M < 1.0mmol/L or F < 1.3mmol/L

BP

☐ Systolic ≥ 130 or Diastolic ≥ 85

Fasting glucose

☐ ≥ 6.1

CCTA - Techniques

Retrospective Gating

- original technique
- higher dose

Prospective Gating

- newer ~ move and shoot
- low radiation dose

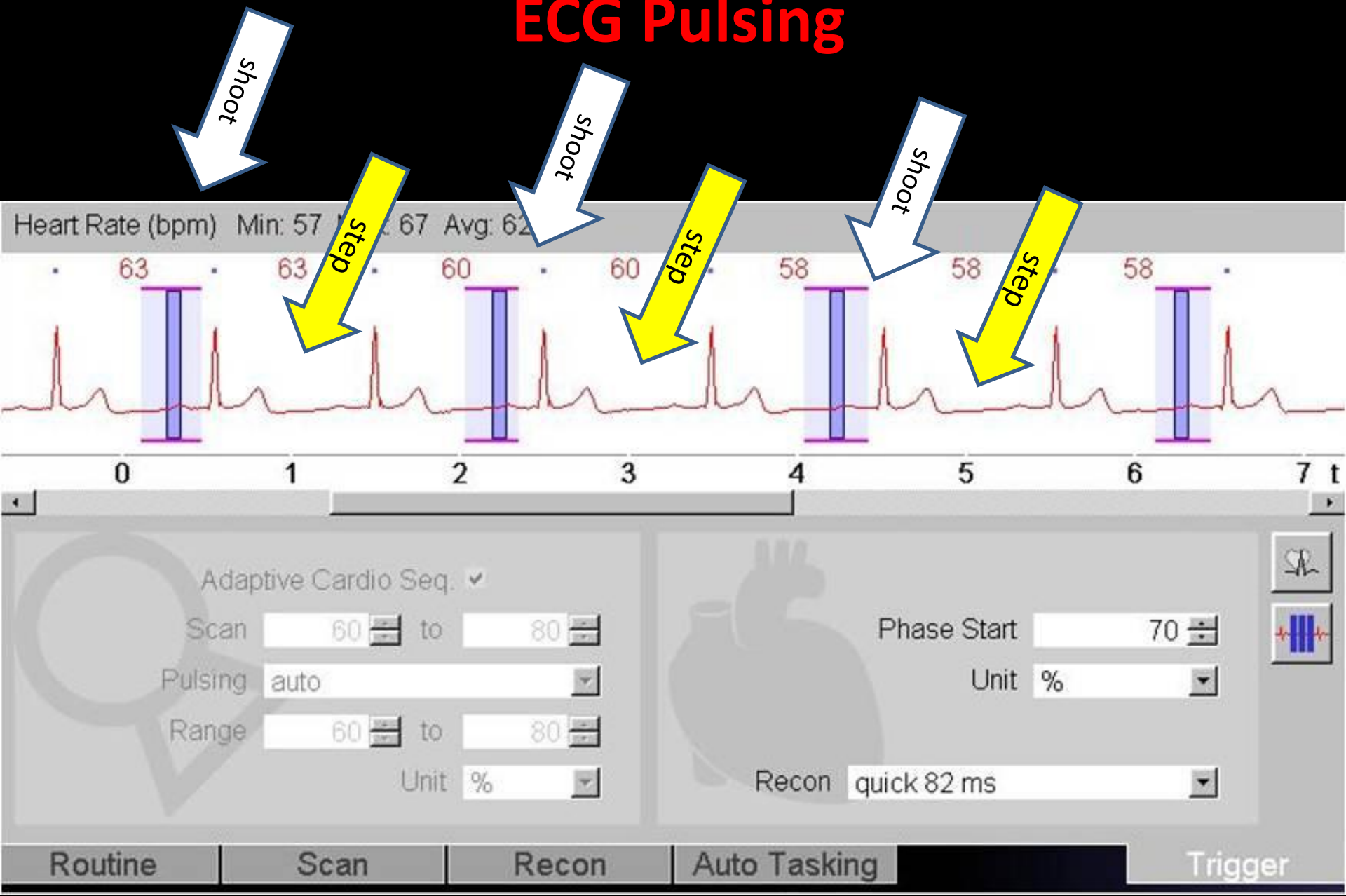
FLASH Scan

- Siemens DSCT, 1 diastolic RR ~ 400msec
- ultralow dose <1mSv

CCTA Technique

- sinus rhythm, heart rate control critical
- +/- β blocker (Metoprolol) 100-150 mg po routinely pre scan
- CACS scan during acquisition range planning
- sublingual GTN spray 2-3 minutes pre scan
- iv right antecubital , Iopamiro 360 @ 60ml 6ml/sec + saline flush

ECG Pulsing


shoot
step
shoot
step
shoot
step
Heart Rate (bpm) Min: 57 67 Avg: 62
63
63
60
60
58
58
58
0
1
2
3
4
5
6
7 t
Adaptive Cardio Seq.
Scan 60 to 80
Pulsing auto
Range 60 to 80
Unit %
Phase Start 70
Unit %
Recon quick 82 ms
Routine
Scan
Recon
Auto Tasking
Trigger

CCTA - Technique β blockade

Technique	Total β blocker
Prospective gated	54%
Retrospective gated DSCT	43%
Total (n= 142)	**49%**

Reference:

Heart Vision Audit 2009: 1 year sample June 2008 - May 2009
Amanda Peacock

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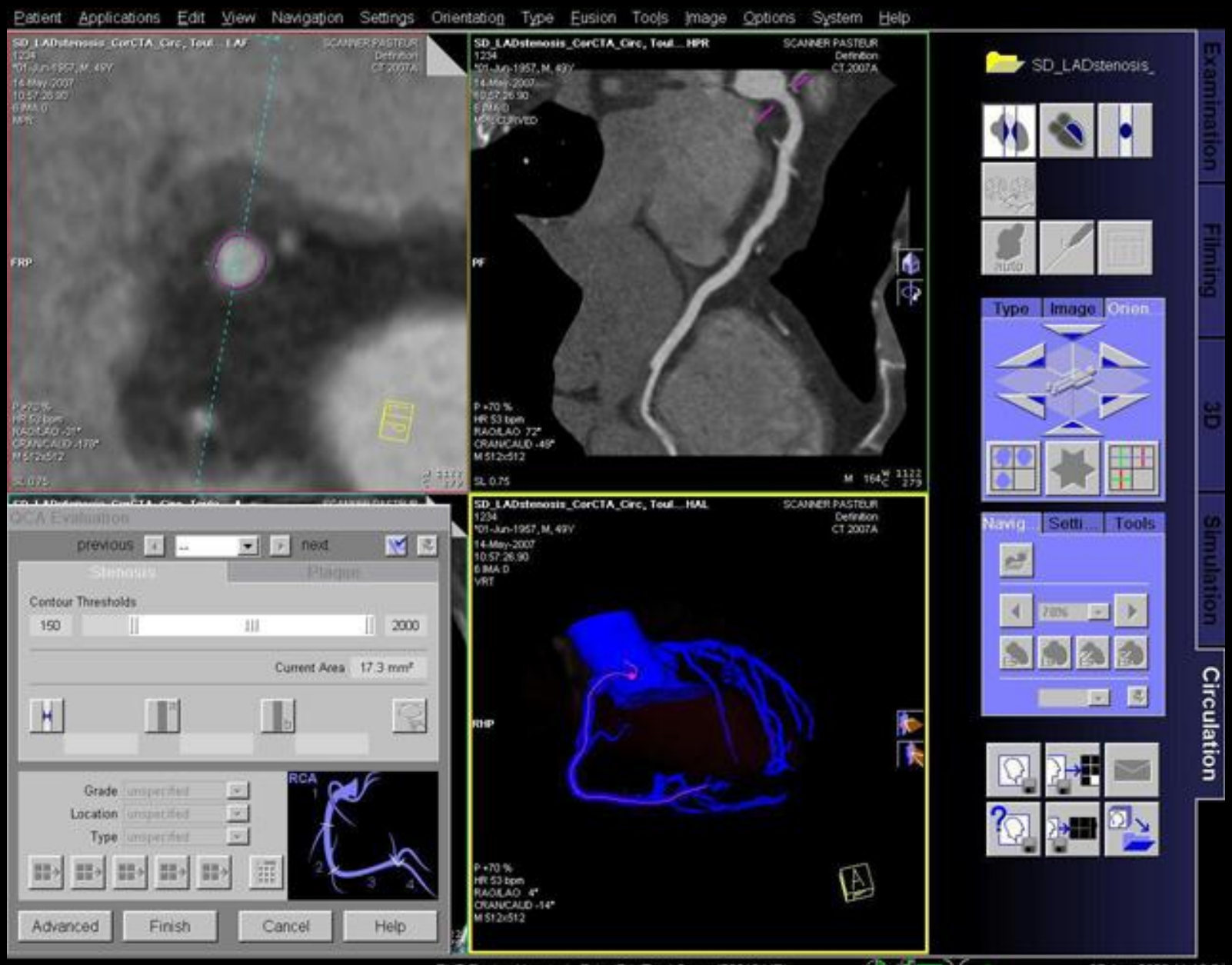
Coronary Analysis Software



"And this report just in. ... Apparently, the grass is greener on the other side."

CCTA - Reporting Triage

Stenosis Grade:

- normal
- minimal < 25%
- mild 25 - 49%

borderline ~ 50% ⇩ “significant” stenosis > 50%

- moderate 50 - 69%
- severe >/= 70%
- occlusion ~ 100%

⇩ “severe” stenosis > 70%

CCTA - Indications 1

Major

- Chest pain – low/intermediate pretest probability CAD
- Chest pain - uninterpretable or equivocal ETT/imaging
- Evaluation acute CP (ED) – intermediate risk CAD/normal ECG-enzymes
- Pre-op exclusion CAD prior to valve-aneurysm surgery
- Suspected coronary anomalies
- CHF or DCM on echo - new onset for exclusion CAD

Reference: CSANZ November 2010

CCTA - Sample Requests

Request 1:

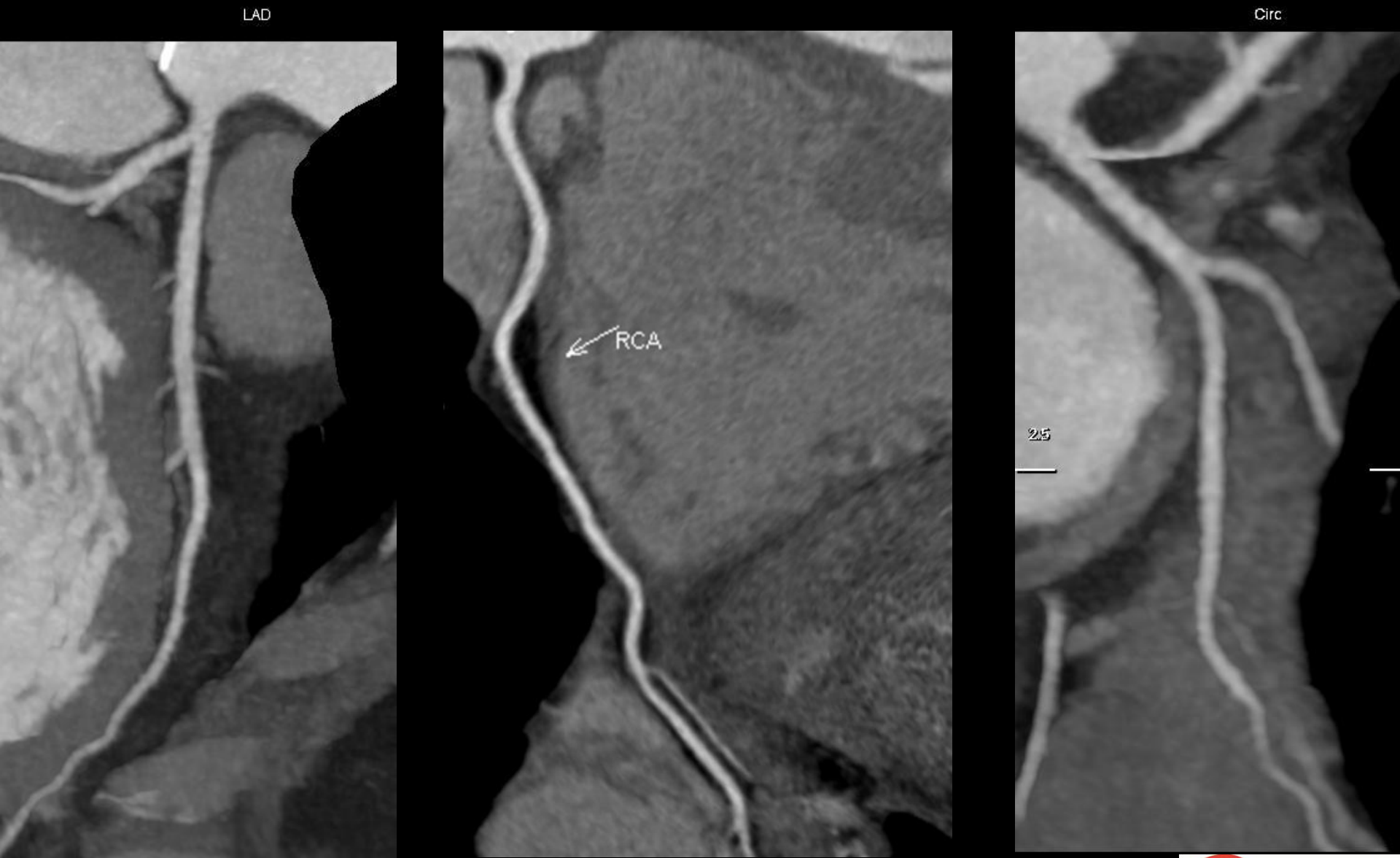
40-65 yr male
FHx - premature CAD
risk factors = ↑ LDL, ↑ CRP
chest “tightness”
asymptomatic equivocal ETT (ex ECG)

Request 2:

55-75yr female
FHx - nil significant
risk factors = hypertensive
SOBOE
? false +ve asymptomatic ETT (ex ECG mild ST changes)

Heart Vision

CCTA



M55yr. Atypical CP. Severe Framingham risk factors. PETT.

Heart Vision

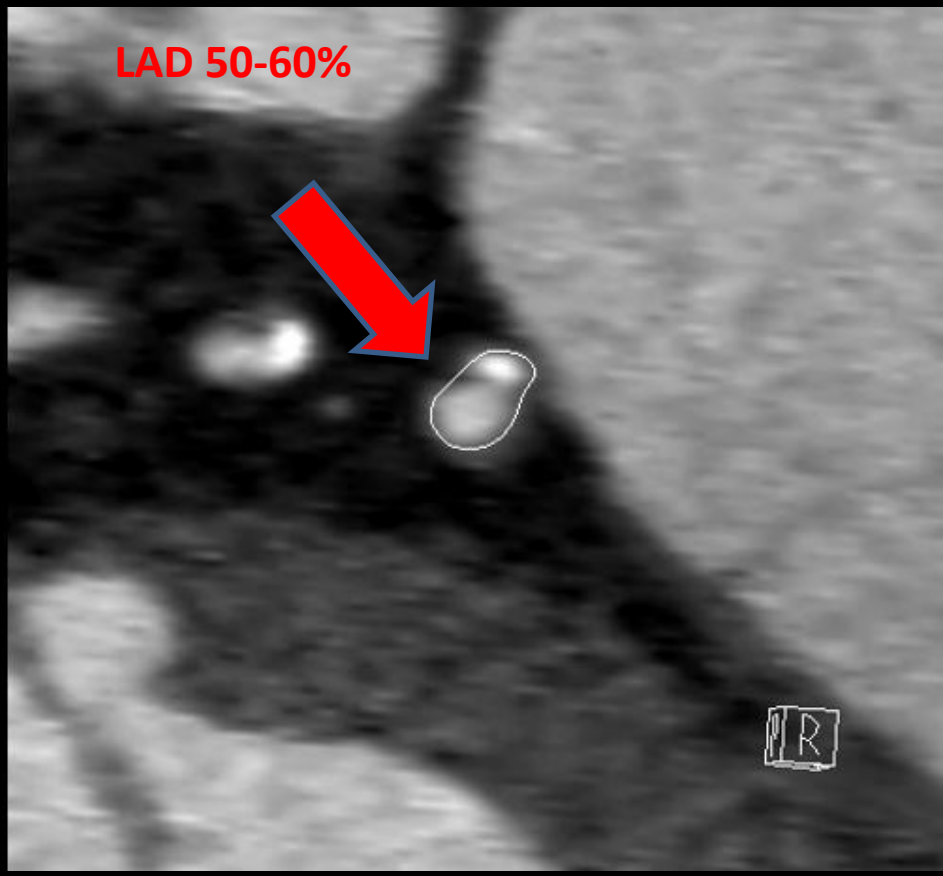
CCTA

M36yr Atypical CP. No Framingham risk factors. NETT.

CCTA

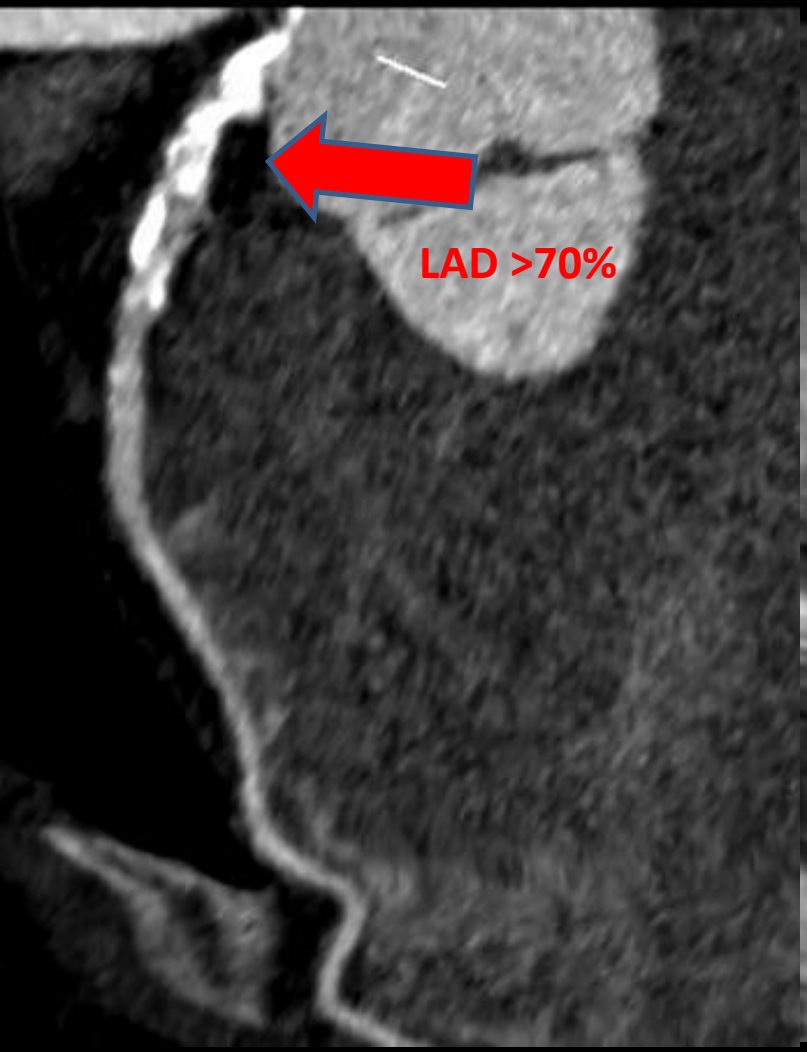
FPH6911: M56yr ICU. Ex-smoker. Assess suitability as cardiac donor.

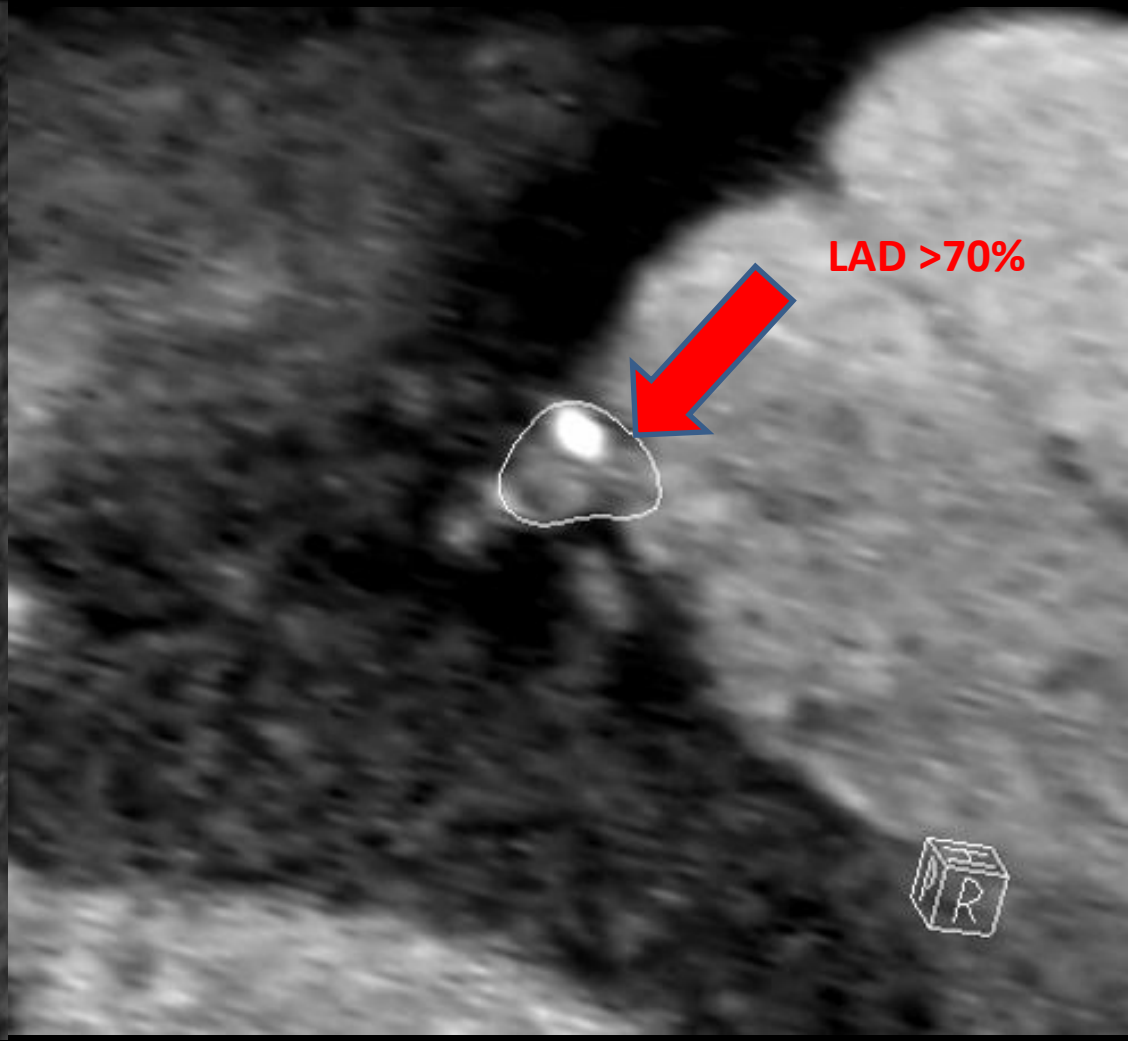
CCTA



DNC3450: M68yr CP. BETT. LBBB → MR stress test -ve Rx medical

CCTA





LPG8917: M74yr Previous MVR. CT. BETT → catheter + PCI

CCTA

AYD4723: M62yr CT. BETT. AF. FHx IHD → catheter

CCTA v Catheter - Concordance

Christchurch Experience

	Cath	CCTA
• Christchurch Hospital Validation Study 2007	112	112
? false negative catheter (n = 3)		
• Heart Vision Audit (1) 2007 - 2008	61	518
• Heart Vision Audit (2) 2009 - 2011	82	1002
• **TOTAL**	**255**	**1632**

CCTA Audits

Analysis:

CCTA v catheter concordance

- analysis by vessels → technical

- analysis by patient → patient management

Stenosis threshold for analysis

- significant (obstructive) CAD > 50%

- severe CAD > 70%

CCTA – Validation 1

- 2007 Christchurch Hospital validation study
- low-intermediate risk pt group, n= 112, av. 60 (+/- 11yr), 64% male
- iv β blocker HR > 65
- radiology - GE 64slice MDCT system, cardiac radiologist reporting
- cardiology - diagnostic cardiac catheter, cardiologist reporting
- all reporters blinded to CCTA/catheter results

CCTA – Validation 2

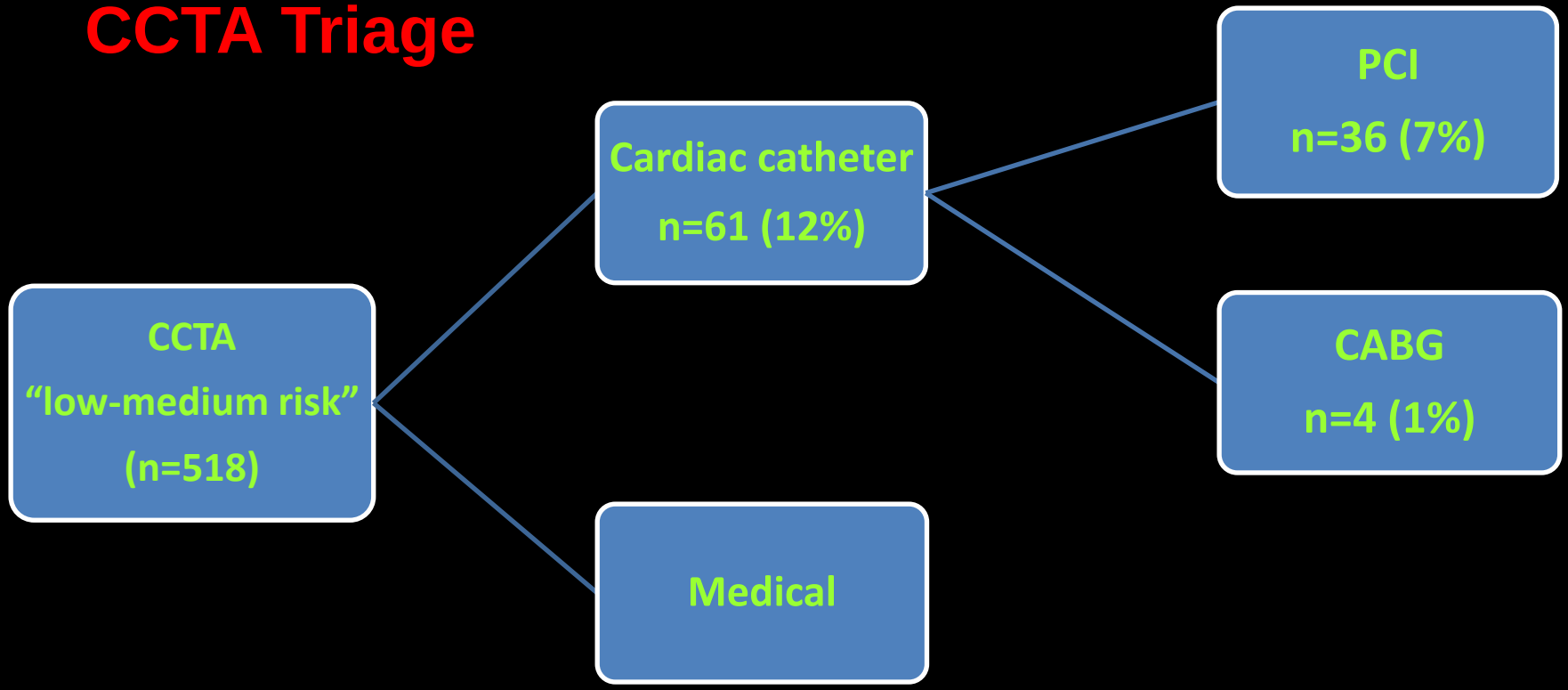
Patient analysis n = 112 CCTA v catheter	sens	spec	PPV	NPV
> 50% stenosis - significant CAD	95%	99.7%	**91%**	**99.4%**
> 75% stenosis - severe CAD	55%	99.4%	75%	**98.6%**
>75% stenosis (calcium adjusted)	69%		85%	

Reference:

CHC Hospital validation study: 2007

HV Audit (1) 2007 - 2009

CCTA Triage



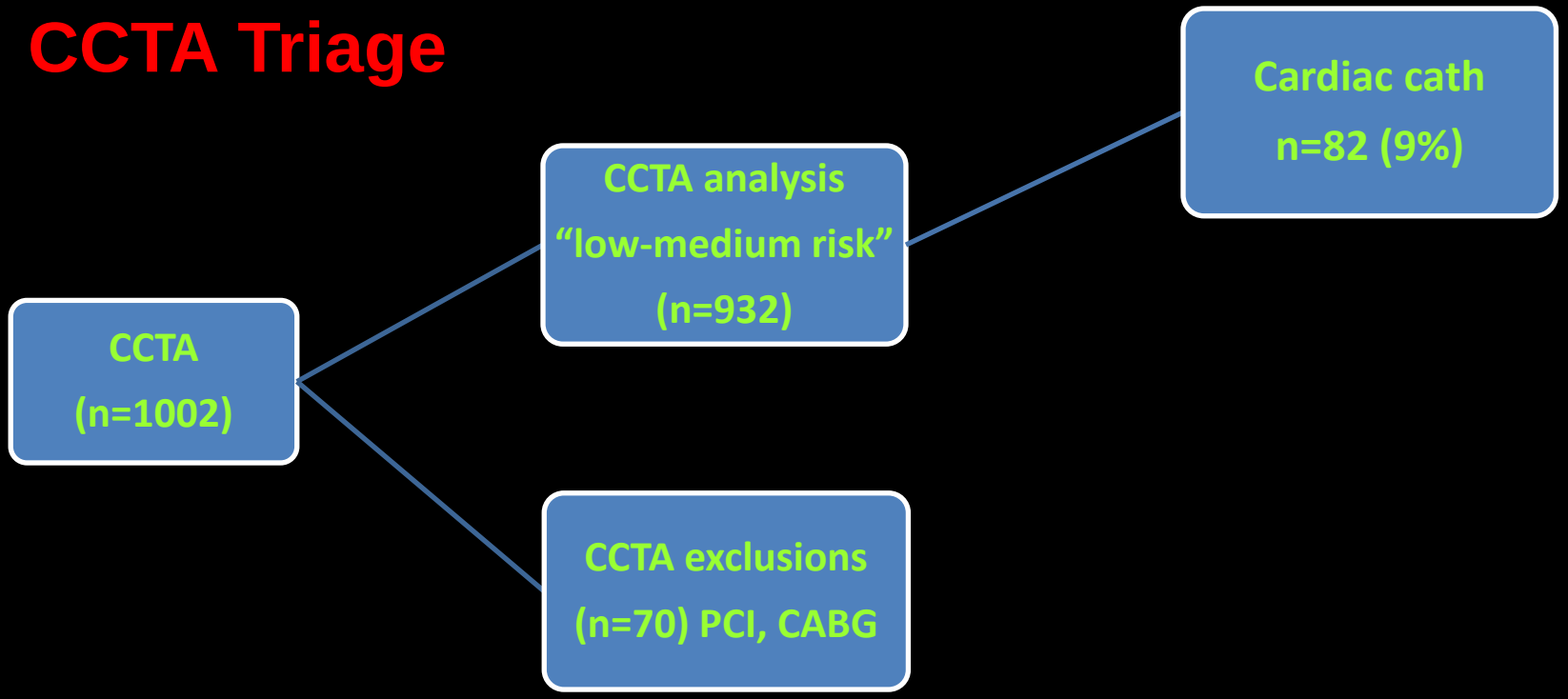
Reference:

Heart Vision Audit 1, Feb 2007 - Jan 2009 (n = 518)
Amanda Peacock extended population

R J Keenan CRG 200

HV Audit (2) 2008 - 2011

CCTA Triage

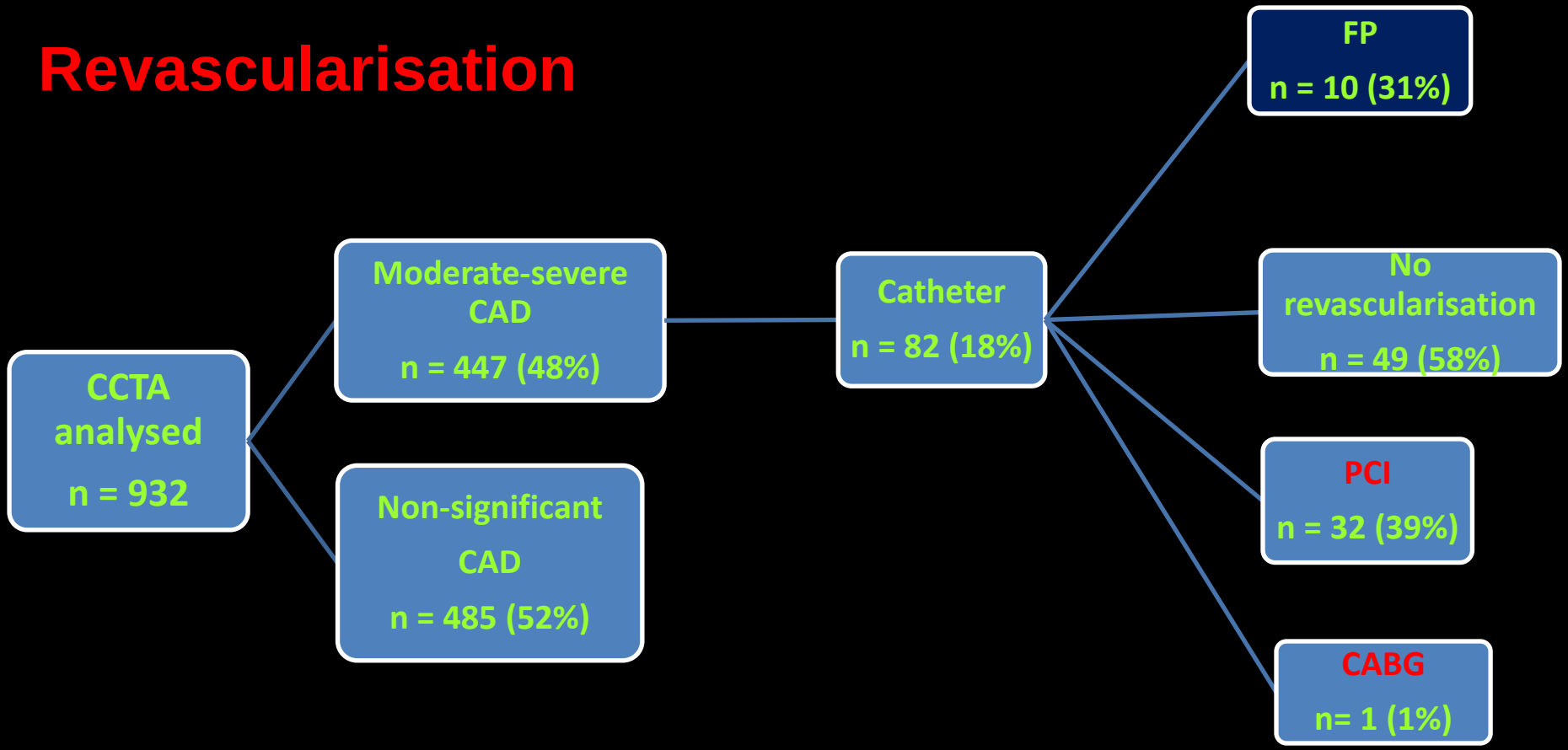


Reference:

Heart Vision Audit 2, Paula England
June 2008 – August 2011 (n = 1002)

HV Audit (2) 2008 - 2011

Revascularisation



Reference:

CCTA v catheter analysis, HV Audit 2, Paula England
June 2008 – August 2011 (n = 1002)

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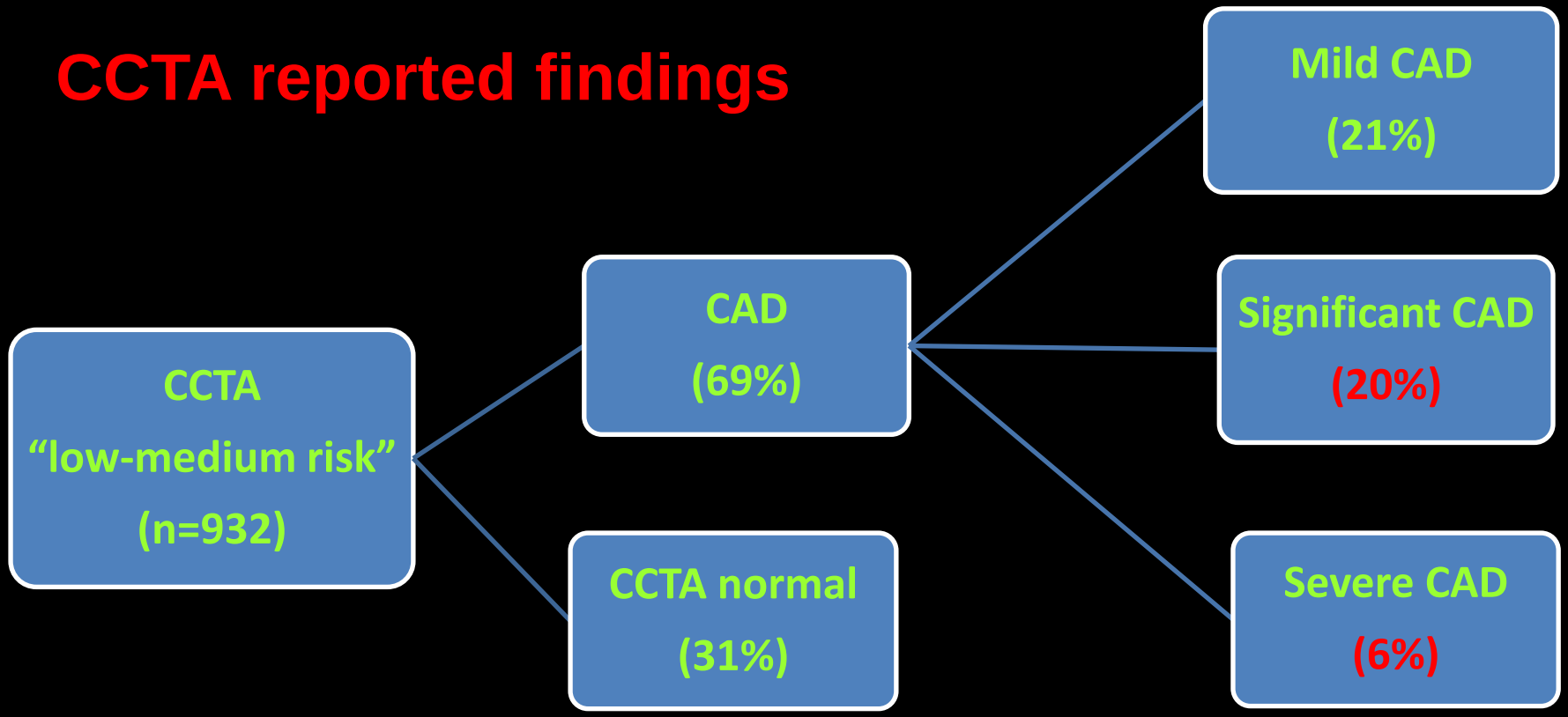
R J Keenan CRG 200

HV Audit (2) 2008 - 2011

CCTA reported findings



Reference:

CCTA report analysis, HV Audit 2, Paula England
June 2008 – August 2011 (n = 1002)

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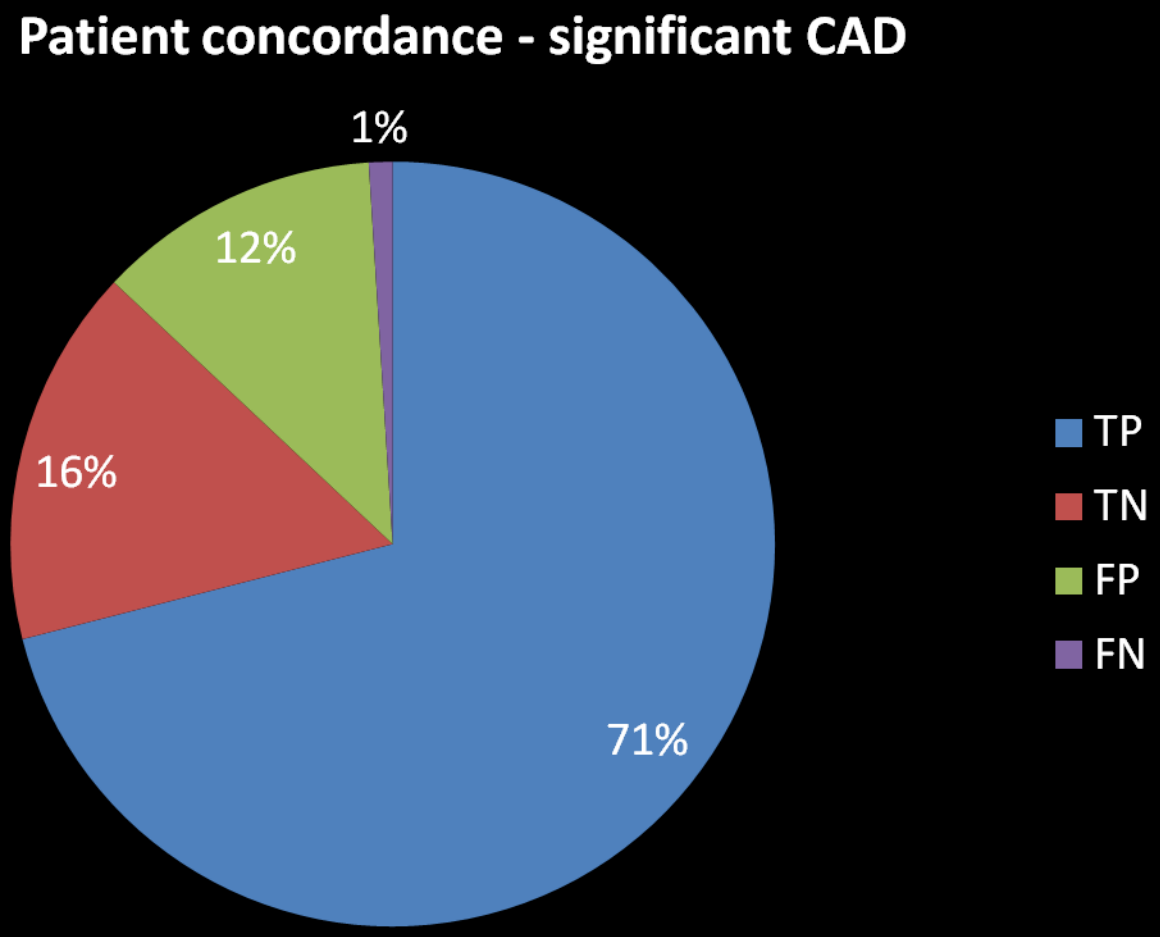
R J Keenan CRG 20

CCTA v Catheter Concordance - Audit (2)



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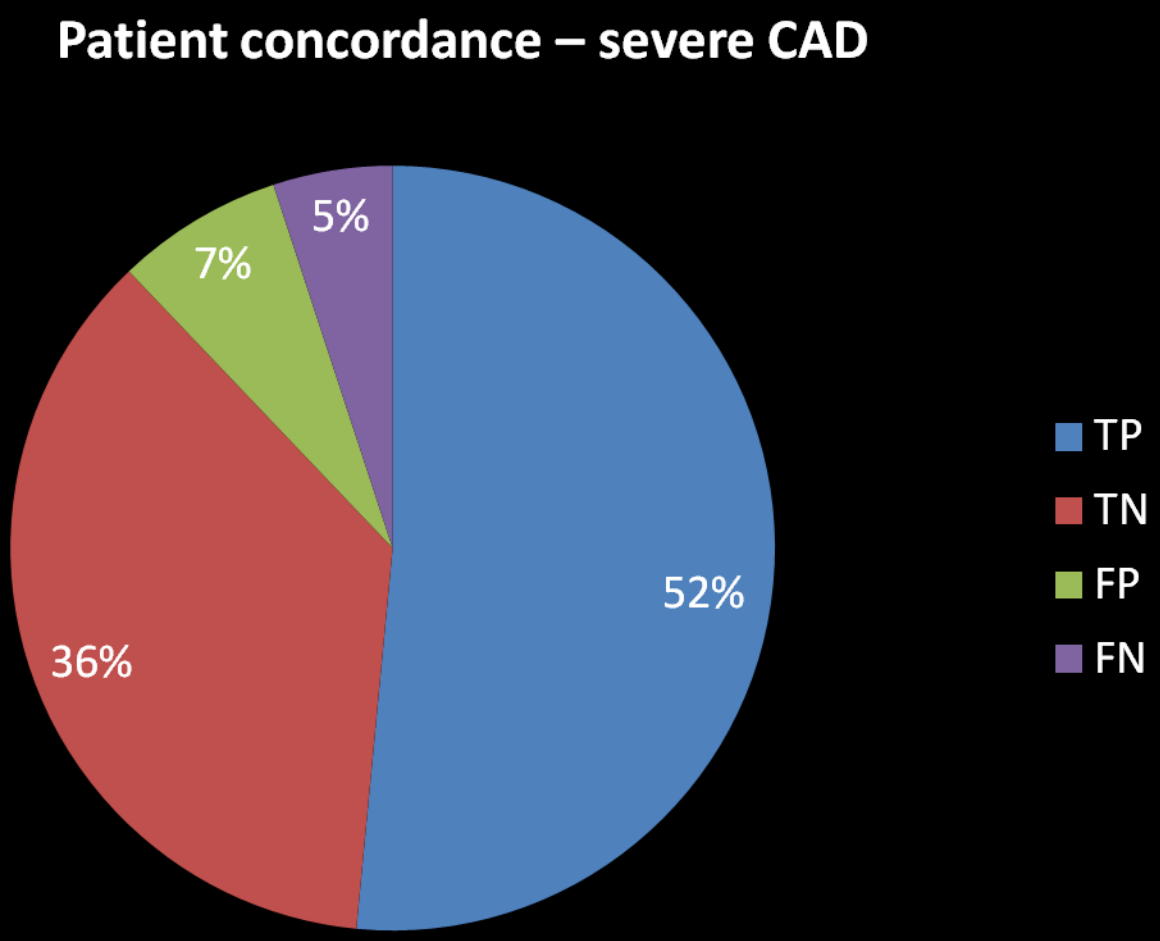
CCTA v Catheter Concordance - Audit (2)



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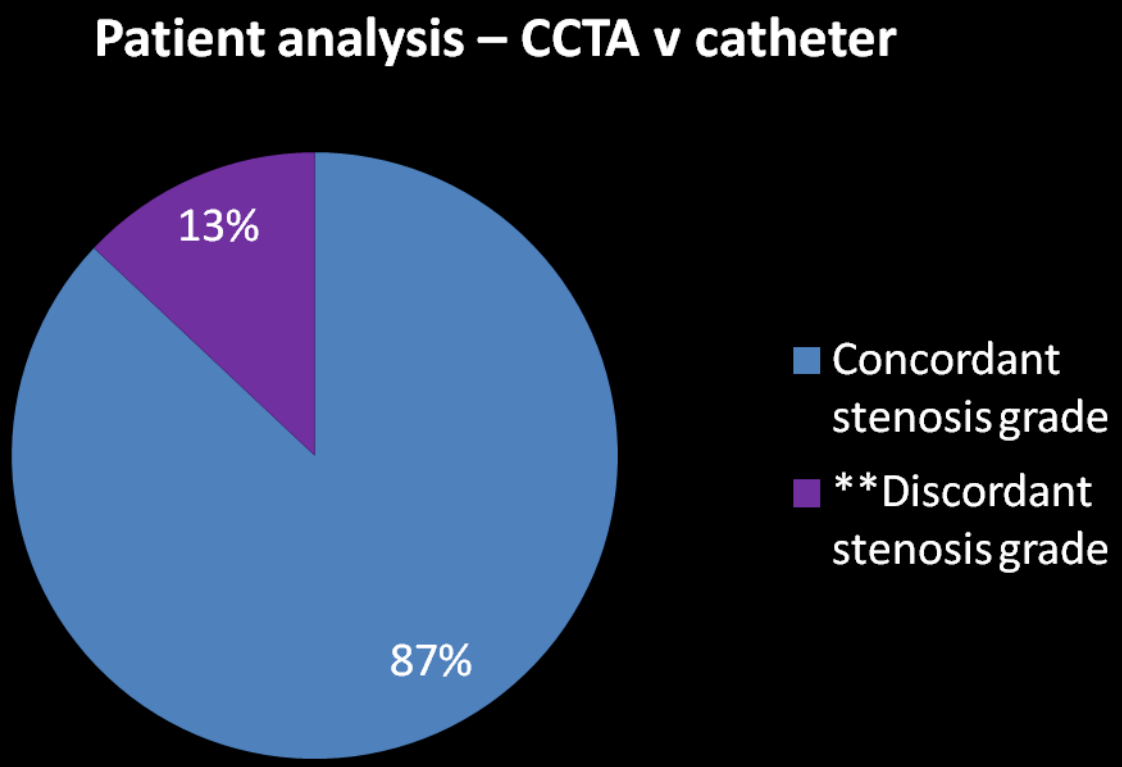
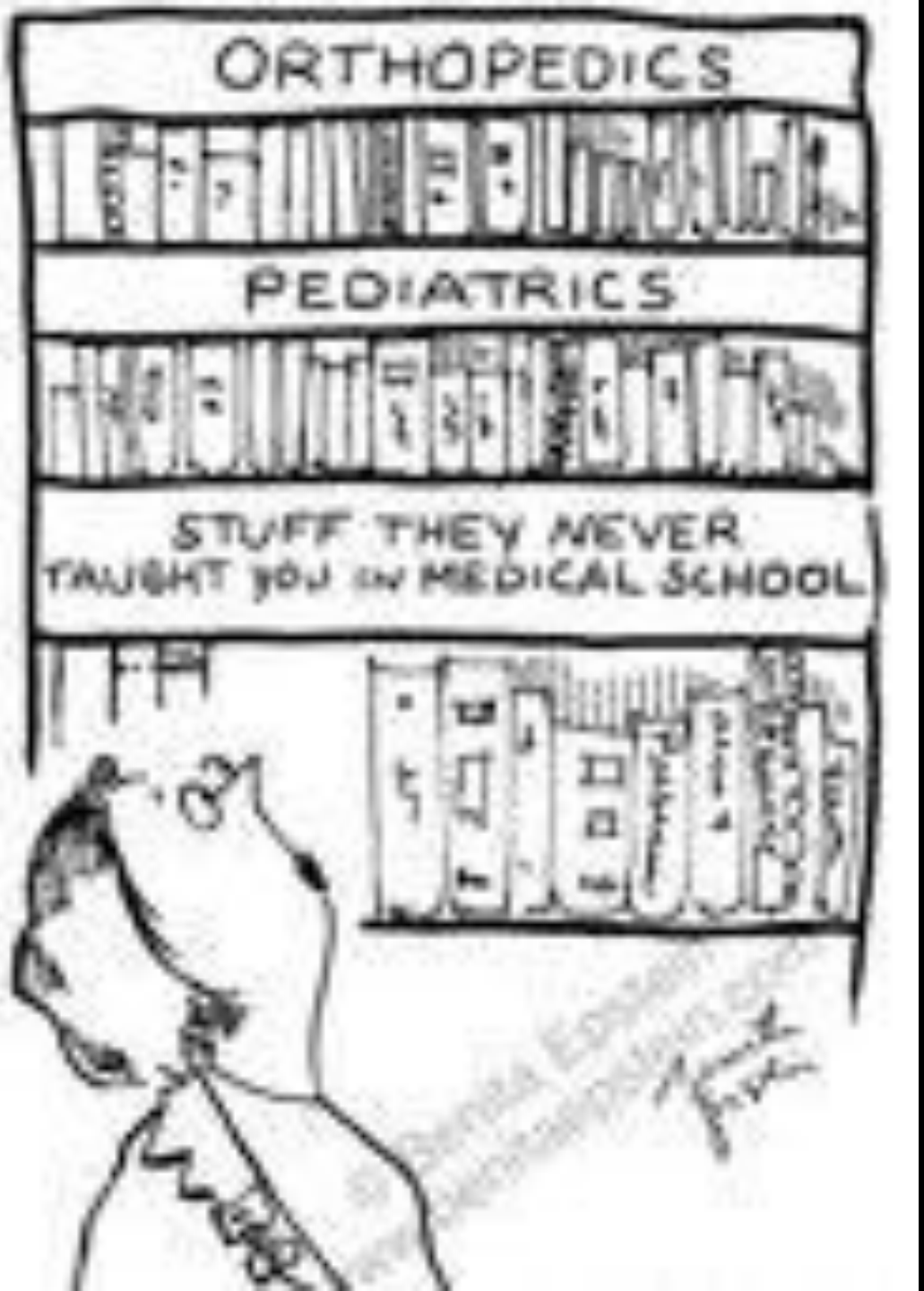
CCTA v Catheter Concordance - Audit (2)



**discordant stenosis grade ≠ missed lesion

Heart Vision
A joint venture between Christchurch Radiology Group and Heart Centre 2003 Ltd.


ORTHOPEDICS
PEDIATRICS
STUFF THEY NEVER TAUGHT YOU IN MEDICAL SCHOOL

CCTA v Cath – Patient discordance > 70%

CTA "False Negative" for Severe CAD

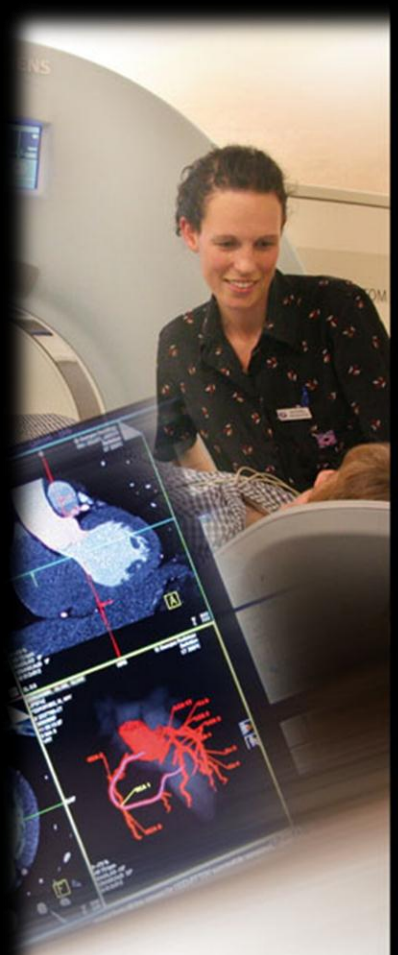
- HV Audit 2 discordance per patient at >/= 70% stenosis (severe disease)
- CCTA "false negative" for severe CAD, n = 5 patients

- CUX7738, CCTA LAD severe Ca^{2+} ~ stenosis 50% → cath recommended → cath 70% RCA lesion → PCI
- MPJ0813, CCTA mild RCA/moderate LAD stenosis → cath 18/12 later→ RCA severe → PCI
- FPV9509, CCTA moderate LAD/Cx stenoses → cath → upgraded severe lesions → PCI
- IEH026Z, CCTA moderate >50% LAD stenosis → cath → upgraded severe lesion → PCI
- FXQ6916, CCTA x1 mild/x2 moderate stenoses → cath → upgraded to severe lesions → PCI
- **SUMMARY:** No patient missed, several lesions upgraded

CCTA - Clinical Decision making

Christchurch Experience 2007-2012

- CCTA normal/mild disease → stop
- CCTA multivessel/moderate disease → Stress Test (MRI)
- CCTA severe → Cardiac catheter planned revascularisation (stent v CABG)



"Negative" CCTA - Prognosis

- "negative CCTA" = absent or "non-significant" CAD
- long term data accumulating - follow-up > 5 years available
- consistent results
- negative CCTA NPV 96-100% (< 5yrs)
- negative CCTA confidently rules out significant CAD
- negative "non-obstructive" CCTA predicts very low rate of major CVD events over the longer term (5yrs)

Cardiac Catheter

- long term data
- cardiac catheter normality rate **~ 30%**
- cardiac catheter complication rate

  diagnostic **1.5%**,

  therapeutic **9%**

  stroke **0.4%**
- cardiac catheter false negative rate ? 2.5%

  Christchurch Hospital validation study

The world was going down the tubes.
They needed a scapegoat. They found Wayne.

"Negative" CCTA

Non steno-occlusive causes for ischemia

- coronary anomalies (interarterial)
- coronary AV fistula
- coronary aneurysm
- hypertrophic cardiomyopathy
- pericardial disease
- chest disease - PE, bronchiectasis, lung malignancy

Figure 1

Figure 2

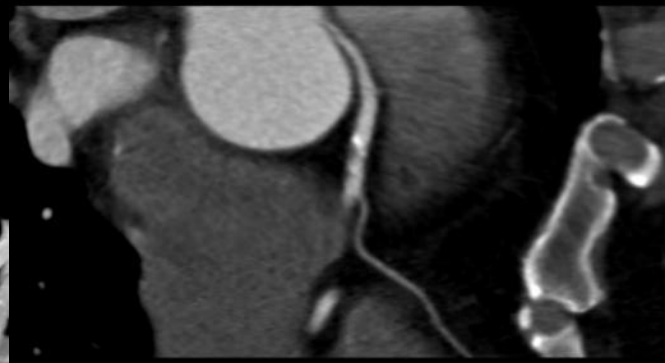


Figure 3

Case 4: Syncope.

History: 53yr old male with CP, near-syncope on exercise ECG with ST changes.

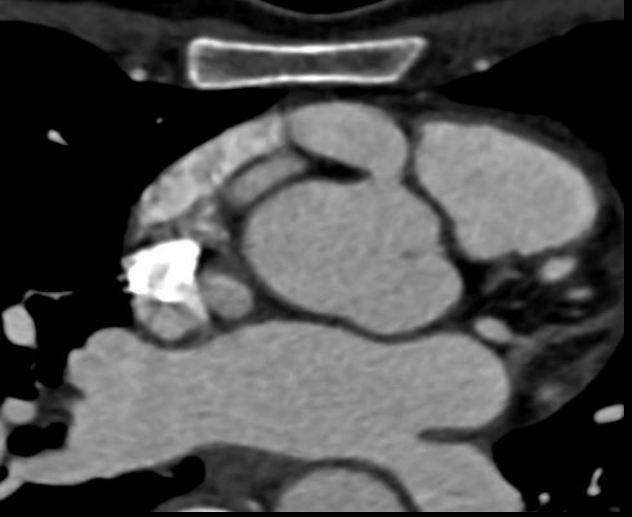


Figure 1

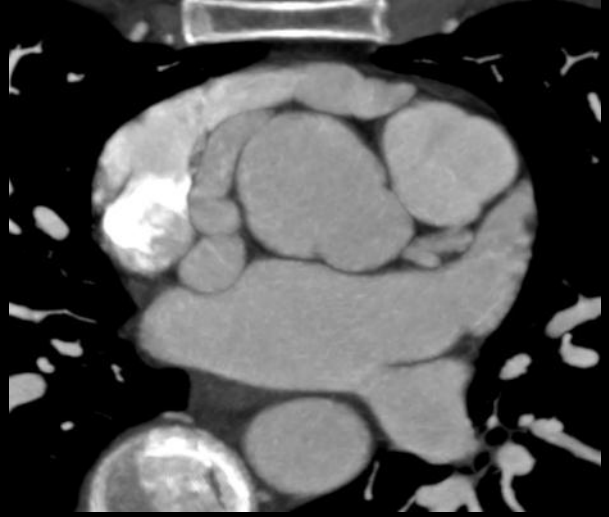


Figure 2

Figure 3

Case 5: Syncope.

History: 53yr old male with chest pain, near-syncope on exercise ECG with ST changes.

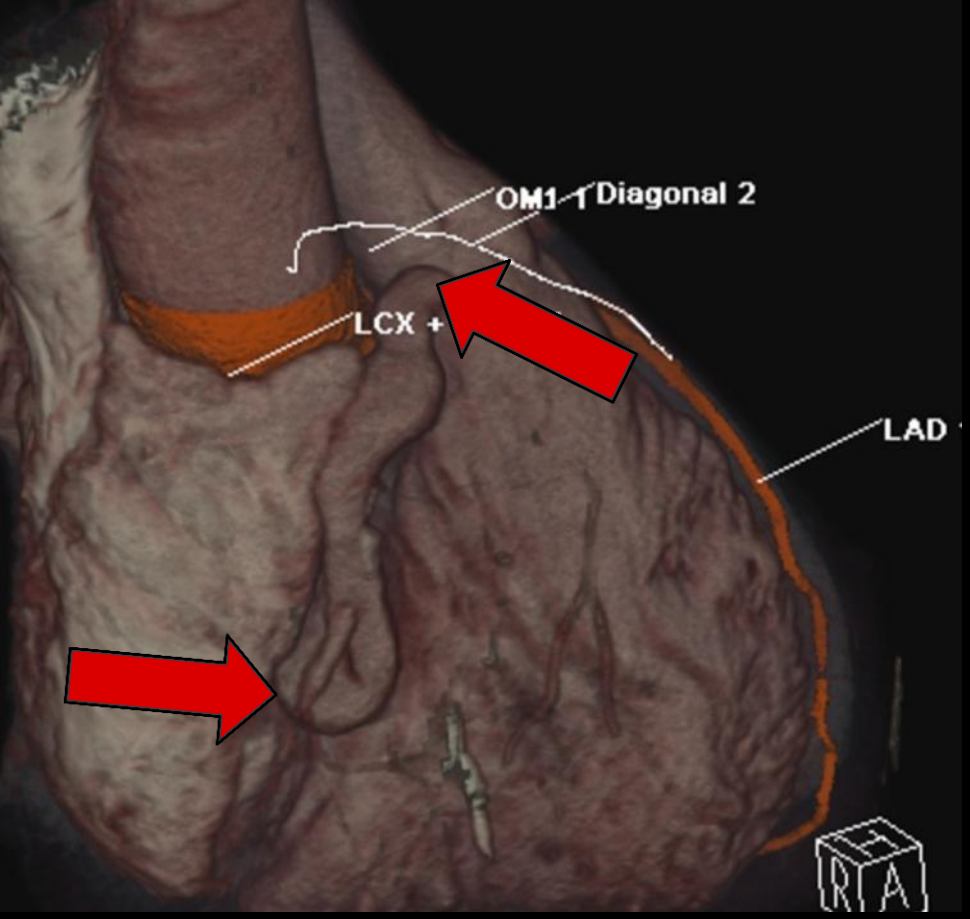


Figure 4

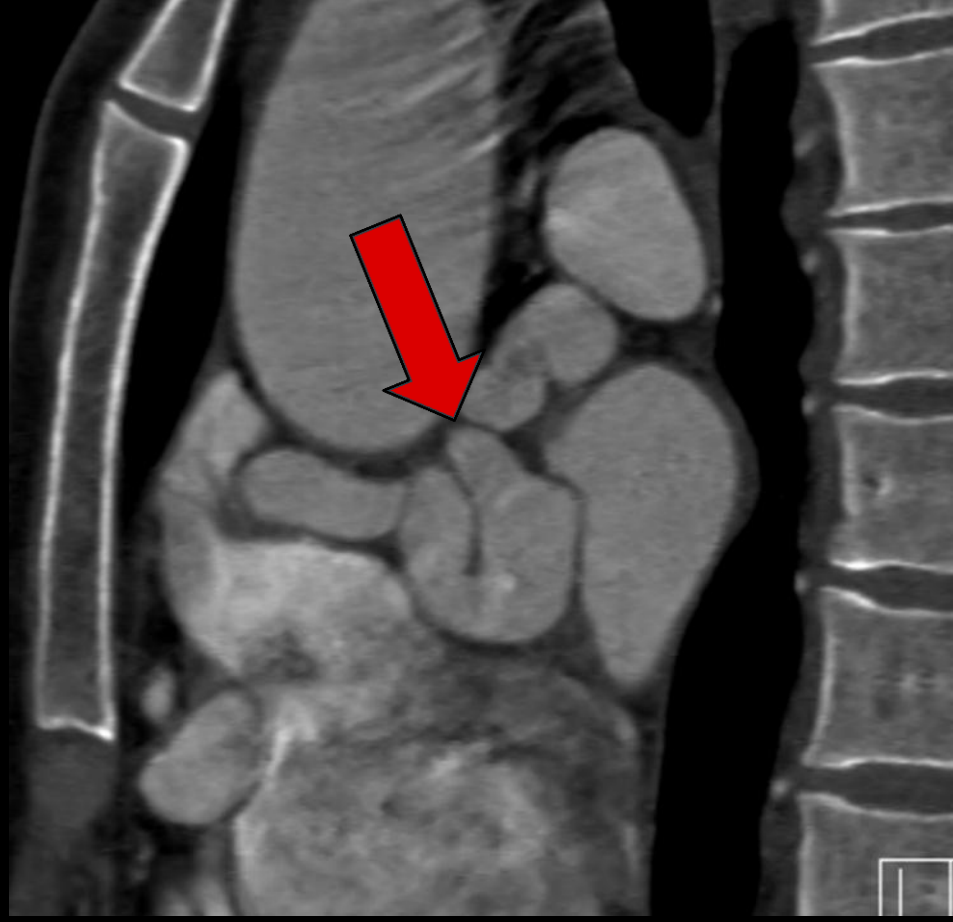


Figure 5

CMRI

Cardiac MRI

"And this one is for going into an MRI machine -- alone."

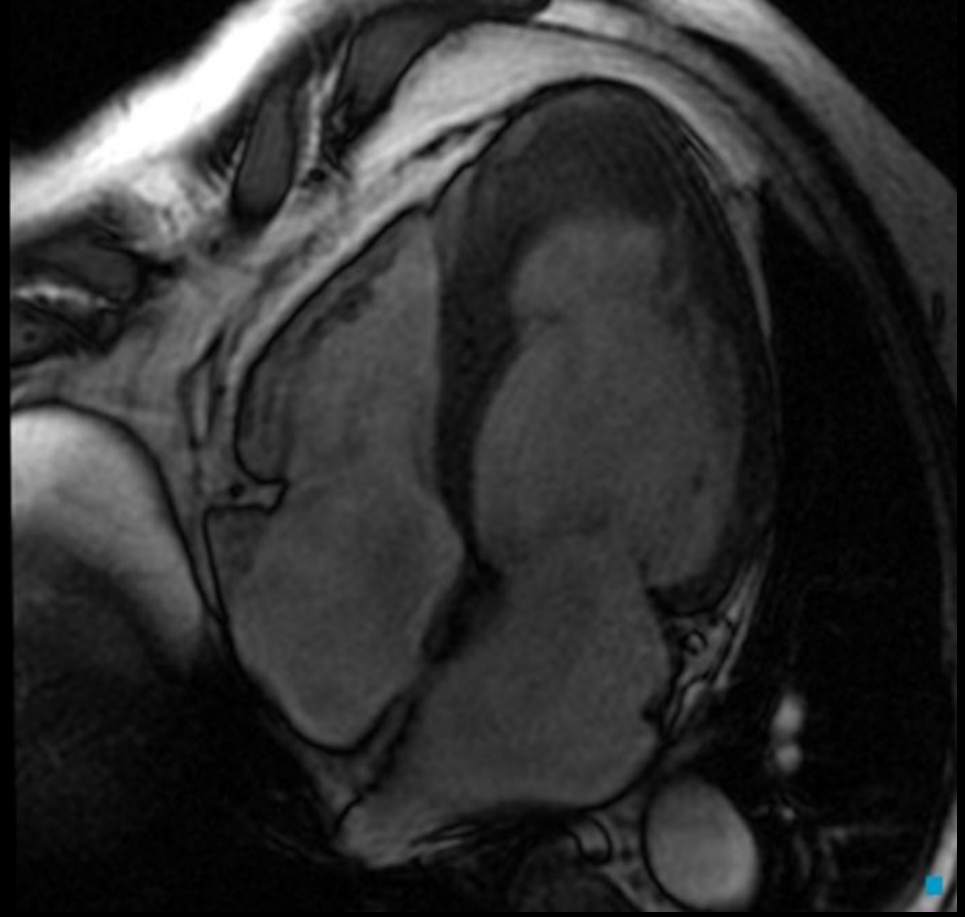


Figure 1 (Fiesta)

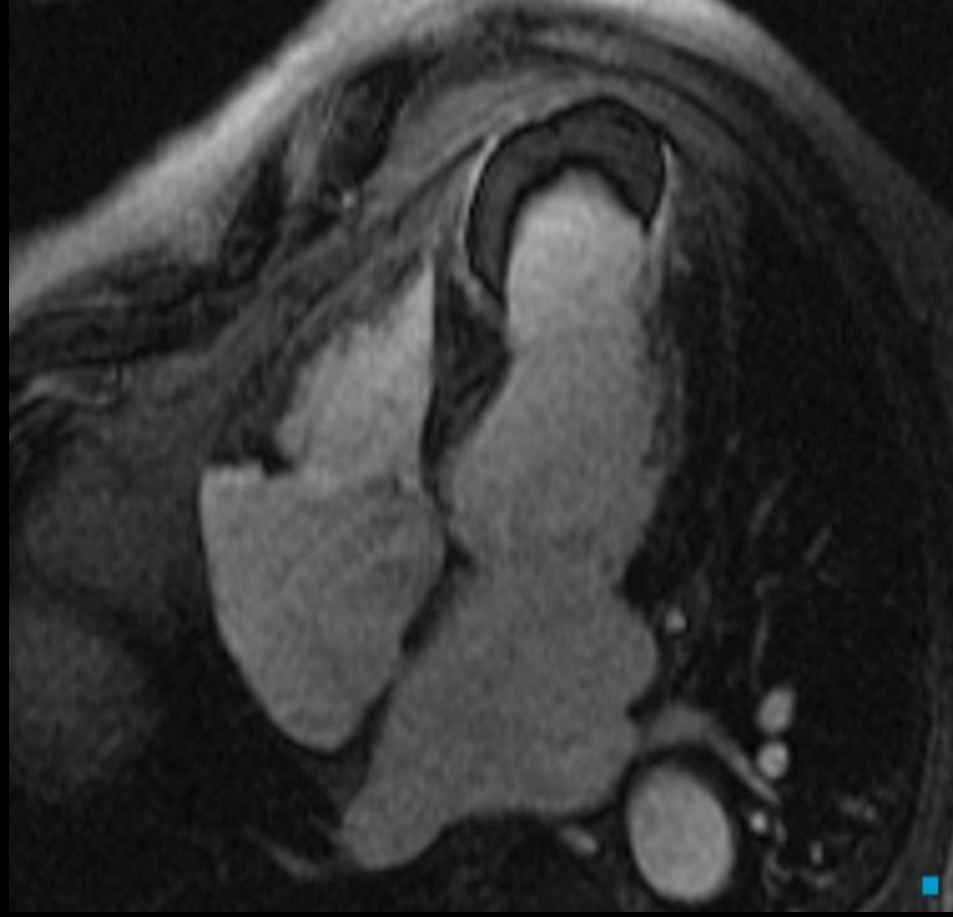


Figure 2 (MDE)

Case 1: Recurrent stroke

History: 74yr old male, recurrent CVA, echo LV dilatation and apical akinesis with normal carotid Doppler.

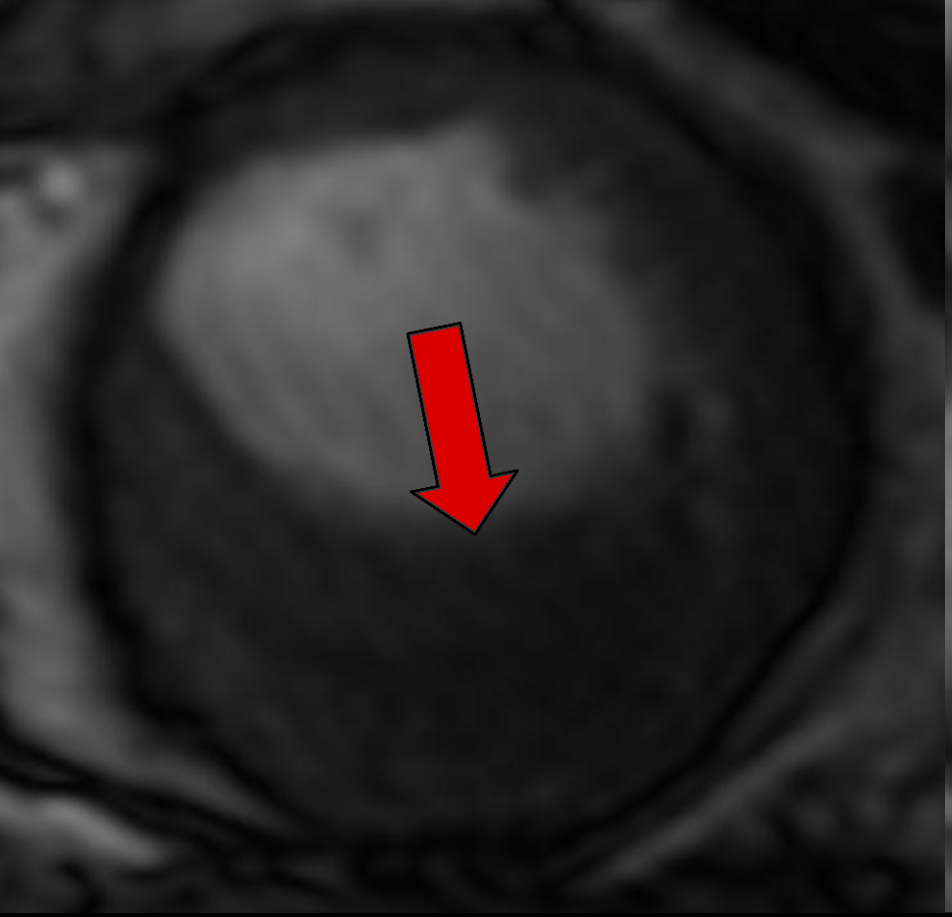


Figure 3 (Fiesta)

Figure 4 (MDE)

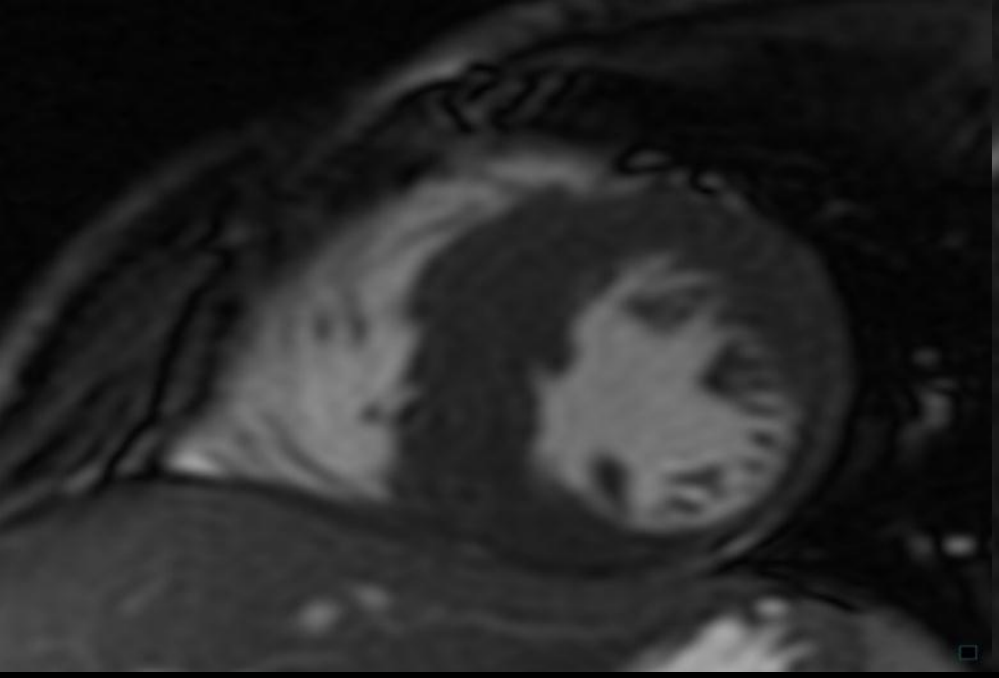


Figure 1 (Fiesta)

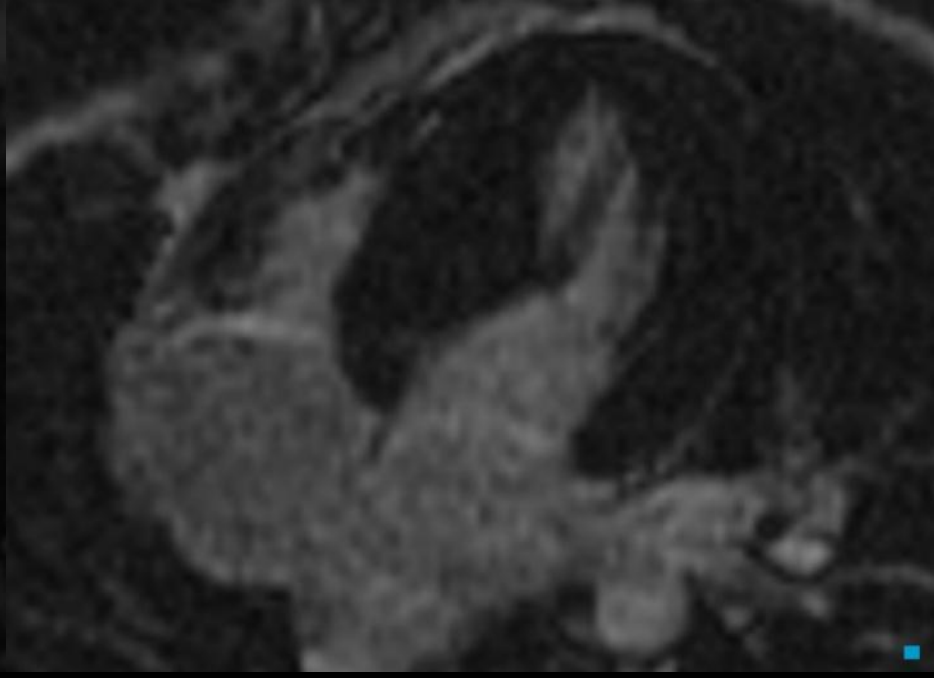


Figure 2 (MDE)

Case 2: Exercise induced syncope.

History: 6yr old female with exercise induced chest pain.

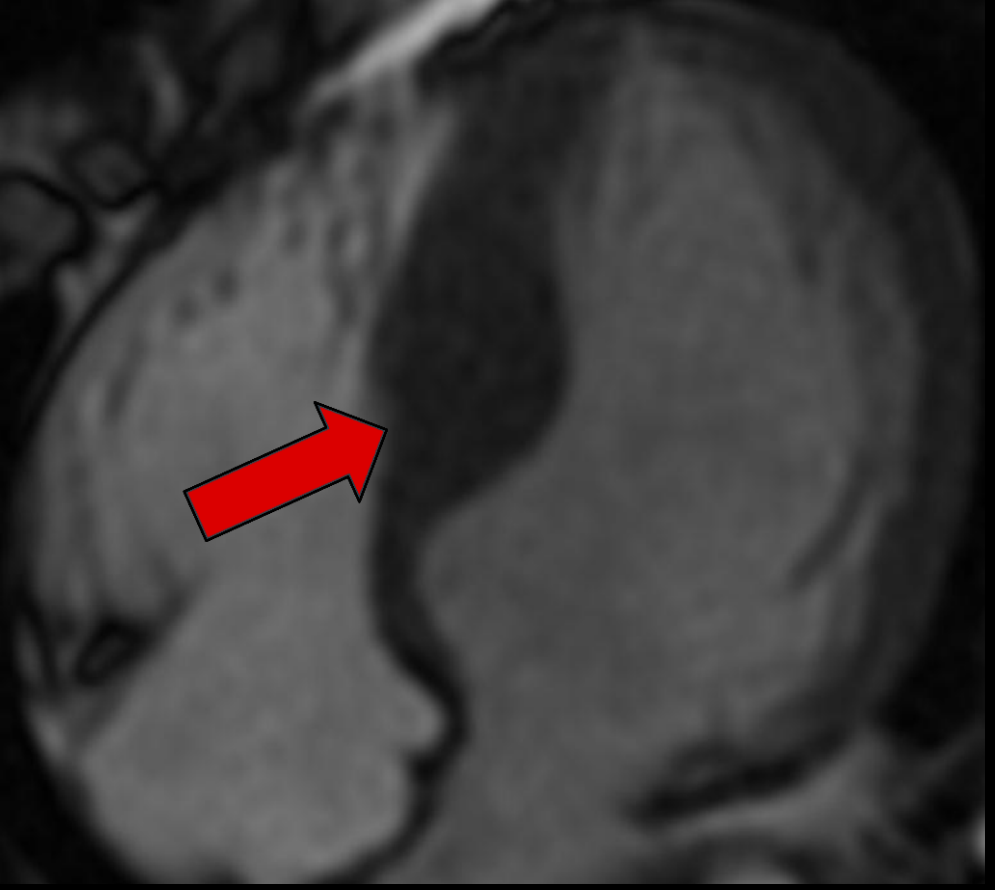


Figure 3 (Fiesta)

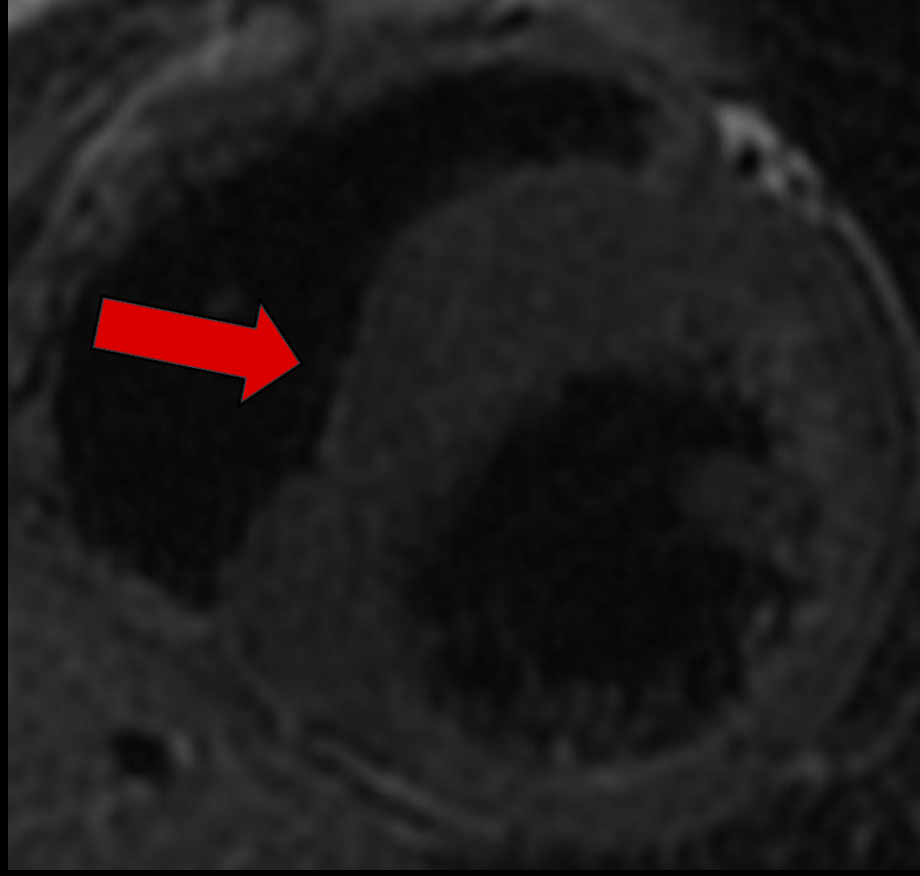


Figure 4 (T2 DIR)

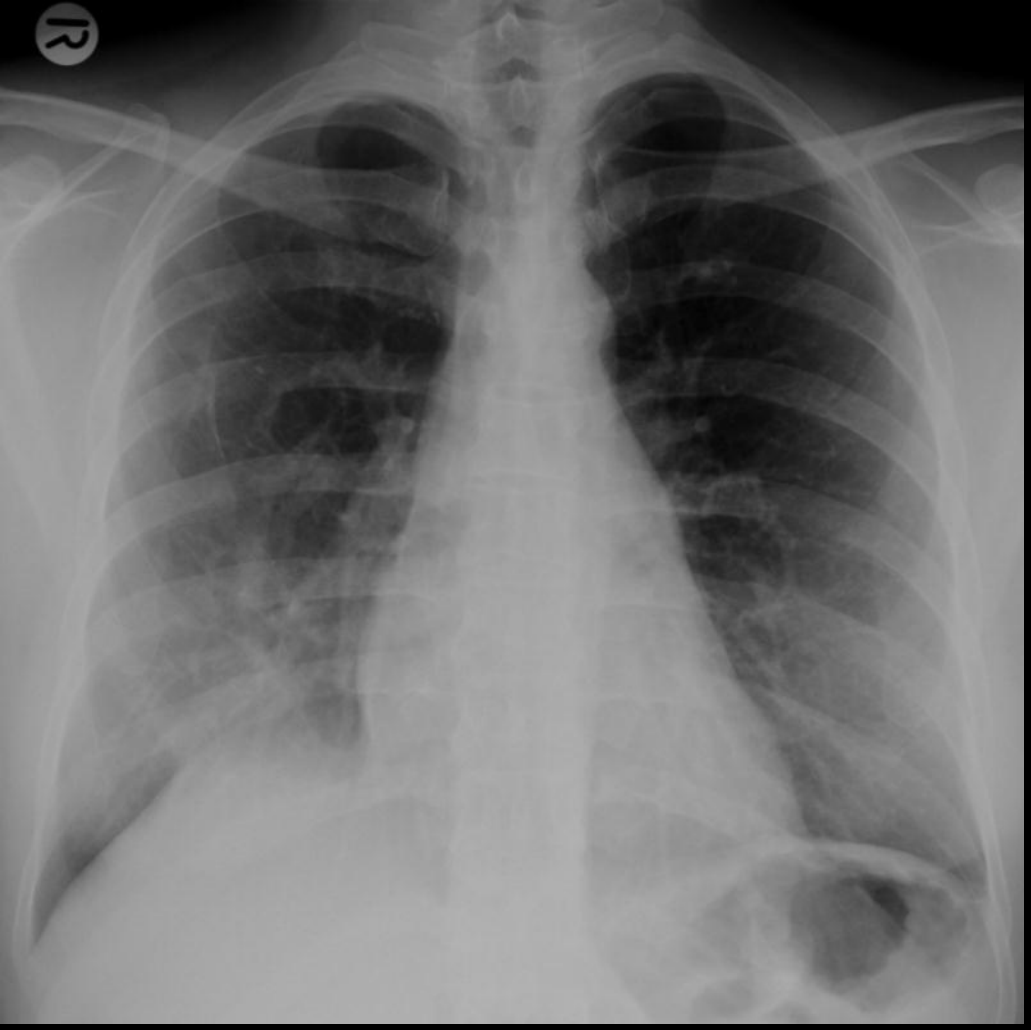


Figure 4

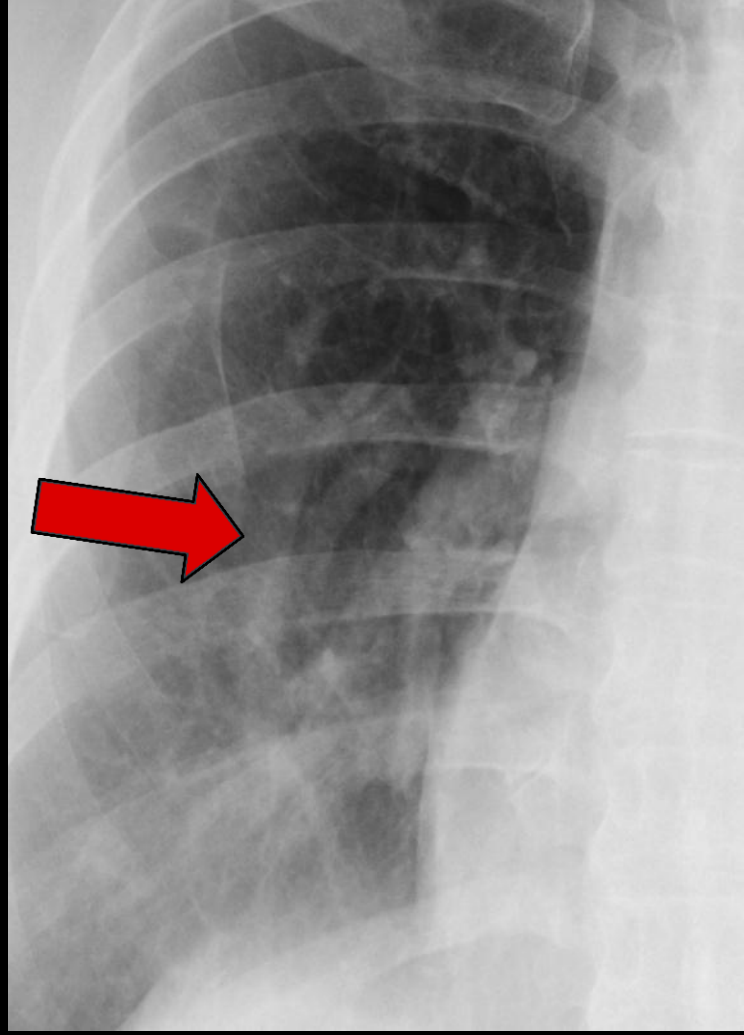


Figure 5

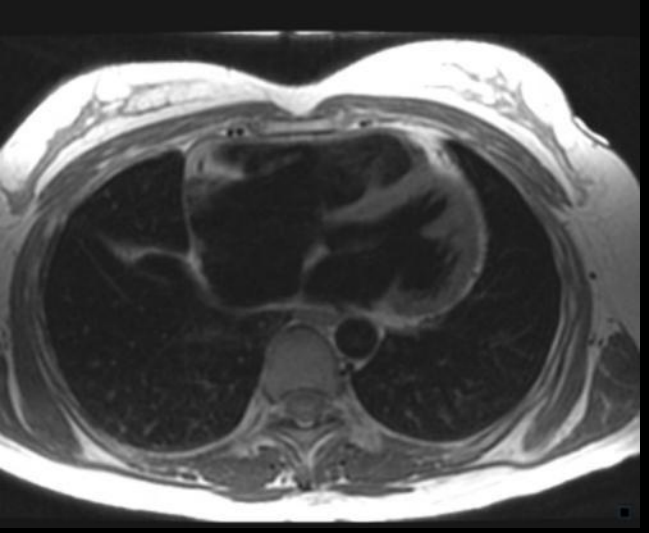


Figure 1

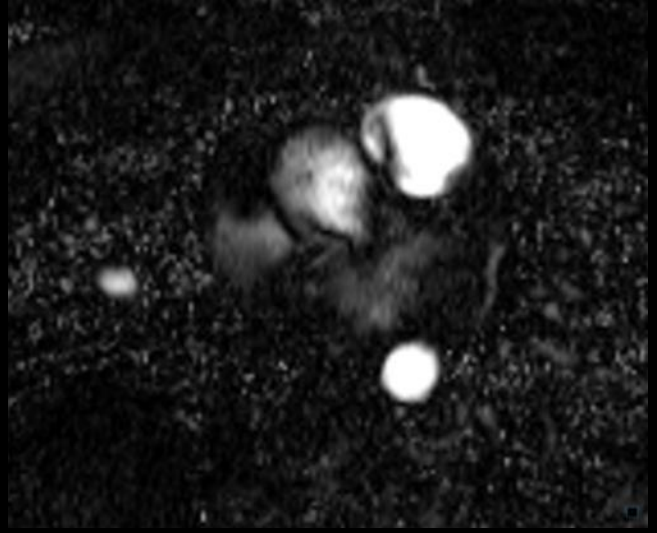


Figure 2

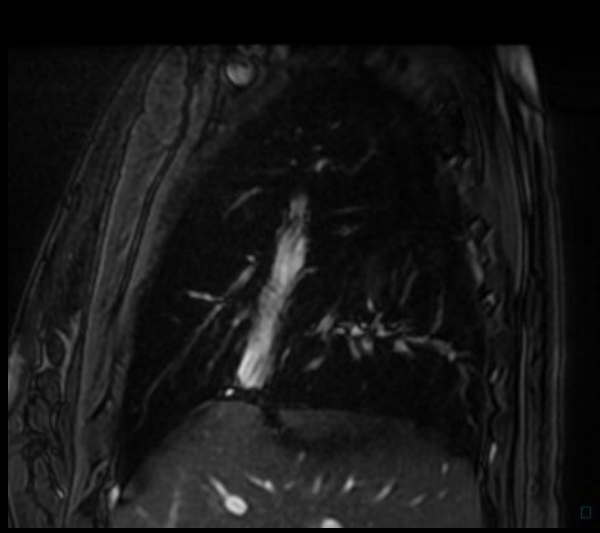


Figure 3

Case 3: Breathlessness and abnormal CXR.

History: 38yr female with RV dilated on echocardiography.

Figure 4

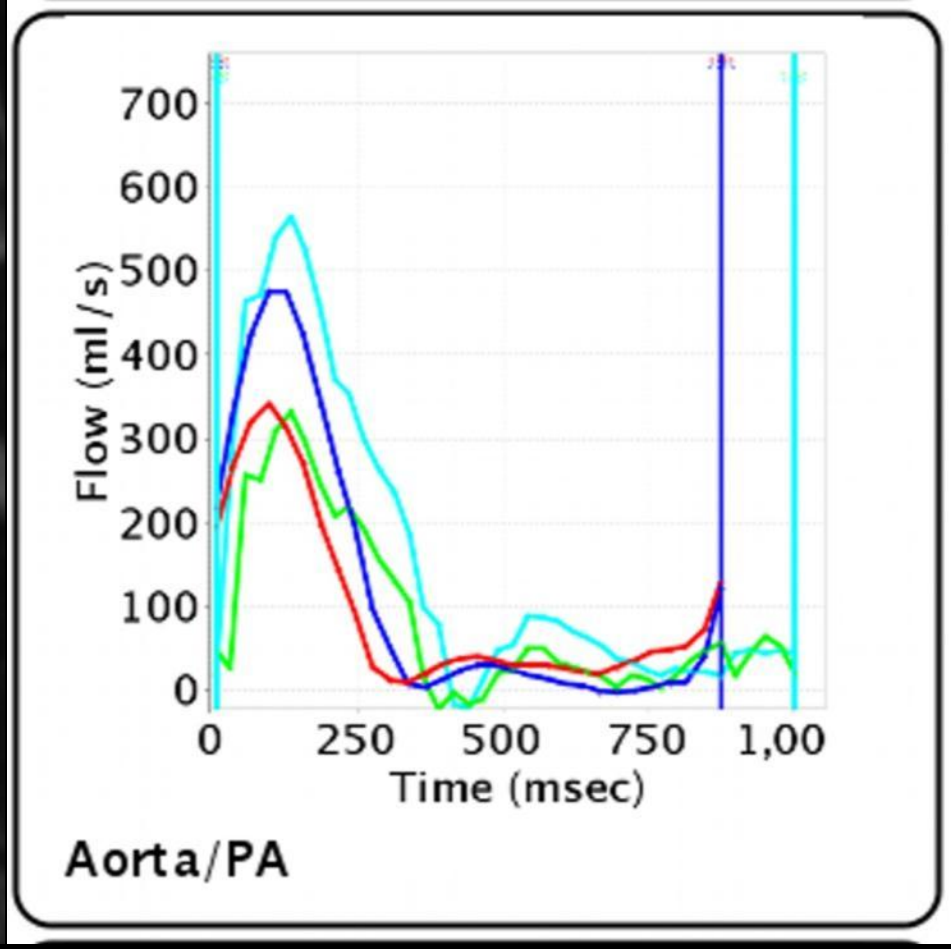
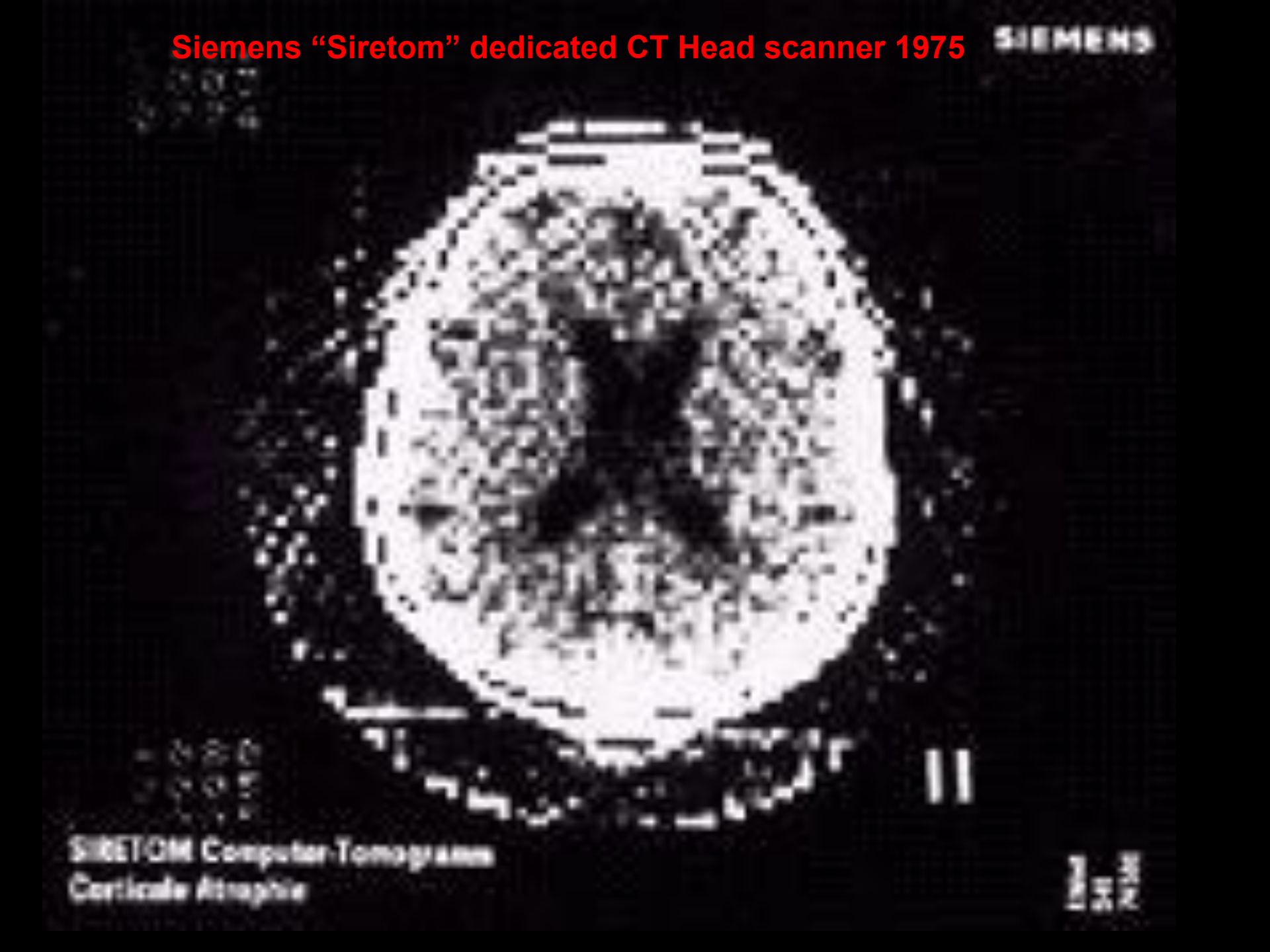


Figure 5

Aorta – red, MPA – blue
LV SV = 108cc
RV SV = 143cc
Qp:Qs = 1.8 : 1.0

Siemens “Siretom” dedicated CT Head scanner 1975



'5' learning points

- CT dose = low and decreasing to sub 1mSv
- CACS = CVD risk stratification adjuvant
- CCTA = coronary stenosis imaging
- cardiac MRI = LV function, myocardial, valvular disease
- **ROUTINE!**

"Mr. Osborne, may I be excused? My brain is full."