

Coronary CT- Who and How?

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Presenter Disclosure



Faculty: Dominique DaBreo and Raveen S. Pal

Relationships with commercial interests:

- Grants/Research Support: None
- Speakers Bureau/Honoraria: None
- Consulting Fees: None
- Other: None

Potential for conflict(s) of interest:

- None

Mitigation of Potential Bias:

- N/A

Objectives



Who

- Patient selection and clinical indications Coronary Artery Computed Tomography Angiography (CCTA)

How

- Order CCTA at KHSC
- Patient preparation, safety, dose reductions and techniques for CCTA

Coronary CT- Who?

Raveen Pal MD FRCPC

Department of Cardiology

Case 1



- 49 year old male referred from the ED for prolonged episode of chest pain
- Pain is left sided and radiates to left arm.
- On and off for 9 hours. Not associated with exertion, but patient is mostly sedentary, with sedentary occupation as a computer programmer. No NTG at home.
- No prior cardiac history.
- Cardiac risk factors include:
 - Hypertension
 - 40 PY Smoking history (2 ppd)
 - No Diabetes, No Dyslipidemia, No Family Hx of Premature CAD

Physical Exam

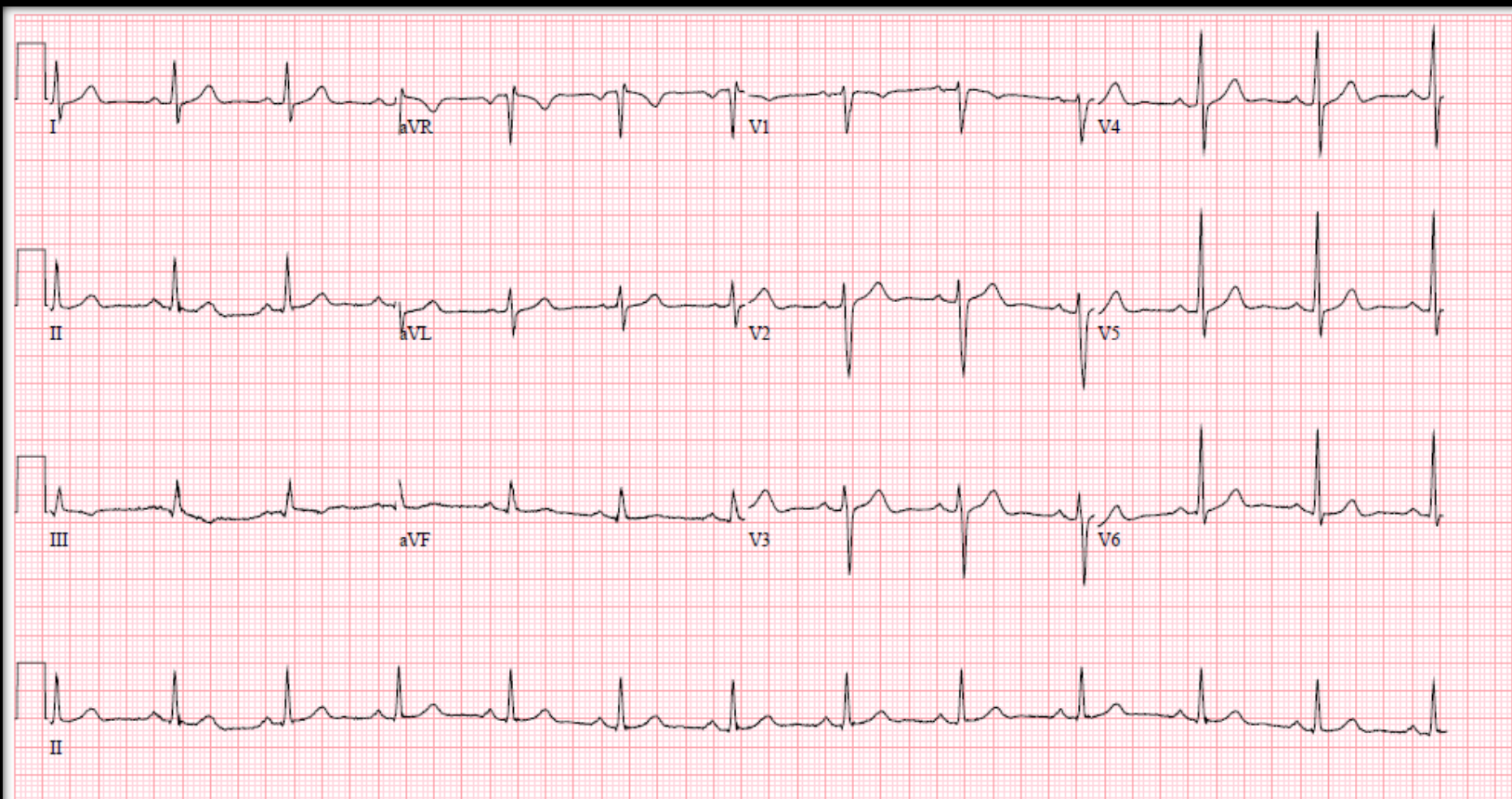


- HR 75 bpm regular
- BP 155-115 Right arm 160/110 Left arm
- CV: S1, S2, no S3 or S4, No murmurs
- Resp: Clear a/e bilaterally

ECG



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25mm/s 10mm/mV 150Hz 9.0.7 12SL 241 CID: 825

SID: 3609513373TK EID:160 EDT: 17:51 15-JAN-2019 ORDER:

ACCOUNT: 1181051909

Page 1 of 1

Blood work

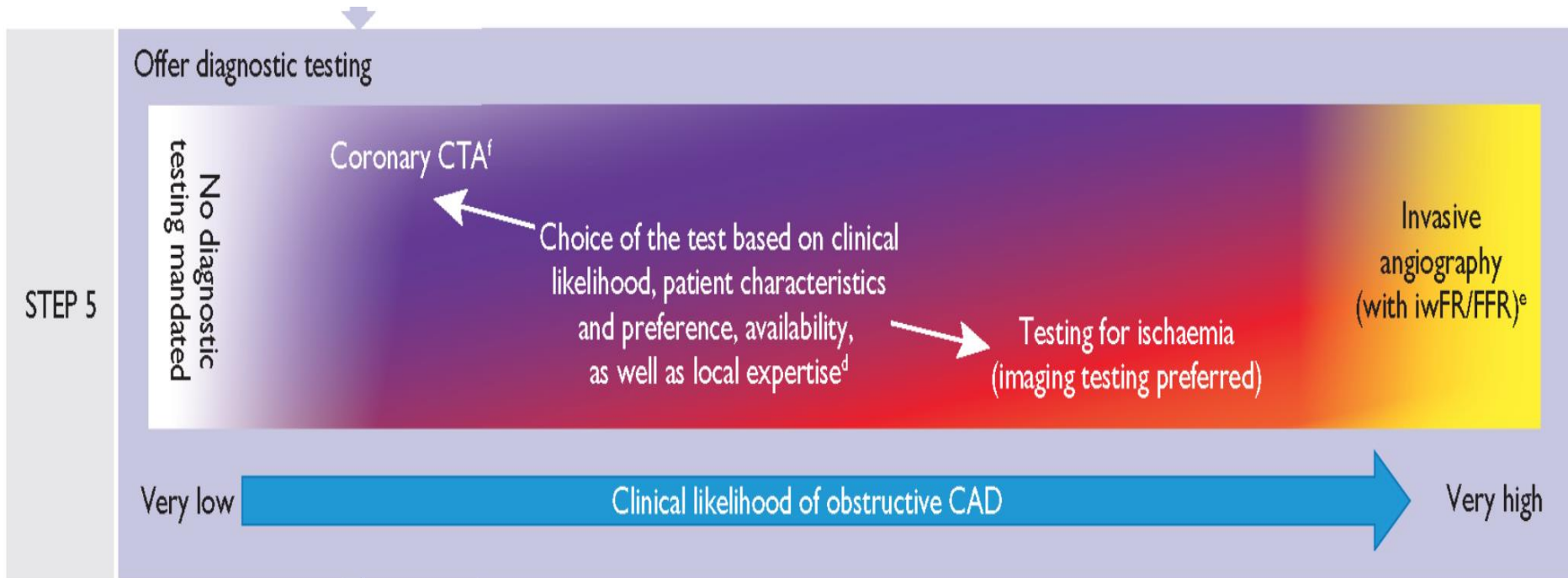


- WBC 6.2, Hb 163, Plt 287
- Na 140, K 4.2, Cl 102
- Glucose 5.2
- Creatinine 101, GFR 75
- CK 148
- Troponin 0.3 at 15:05
- Troponin < 0.1 at 17:59

Is this a good patient for a CTA?

Started on Amlodipine for BP, given BB dose x 2 for test

Coronary CTA Indications



Use of diagnostic imaging tests in the initial diagnostic management of symptomatic patients with suspected CAD

Non-invasive functional imaging for myocardial ischaemia or coronary CTA is recommended as the initial test for diagnosing CAD in symptomatic patients in whom obstructive CAD cannot be excluded by clinical assessment alone.

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Coronary CTA Indications

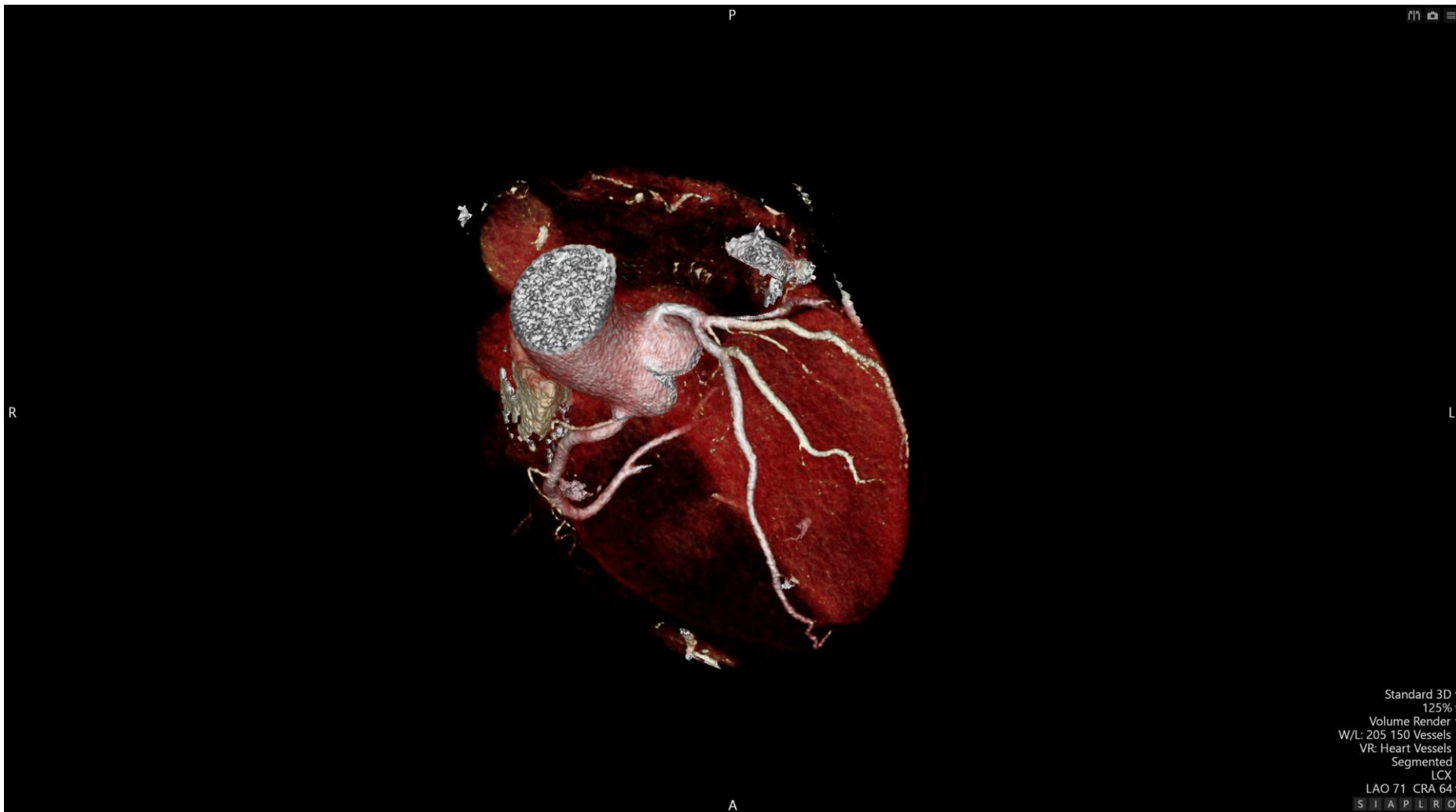


- Low or intermediate risk patients with CP
 - Age less than 65
 - Less than 2 risk factors
 - Family history of CAD
- Atypical CP
- Indeterminate stress testing
- Ongoing CP despite normal stress test

Patient Selection: who Not to consider



- Atrial fibrillation
- Frequent PACs or PVCs
- Patient unable to tolerate BB or CCB to get HR < 65
- Patient with renal dysfunction, GFR < 30
- Contrast allergy
- BMI > 40 kg/m²



03 Apr 2019
10:27:35

CT
CARDIAC
HALF 75% 1.18s Cardiac 0.5 CE CTA/HALF CTA FC04



R

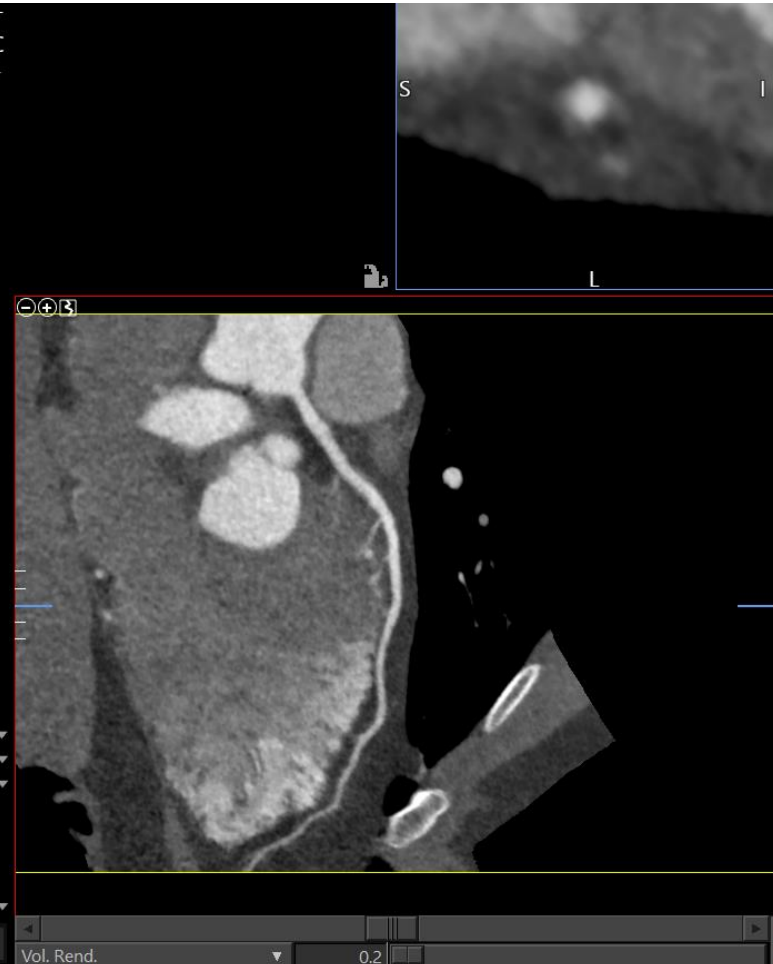
L

A

kVP:120
mA:410
msec:350
mAs:91
Krn:FC04
Thk:0.5 mm
Aquilion ONE
Phase %075

Standard 3D ▾
125% ▾
Volume Render ▾
W/L: 205 150 Vessels
VR: Heart Vessels
Segmented
LAD
LAO 50 CRA 62 ▾

S I A P L R O



Vol. Rend.

0.2



Agatston Score: The total calcium score is 1.

This observed calcium score of 1 is between the 25th and 50th percentile for subjects of the same age, gender and race/ethnicity for subjects who are free of clinical cardiovascular disease.

Impression:

Minimal calcified atherosclerotic plaque with no evidence of coronary artery stenosis.

Coronary CT- How?

Dominique DaBreo MD FRCPC

Department of Radiology

Division Cardiothoracic Radiology

Case 1



- 52 yo F
- Low ASCVD risk (<5%)
- Mild hypertension, dyslipidemia
- + Family history premature CAD
- **Asymptomatic**

How to Order Calcium Score



KG+ KINGSTON GENERAL HOSPITAL
 Religious Hospitaliers of Saint Joseph of the Hotel Dieu of Kingston HOTEL DIEU HOSPITAL
 Fax: 613-548-2427 Fax: 613-544-6505
 Tel: 613-548-2301 Tel: 613-544-3400 ext. 3020
www.kgh.on.ca www.hoteldieu.com

CT REQUISITION

INPATIENT Service: _____
 Floor: _____ Room # _____ ER: _____
 Stretcher Wheelchair Walk O2

OUTPATIENT
 Clinic CCSEO ER/UCC Other _____
 Isolation: No Yes/Type _____
 Consultation only: Research:
 Department of Veterans Affairs ID # _____
 WSIB #: _____ Injury Date: _____

CR#: _____ Female Male
 Surname: _____
 First Name: _____
 Date of Birth: _____
 Address 1: _____
 Address 2: _____
 Phone # (H) _____ (W) _____
 Health Card #: _____

INCOMPLETE or ILLEGIBLE requisitions will be returned and may DELAY Study

CT EXAMINATION REQUESTED: CT Coronary Calcium score
 Clinical Information: _____
 Reason for scan: Diagnosis Surgical Planning Oncologic Staging Dx Follow Up
 Previous related Imaging: No Yes, if yes - where _____

CAUTION: RISKS FOR CONTRAST INDUCED NEPHROPATHY
 Blood work is required & must be available at time of appointment for patients with ANY of the following:

Yes	If yes, explain	Yes
<input type="checkbox"/>	Known Renal Dysfunction	<input type="checkbox"/>
<input type="checkbox"/>	Diabetes Mellitus	<input type="checkbox"/>
<input type="checkbox"/>	Age greater than 70 Yrs	<input type="checkbox"/>
<input type="checkbox"/>	Previous Chemotherapy	<input type="checkbox"/>
<input type="checkbox"/>	Organ Transplant	<input type="checkbox"/>
<input type="checkbox"/>	Cardiovascular Disease (Hypertension, CHF, CAD, PVD)	<input type="checkbox"/>
<input type="checkbox"/>	Nephrotoxic Drugs-Loop Diuretics, NSAIDS, Vancomycin, Aminoglycosides, etc.	<input type="checkbox"/>
<input type="checkbox"/>	On Metformin?	<input type="checkbox"/>
<input type="checkbox"/>	Volume Contraction, Dehydration	<input type="checkbox"/>
<input type="checkbox"/>	Solitary Kidney	<input type="checkbox"/>
<input type="checkbox"/>	Sepsis, Acute Hypotension	<input type="checkbox"/>

Adverse Reaction to contrast: No Yes
 If yes, explain _____
 Possibility of Pregnancy? No Yes
 Is patient able to give informed consent? No Yes
 If No, please provide written consent _____

 Ordering Physician Signature

PATIENT DOES NOT HAVE ANY ABOVE RISK FACTORS

Creatinine: _____ (µ mol/L) eGFR: _____ (mL/minute)
 Date Drawn: (YYYY/MM/DD) _____

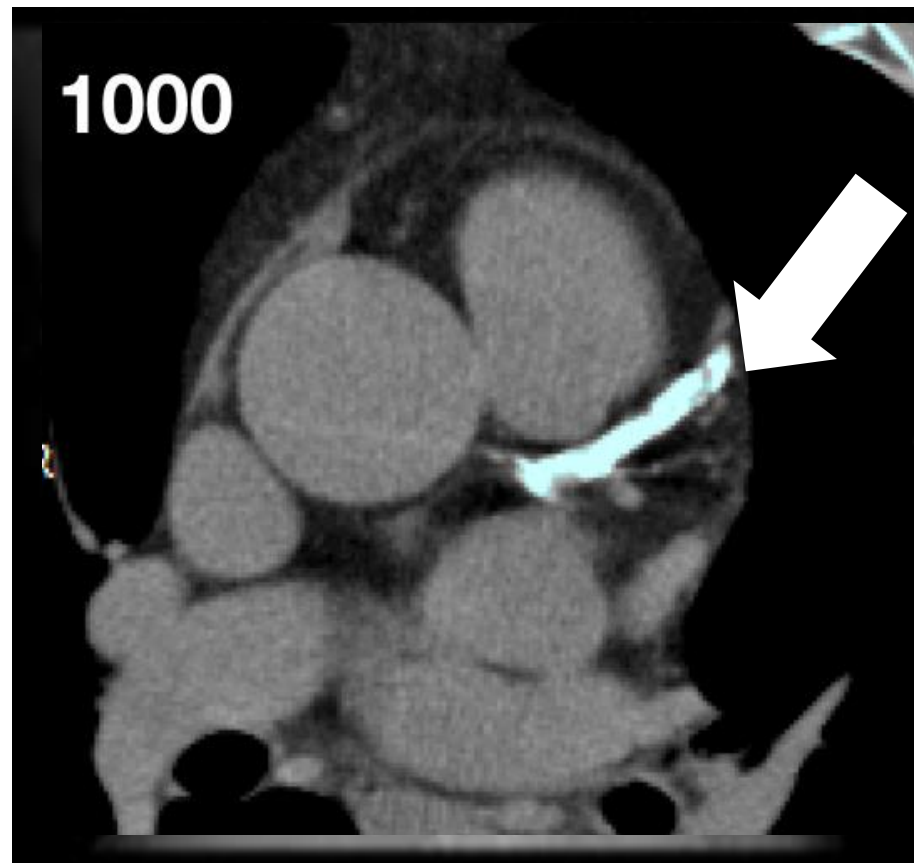
- Outpatients require bloodwork within 60 days of examination date. Inpatients within 7 days or sooner.
- Metformin should be held following IV contrast administration and serum creatinine repeated between 48 and 72 hours after CT and verified before restarting.

Name & First Initial: _____
 Phone/ Pager: _____
 Attending Physician: _____
 Copy Report to: _____ (Name and first Initial)
 Date Requisition Completed: _____ (YYYY/MM/DD)

**Non contrast CT
 No bloodwork!
 No IV!**

Calcium Score CT Protocol

- 3 lead ECG for gating
- Single breath hold CT acquisition
- Quantify Ca^{2+} plaque



Calcium Score Radiation Dose

- CACS 0.5 - 1.0 mSv
- Chest Radiograph 0.1 mSv
- CT thorax 5.0 mSv

- Background radiation 3.0 mSv/year
- Flight YYZ to YVR 0.03 mSv

KHSC Cardiac CT



- Wednesday AM 8:00 to 11:00 am
- Hotel Dieu Hospital
- 6 outpatients
- Current wait time 4 - 6 weeks

Case 1

Calcium Score Reporting



- Calcium score 300
- MESA 99 % for age, gender and ethnicity
- Reclassify risk 10 year risk of CHD event from 4% to 12%

MESA 10-Year CHD Risk with Coronary Artery Calcification [Back to CAC Tools](#)

1. Gender	Male <input type="radio"/>	Female <input checked="" type="radio"/>			
2. Age (45-85 years)	<input type="text" value="50"/>	Years			
3. Coronary Artery Calcification	<input type="text" value="300"/>	Agatston			
4. Race/Ethnicity	Choose One				
	Caucasian	<input checked="" type="radio"/>			
	Chinese	<input type="radio"/>			
	African American	<input type="radio"/>			
	Hispanic	<input type="radio"/>			
5. Diabetes	Yes <input type="radio"/>	No <input checked="" type="radio"/>			
6. Currently Smoke	Yes <input checked="" type="radio"/>	No <input type="radio"/>			
7. Family History of Heart Attack <small>(History in parents, siblings, or children)</small>	Yes <input checked="" type="radio"/>	No <input type="radio"/>			
8. Total Cholesterol	<input type="text" value="200"/>	mg/dL	or	<input type="text" value="5.2"/>	mmol/L
9. HDL Cholesterol	<input type="text" value="50"/>	mg/dL	or	<input type="text" value="1.3"/>	mmol/L
10. Systolic Blood Pressure	<input type="text" value="139"/>	mmHg	or	<input type="text" value="18.5"/>	kPa
11. Lipid Lowering Medication	Yes <input type="radio"/>	No <input checked="" type="radio"/>			
12. Hypertension Medication	Yes <input type="radio"/>	No <input checked="" type="radio"/>			

Case 1

Utility Calcium Score



- Adjunct decision making Statin and ASA therapy
- Useful in patients with Statin intolerance
- Improved adherence to therapy

Table 3

CAC score determined risk classifications and treatment recommendations in the 5–20% ASCVD risk group.

Score	Risk	Treatment Recommendation
0	very low	statin not recommended ^a
1–99	mildly Increased	moderate intensity statin if < 75th%; moderate to high intensity if > 75th%
100–299	moderately increased	moderate to high intensity statin + ASA 81mg
>300	moderate to severely increased	high intensity statin + ASA 81mg

^a Excluding familial hypercholesterolemia.

Case 2



- 50 yo F
- Chronic, atypical CP
- Ex-smoker, HTN and dyslipidemia

How to order Coronary CTA



Fax: 613-548-2427 Fax: 613-544-6505
Tel: 613-548-2301 Tel: 613-544-3400 ext. 3020
www.kgh.on.ca www.hoteldieu.com

CT REQUISITION

INPATIENT Service: _____
Floor: _____ Room # _____ ER: _____
 Stretcher Wheelchair Walk O2

OUTPATIENT

Clinic CCSEO ER/UCC Other _____
Isolation: No Yes/Type _____
Consultation only: Research: _____
Department of Veterans Affairs ID # _____
WSIB #: _____ Injury Date: _____

CR#: _____ Female Male

Surname: _____
First Name: _____
Date of Birth: _____
Address 1: _____
Address 2: _____
Phone # (H) _____ (W) _____
Health Card #: _____

INCOMPLETE or ILLEGIBLE requisitions will be returned and may DELAY Study

CT EXAMINATION REQUESTED: _____

Clinical

Information: _____

Reason for scan: Diagnosis Surgical Planning Cancer Staging/Dx Follow Up
Previous related Imaging: No Yes, if yes - where _____

CAUTION: RISKS FOR CONTRAST INDUCED NEPHROPATHY

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Diabetes Mellitus	<input type="checkbox"/>	On Metformin? _____
Age greater than 70 Yrs	<input type="checkbox"/>	Volume Contraction, Dehydration _____
Previous Chemotherapy	<input type="checkbox"/>	Solitary Kidney _____
Organ Transplant	<input type="checkbox"/>	Sepsis, Acute Hypotension _____
Cardiovascular Disease (Hypertension, CHF, CAD, PVD)	<input type="checkbox"/>	_____
Nephrotoxic Drugs-Loop Diuretics, NSAIDS, Vancomycin, Aminoglycosides, etc.	<input type="checkbox"/>	_____

PATIENT DOES NOT HAVE ANY ABOVE RISK FACTORS

Creatinine: _____ (µ mol/L) eGFR: _____ (mL/minute)

Date Drawn: (YYYY/MM/DD) _____

1. Outpatients require bloodwork within 60 days of examination date. Inpatients within 7 days or sooner.

2. Metformin should be held following IV contrast administration and serum creatinine repeated between 48 and 72 hours after CT and verified before restarting.

Adverse Reaction to contrast: No Yes

If yes, explain _____

Possibility of Pregnancy? No Yes

Is patient able to give informed consent? No Yes
If No, please provide written consent _____

Ordering Physician Signature _____

Name & First Initial: _____

Phone/ Pager _____

Attending Physician: _____

Copy Report to: _____
(Name and first Initial)

Date Requisition Completed: _____
(YYYY/MM/DD)

Coronary CTA (CT Angiography) Explained



What:

- CT scan limited to the heart
- Visualizes Coronary Arteries = Invasive coronary angiogram without risk of vascular access, MI or stroke.
- Used to rule out Coronary Artery Disease (CAD)

Who:

- Rule Out CAD:
 - Low to intermediate risk patients with chest pain (CP)
 - Eg. 65 y.o. with < 2 cardiac risk factors
 - CP in someone with a Framingham risk score <50%
 - Atypical CP
 - Indeterminate Stress test
 - Ongoing CP despite normal stress test
- Evaluation of cardiac structure and function – if poor imaging by echo

Where:

- **Hotel Dieu Hospital** Department of Radiology CT Scan– Level 0

When:

- Every Wednesday – 0800 AM

How:

- Complete **regular KHSC CT requisition**. Include information on recent GFR
- Need HR less than 60 bpm (***Please prescribe Metoprolol 50 mg, one pm before test, Metoprolol 50 mg one am of test.***)

Upside:

- Very high negative predictive value (99%) – RULES OUT CAD if normal

Downsides:

- Radiation (though less than nuclear stress study – currently approx. 3-5 mSv)
- Contrast – renal function cannot be less than GFR of 30

Ordering physician



- HR < 65 and sinus
- SBP > 90
- **Prescribe Metoprolol 50 mg PO night before and 50 mg PO 1 hr morning of CT**

Unless :

- C/I to Beta Blocker
- Currently on rate control meds
- Resting HR < 65 bpm

CT Cardiac Imaging Patient Information Sheet

Your physician should have arranged for you to have an oral medication called Metoprolol (unless contraindicated) to control your heart rate for the exam. Take this medicine as advised by your physician.

The drugs you receive prior to the CT may cause a short term lowering of blood pressure or headache.

You should not drive after the study- please arrange for a driver or use public transport or taxi

- Have nothing to eat 2 hours prior to your appointment.
- No caffeine or other stimulants 12 hours prior to your scan.
- Continue to take your regular medications the day of the appointment

If you are taking erectile dysfunction medications, such as Viagra or Cialis, please stop these meds at least 48 hrs. prior to the appointment.

~~Please~~ bring a list of current medications the day of your appointment.

Diabetic Patients: For this fasting exam, to maintain your sugar levels you are allowed clear fruit juices up to an hour prior to your appointment.

Dialysis Patients: If you are on chronic dialysis with fluid intake restrictions, do not follow the drinking instructions outlined above

Wear comfortable clothing- no zippers, jewelry or metallic objects in the area to be scanned

Hotel Dieu Hospital is a scent free facility. Do not wear perfume, cologne or any scented products

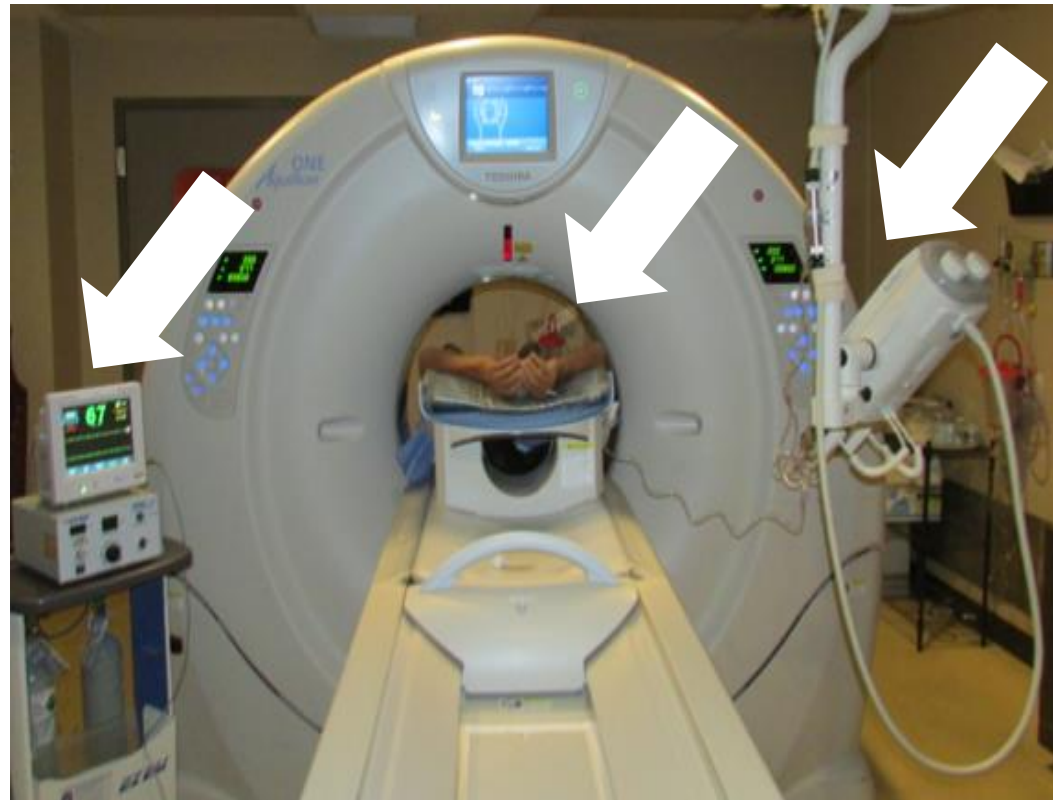
Patient Preparation



- Take regular and rate control meds
- No phosphodiesterase inhibitors(48 hrs)
 - Erectile dysfunction and pulmonary hypertension

CT Acquisition

- HR and BP monitor
- IV access for contrast
- IV Beta Blocker PRN
- Nitro S/L 0.4 mg
- **Time to acquire CT 1 heart beat**

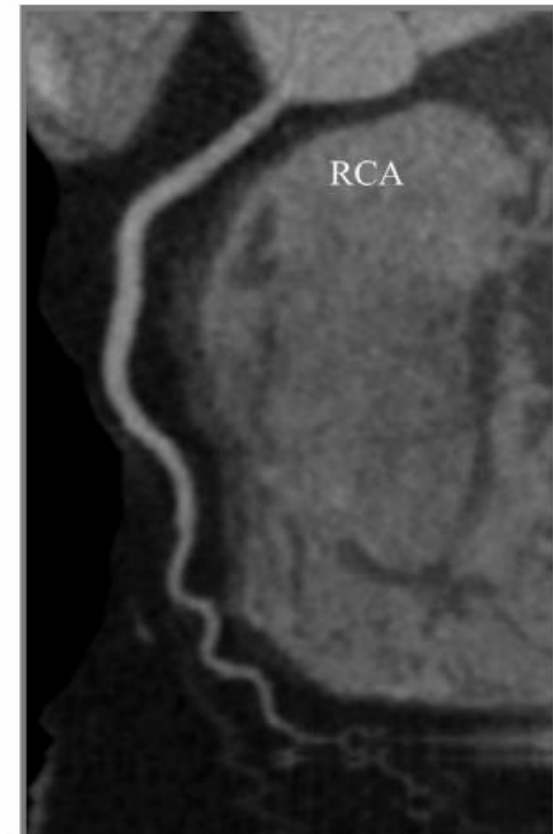
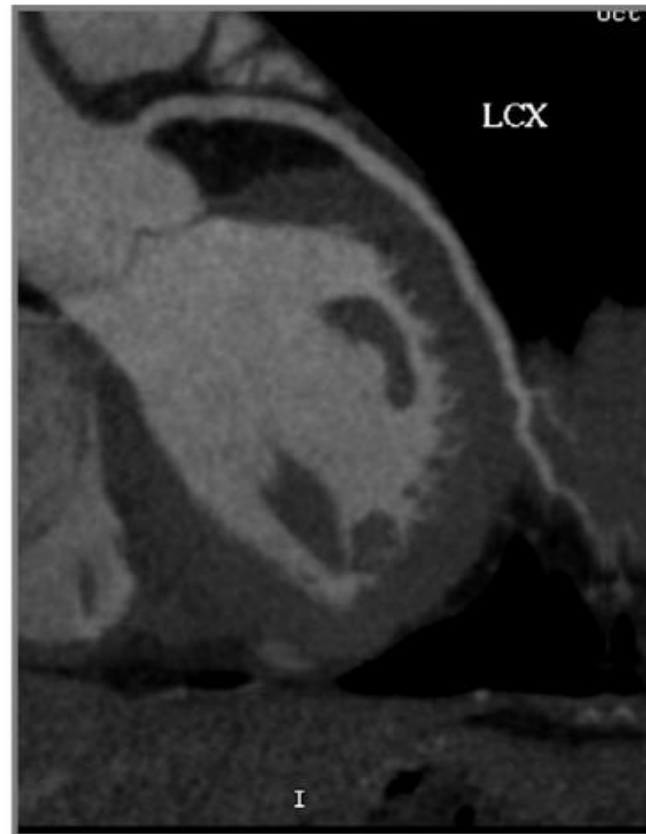


CCTA Dose



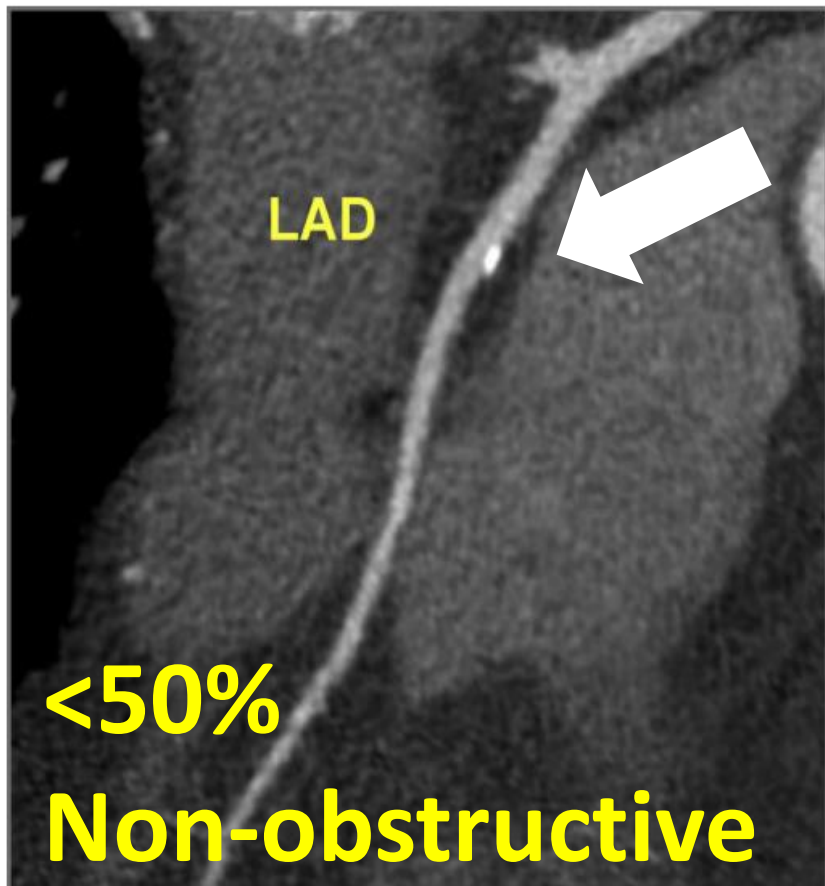
- **CCTA 2-5 mSv** (Historically 12 mSv)
- Stress MIBI 10 mSv
- Cath 5 – 20 mSv
- ECHO 0 mSv
- MRI 0 mSv

Coronary Stenosis Reporting



Normal

Coronary Stenosis Reporting



Stenosis Minimal < 25%

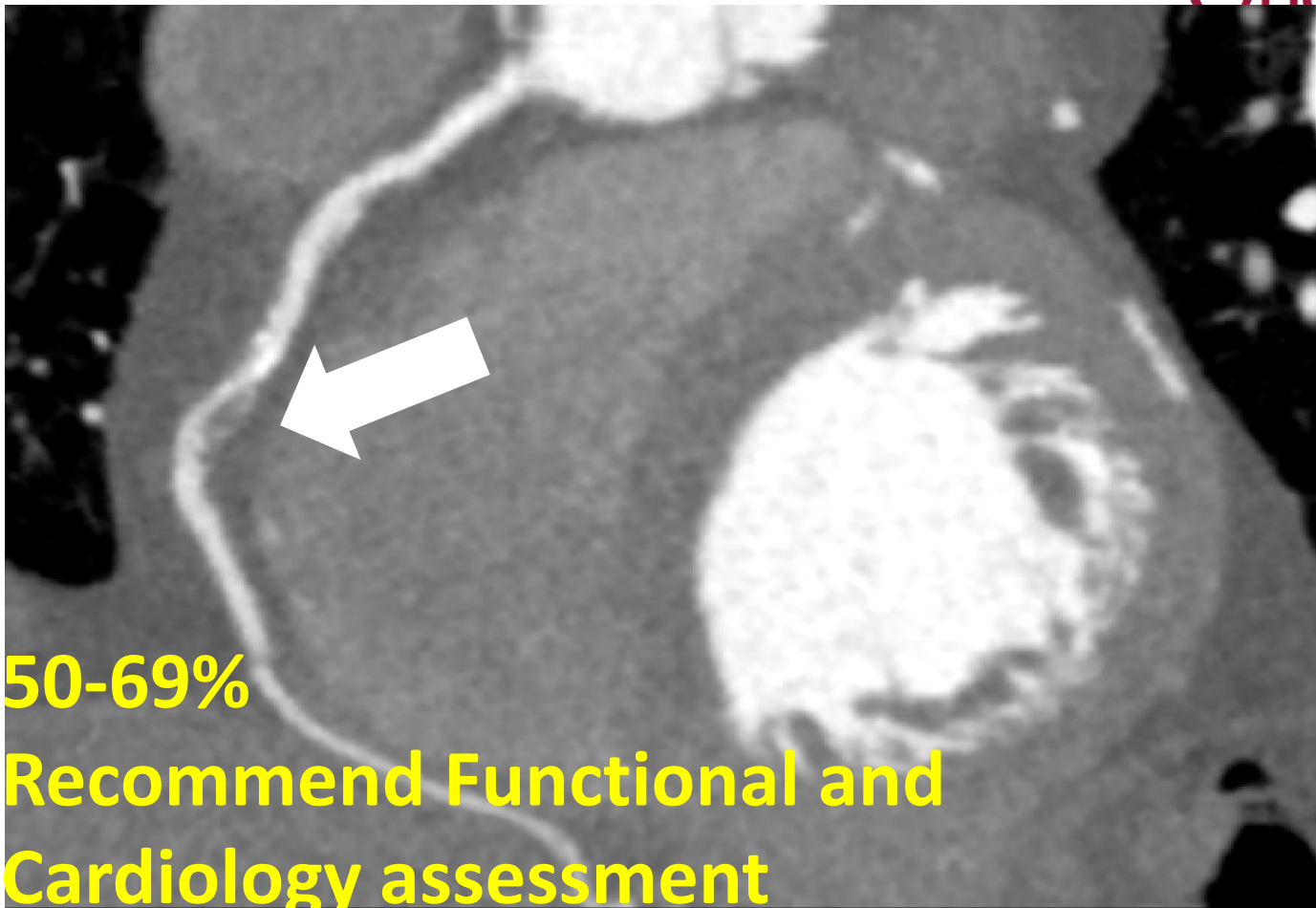


Mild 25 – 49 %

Coronary Stenosis Reporting



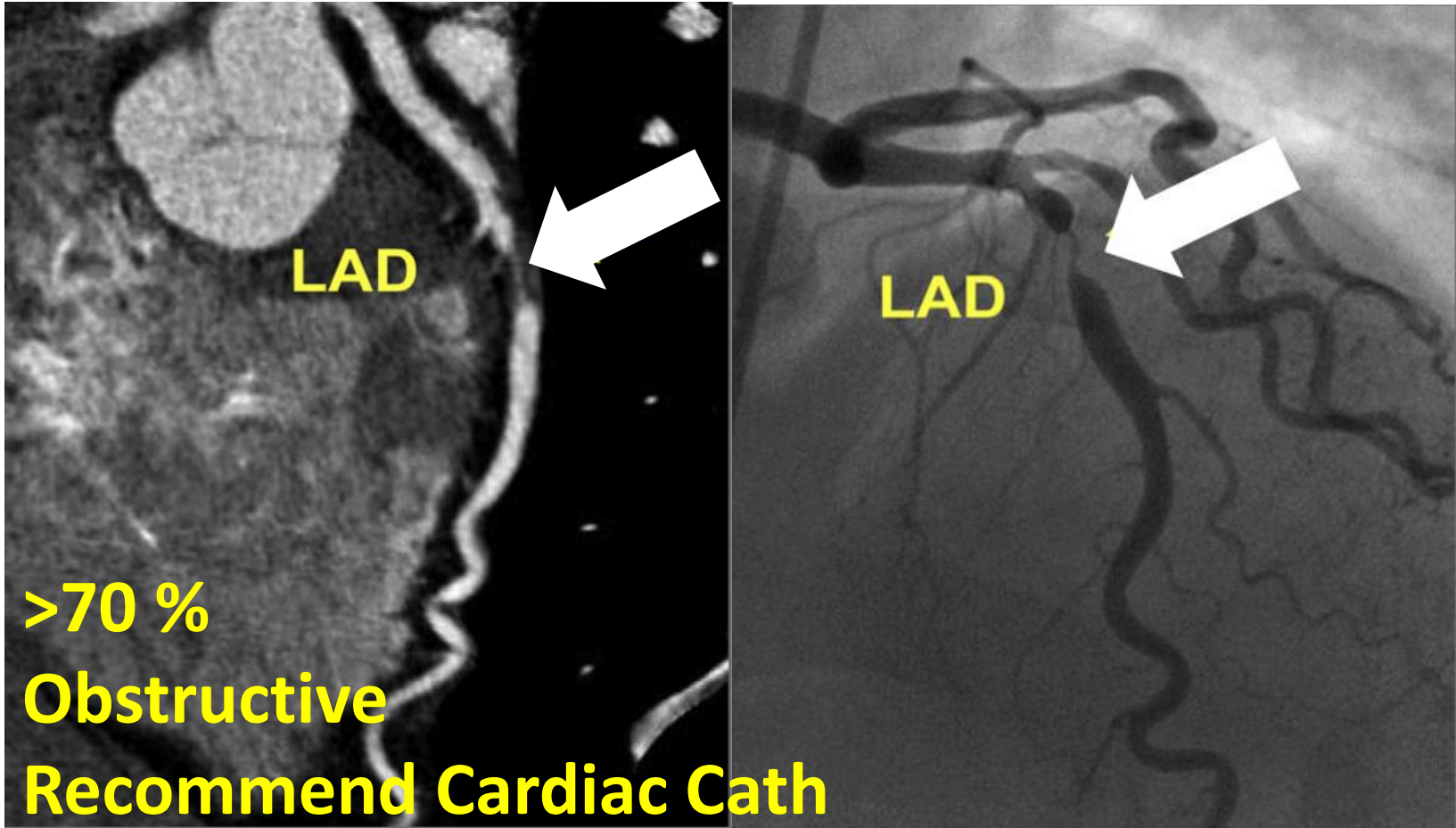
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Stenosis Moderate 50 – 69%

Case 2

Coronary Stenosis Reporting



Stenosis Severe >70%

- In your clinical practice, consider using CTA to **rule out** CAD in a low to intermediate risk patient
 - Age less than 65
 - Less than 2 risk factors
 - Family history of CAD
 - Atypical Pain
 - Indeterminate stress test
- Consider Calcium score to improve definition of CAD risk
- Referring for CTA and CACS is simple, with low risk to the patient

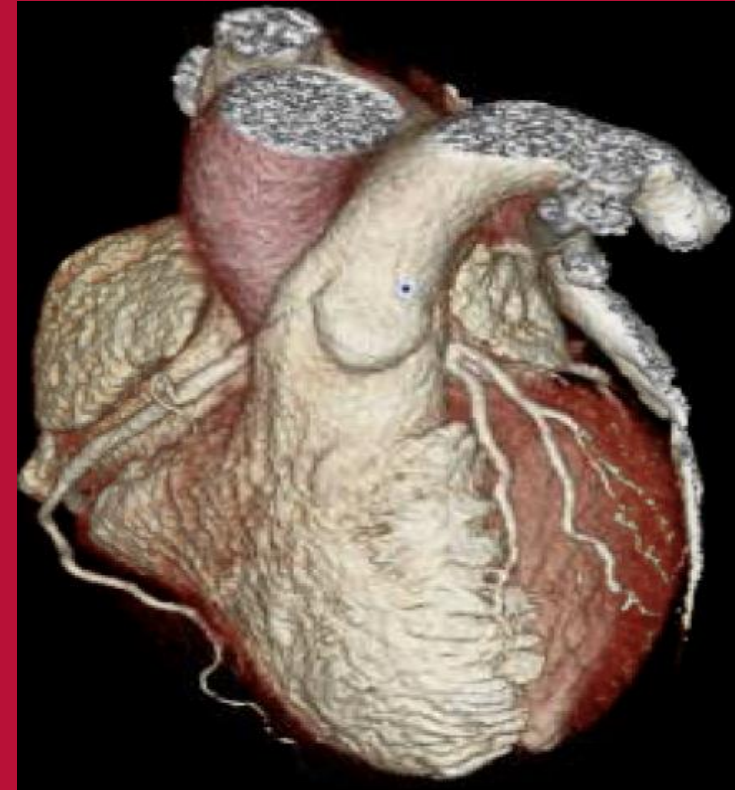


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Thank you!
Questions?

Raveen.Pal@kingstonhsc.ca

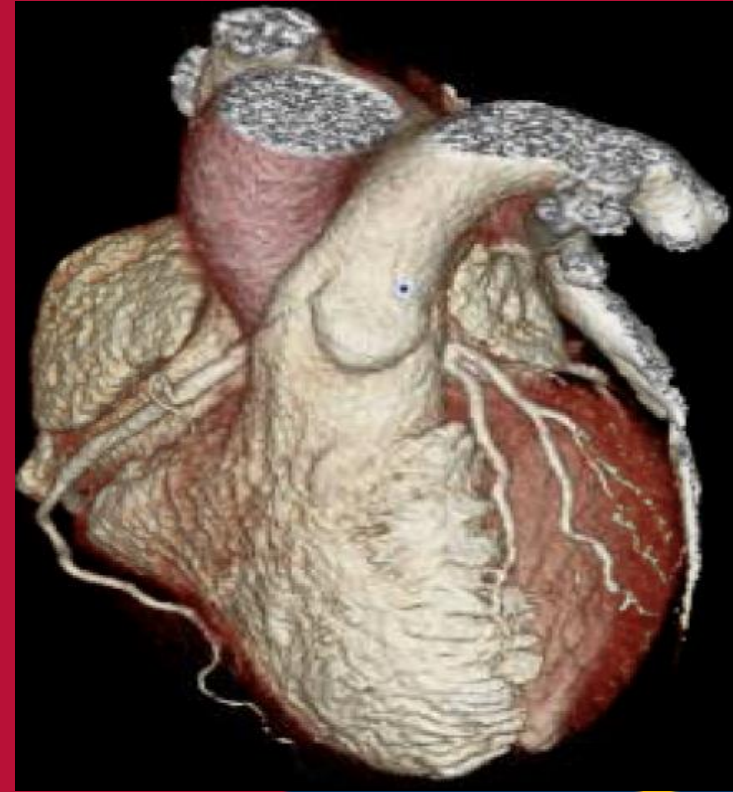
Dominique.Dabreo@kingstonhsc.ca





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References



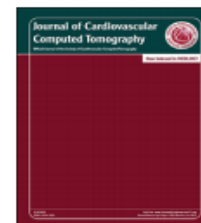


ELSEVIER

Contents lists available at ScienceDirect

Journal of Cardiovascular Computed Tomography

journal homepage: www.JournalofCardiovascularCT.com



Guidelines

Clinical indications for coronary artery calcium scoring in asymptomatic patients: Expert consensus statement from the Society of Cardiovascular Computed Tomography



Harvey Hecht, MD, FSCCT^{a,*}, Michael J. Blaha, MD, MPH^b, Daniel S. Berman, MD, FSCCT^c,
Khurram Nasir, MD, MPH, FSCCT^d, Matthew Budoff, MD, FSCCT^e,
Jonathon Leipsic, MD, FSCCT^f, Ron Blankstein, MD, FSCCT^g, Jagat Narula, MD, PhD^a,
John Rumberger, MD, FSCCT^h, Leslee J. Shaw, PhD, FSCCTⁱ

^a Division of Cardiology, Icahn School of Medicine at Mount Sinai, Mount Sinai St. Luke's Medical Center, New York, NY, USA

^b The Johns Hopkins Ciccarone Center for the Prevention of Heart Disease, Baltimore, MD, USA

^c Department of Medicine, David Geffen School of Medicine, University of California, Los Angeles, CA, USA

^d Miami Cardiac and Vascular Institute, Baptist Health South Florida, Miami, FL, USA

^e Division of Cardiology, Los Angeles Biomedical Research Institute at Harbor–UCLA Medical Center, Torrance, CA, USA

^f Department of Medicine and Radiology, University of British Columbia, Vancouver, Canada

^g Non-Invasive Cardiovascular Imaging Program, Departments of Medicine (Cardiovascular Division) and Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA

^h The Princeton Longevity Center, Princeton, NJ, USA

ⁱ Department of Medicine, Emory University School of Medicine, Atlanta, GA, USA

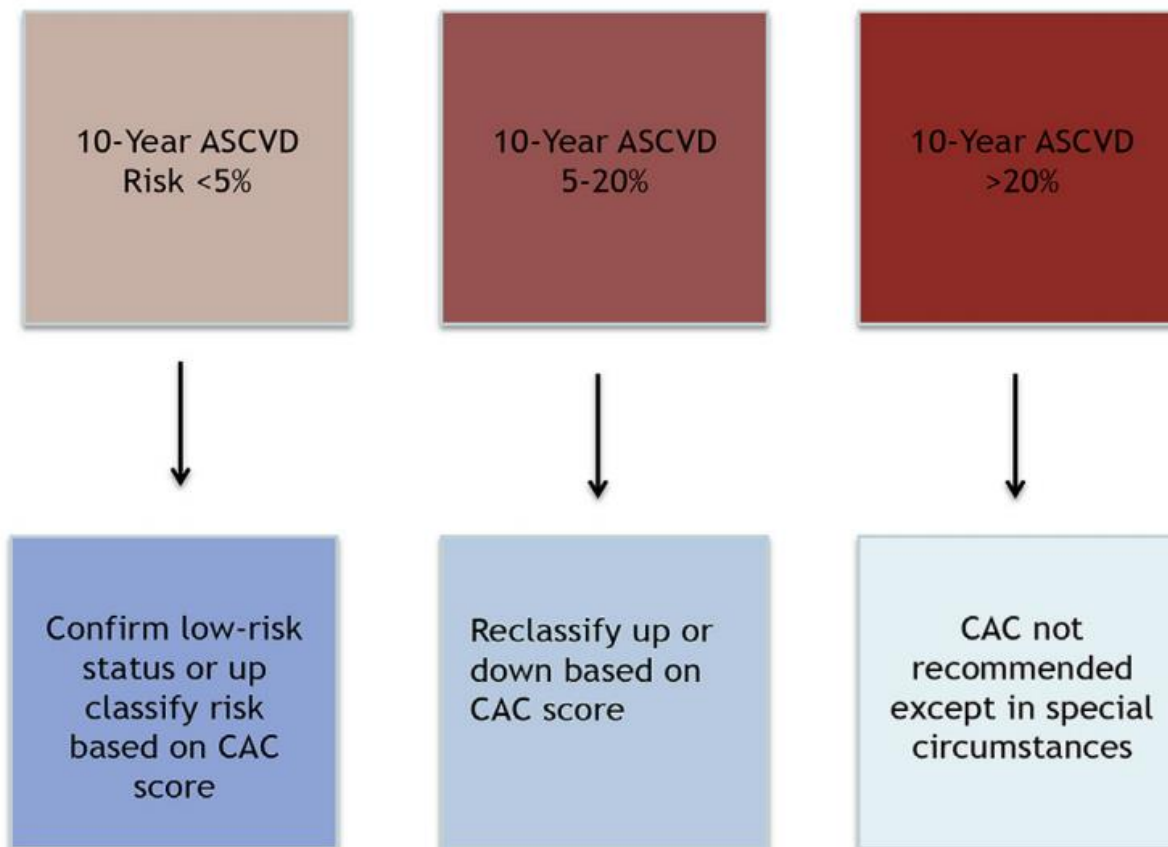
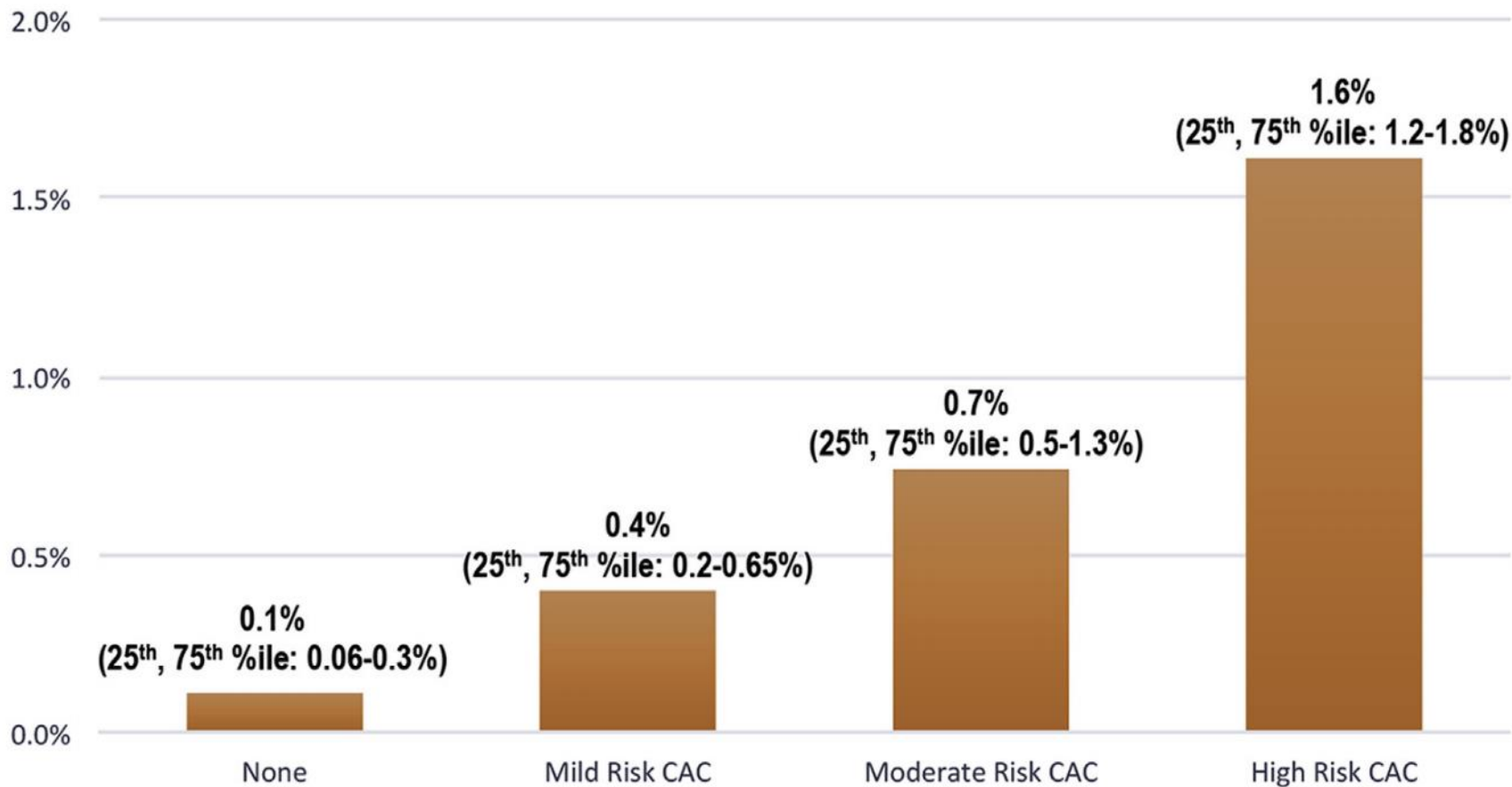


Fig. 3. The role of coronary artery calcium in guiding treatment in the 10-year ASCVD risk categories.

Abbreviations: ASCVD = arteriosclerotic cardiovascular disease. CAC = coronary artery calcium.



H. Hecht et al. / Journal of Cardiovascular Computed Tomography 11 (2017) 157–168



ORIGINAL ARTICLE

Outcomes of Anatomical versus Functional Testing for Coronary Artery Disease

Pamela S. Douglas, M.D., Udo Hoffmann, M.D., M.P.H., Manesh R. Patel, M.D., Daniel B. Mark, M.D., M.P.H., Hussein R. Al-Khalidi, Ph.D., Brendan Cavanaugh, M.D., Jason Cole, M.D., Rowena J. Dolor, M.D., Christopher B. Fordyce, M.D., Megan Huang, Ph.D., Muhammad Akram Khan, M.D., Andrzej S. Kosinski, Ph.D., Mitchell W. Krucoff, M.D., Vinay Malhotra, M.D., Michael H. Picard, M.D., James E. Udelson, M.D., Eric J. Velazquez, M.D., Eric Yow, M.S., Lawton S. Cooper, M.D., M.P.H., and Kerry L. Lee, Ph.D.,
for the PROMISE Investigators*

ABSTRACT

BACKGROUND

Many patients have symptoms suggestive of coronary artery disease (CAD) and are often evaluated with the use of diagnostic testing, although there are limited data from randomized trials to guide care.

Secondary Endpoint: Catheterization Without CAD ≤ 90 days

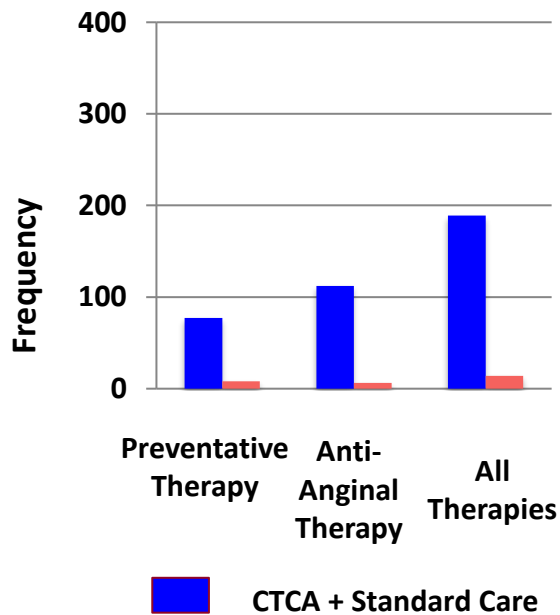
	CTA (n=4996)	Functional (n=5007)	P value
Invasive catheterization without obstructive CAD — N (%)	170 (3.4)	213 (4.3)	0.022
Invasive catheterization	609 (12.2%)	406 (8.1%)	
With obstructive CAD (% of caths)	439 (72.1%)	193 (47.5%)	
Revascularization	311 (6.2%)	158 (3.2%)	
CABG	72	38	

An initial CTA strategy was associated with a lower rate of invasive catheterization without obstructive CAD

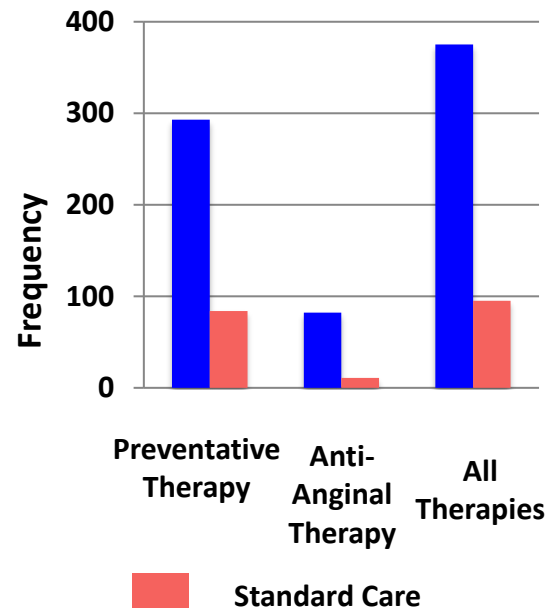
Scottish COmputed Tomography of the HEART (SCOT-HEART)

**CTCA and Medical Therapy
Baseline Compared to 6 Weeks**

Cancellations



New Treatments

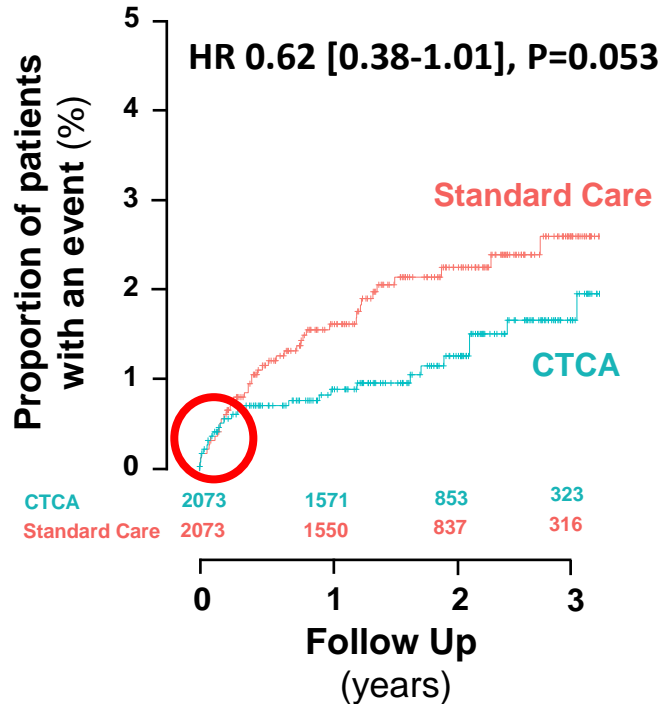


Overall Changes in Treatments: 23% versus 5%, P<0.001

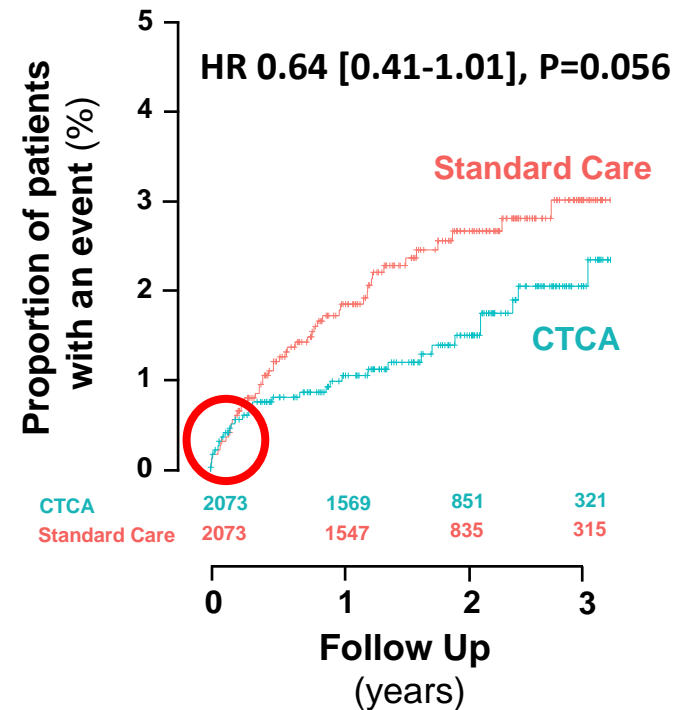
CTCA and Clinical Outcome

1.7 Years of Follow-up

CHD Death and Non-Fatal MI



CHD Death, Non-Fatal MI and Non-fatal Stroke



Conclusions

In patients presenting with suspected angina due to coronary heart disease, the addition of computed tomography coronary angiography

- Clarifies the diagnosis: 1 in 4
- Alters subsequent investigations: 1 in 6
- Changes treatments: 1 in 4
- **May increase coronary revascularisation and reduce fatal and non-fatal myocardial infarction**