Coronary CT- Who and How?

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Presenter Disclosure

Faculty: Dominique DaBreo and Raveen S. Pal

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- None

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- 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
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

**STEP 5**

- **No diagnostic testing mandated**
- **Clinical likelihood of obstructive CAD**
- **Choice of the test based on clinical likelihood, patient characteristics and preference, availability, as well as local expertise**
- **Coronary CTA**
- **Invasive angiography (with iFR/FFR)**

**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.

2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes: The Task Force for the diagnosis and management of chronic coronary syndromes of the European Society of Cardiology (ESC)
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
Agatston Score: The total calcium score is 1. This observed calcium score of 1 is between the 25\textsuperscript{th} and 50\textsuperscript{th} 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

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
• 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%

Clinical indications for coronary artery calcium scoring in asymptomatic patients: Expert consensus statement from the Society of Cardiovascular Computed Tomography. JCCT 2017
https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx
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.

<table>
<thead>
<tr>
<th>Score</th>
<th>Risk</th>
<th>Treatment Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>very low</td>
<td>statin not recommended(^a)</td>
</tr>
<tr>
<td>1–99</td>
<td>mildly Increased</td>
<td>moderate intensity statin if &lt; 75th%;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>moderate to high intensity if &gt; 75th%</td>
</tr>
<tr>
<td>100–299</td>
<td>moderately increased</td>
<td>moderate to high intensity statin + ASA 81mg</td>
</tr>
<tr>
<td>&gt;300</td>
<td>moderate to severely increased</td>
<td>high intensity statin + ASA 81mg</td>
</tr>
</tbody>
</table>

\(^a\) Excluding familial hypercholesterolemia.

Clinical indications for coronary artery calcium scoring in asymptomatic patients: Expert consensus statement from the Society of Cardiovascular Computed Tomography. JCCT 2017
Case 2

- 50 yo F
- Chronic, atypical CP
- Ex-smoker, HTN and dyslipidemia
How to order Coronary CTA

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 #: ____________ Injury Date: ____________

WSIB #: ____________

Inpatient/Outpatient: ____________

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: □ Yes □ No, if yes - where ____________

CAUTION: RISKS FOR CONTRAST INDUCED NEPHROTIC SYNDROME

Blood work is required & must be available at time of appointment for patients with ANY of the following:

- Known Renal Dysfunction
- Diabetes Mellitus
- Age greater than 70 yrs
- Previous Chemotherapy
- Organ Transplant
- Sepsis, Acute Hypotension
- Cardiovascular Disease (Hypertension, CHF, CAD, PVD)
- Nephrotic Drugs-Loop Diuretics, NSAIDS, Vancycin, Aminoglycosides, etc.

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 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

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

Stenosis Minimal < 25%

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

<50%
Non-obstructive

Stenosis Minimal < 25%

Mild 25 – 49 %
Coronary Stenosis Reporting

Stenosis Moderate 50 – 69%

Recommend Functional and Cardiology assessment

Stenosis Moderate 50 – 69%
Case 2
Coronary Stenosis Reporting

>70% Obstructive
Recommend Cardiac Cath

Stenosis Severe >70%

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

• 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
Thank you!

Questions?

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References
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, FSCCT i

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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.
Clinical indications for coronary artery calcium scoring in asymptomatic patients: Expert consensus statement from the Society of Cardiovascular Computed Tomography. JCCT 2017
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

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

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**

<table>
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<th>Follow Up (years)</th>
<th>Proportion of patients with an event (%)</th>
<th>CTCA</th>
<th>Standard Care</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>CTCA</td>
<td>Standard Care</td>
</tr>
<tr>
<td>1</td>
<td>1.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2.3%</td>
<td></td>
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<tr>
<td>3</td>
<td>3.0%</td>
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HR 0.62 [0.38-1.01], P=0.053

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

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HR 0.64 [0.41-1.01], P=0.056

CTCA and Clinical Outcome
1.7 Years of Follow-up

**CHD Death and Non-Fatal MI**

HR 0.62 [0.38-1.01], P=0.053

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

HR 0.64 [0.41-1.01], P=0.056
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