Coronary CT Angiography
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CCTA

- What is it?
  - Non-invasive method of imaging the coronary arteries using computed tomography (CT)
- What is it used for?
  - Diagnosis of coronary artery disease (CAD)***
  - Diagnosis of in-stent restenosis
  - Evaluation of coronary bypass graft patency

CCTA

- Clinical application in CAD

- Nine specialty societies agreed

  - Taylor AJ, et al. Appropriate Use Criteria for Cardiac Computed Tomography. *Circulation.* Nov 23 2010;122(21):e525-55.

    - American College of Cardiology Foundation Appropriate Use Criteria Task Force
    - Society of Cardiovascular Computed Tomography
    - American College of Radiology
    - American Heart Association
    - American Society of Echocardiography
    - American Society of Nuclear Cardiology
    - North American Society for Cardiovascular Imaging
    - Society for Cardiovascular Angiography and Interventions
    - Society for Cardiovascular Magnetic Resonance

CCTA

o Categories appropriate for CCTA:

   o Detection of CAD in symptomatic patients without known heart disease, either nonacute or acute presentations

   o Detection of CAD in patients with new-onset or newly diagnosed clinical heart failure and no prior CAD

   o Preoperative coronary assessment prior to noncoronary cardiac surgery

   o Patients with prior electrocardiographic exercise testing - Normal test with continued symptoms or intermediate risk Duke treadmill score

   o Patients with prior stress imaging procedures - Discordant electrocardiographic exercise and imaging results or equivocal stress imaging results

CCTA

- o Categories appropriate for CCTA:
    - o Evaluation of new or worsening symptoms in the setting of a past normal stress imaging study
    - o Risk assessment post-revascularization - Symptomatic if post-coronary artery bypass grafting or asymptomatic with prior left main coronary stent of 3 mm or greater
    - o Evaluation of cardiac structure and function in adult congenital heart disease
    - o Evaluation of cardiac structure and function - Ventricular morphology and systolic function
    - o Evaluation of cardiac structure and function - Intracardiac and extracardiac structures

o **CCTA clinical application in CAD**

o **Advantages**

  o Quick, accurate & proven

  o Highly sensitive & specific

  o High negative predictive value

  o Readily available in our communities

    o >10,000 cases since 2001

    o Galloway, CMCH and Wall

    o GE 64-Slice CT with ACiR technology

   o Dedicated CCTA staff of techs & nurses

- CCTA clinical application in CAD
- Disadvantages
  - Requires optimization of HR and breath hold
    - <60 BPM and 5-10 second breath hold
  - Ionizing radiation and iodine contrast
  - Limited by artifacts of CT scanning
  - Contraindicated in arrhythmias, pacemaker, renal insufficiency and contrast allergy
  - Special equipment and staff
    - Minimum 64-slice CT and dedicated CT techs and nurses
  - Limited by large amount of calcified plaque
  - May not be covered by insurance

- Requires optimization of HR and breath hold
- Patient Preparation
  - HR < 60 (oral beta blockade)
  - Coaching of patients for breath hold
  - Coronary dilation (sub-lingual nitro)
  - IV access

- o Ionizing radiation and iodine contrast
  - o Necessary and unavoidable
- o Typical* radiation effective dose (mSv)
  - o CXR (PA / LAT): 0.05
  - o Mammogram (4 views): 0.70
  - o CT head: 2
  - o Yearly background exposure in US: 3
  - o CT chest / abdomen / pelvis: 8 / 10 / 10
  - o Conventional coronary angiogram: 5 - 15
  - o SPECT Sestamibi: 5 - 15
  - o Retrospective CCTA: 10 - 25
  - o SPECT Thallium: 25 - 35
  - o Coronary angioplasty: 8 – 57

o Recent technology to lower radiation dose

o Selective scanning - Prospective ECG triggering

o Earls JP, et al. Prospectively gated transverse coronary CT angiography versus retrospectively gated helical technique: improved image quality and reduced radiation dose. *Radiology.* Mar 2008;246(3):742-53.

Retrospective ECG-triggering (RT)

Prospective ECG-triggering (PT)
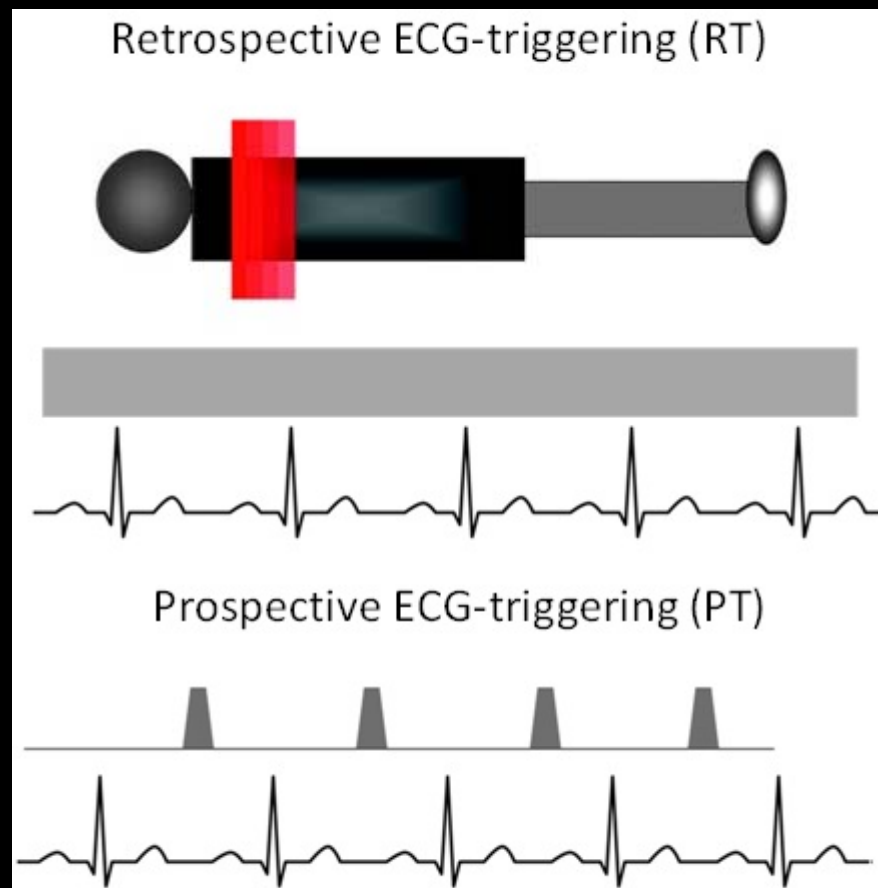
o PROSPECTIVE gated CCTA technique

BMI	Kvp	mA	mSv
<24 Peds	80	350	0.78
24-26	100	450	1.2
26-30	100	550	2.0
30-34	120	650	3.7
34-40	120	800	4.6
>40	120	800	4.6
CAC score	120	300	1.8

o Recent technology to lower radiation dose

o Scan faster = less radiation

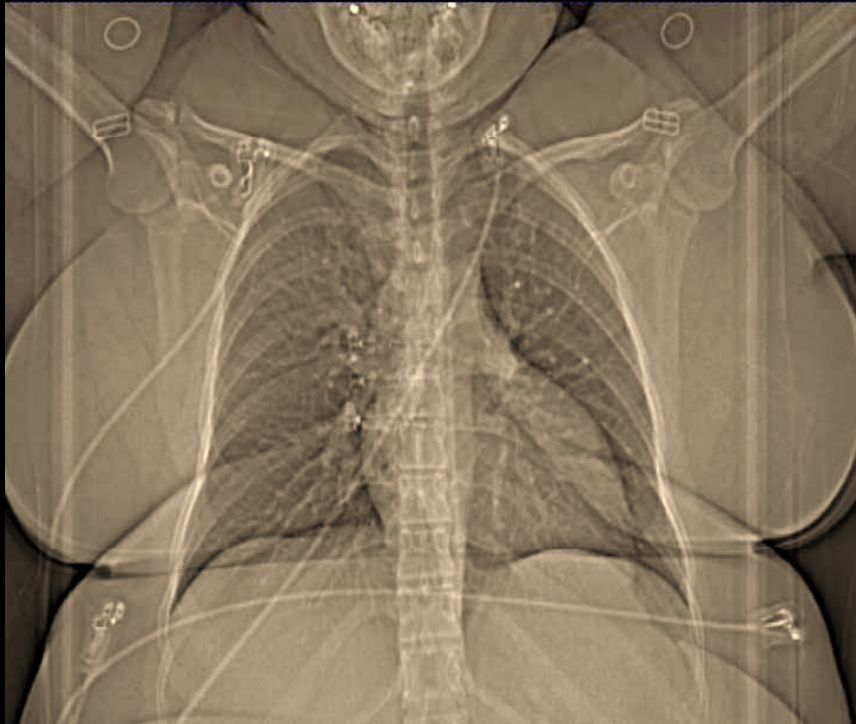o Dual-Source and Dual-Energy CT
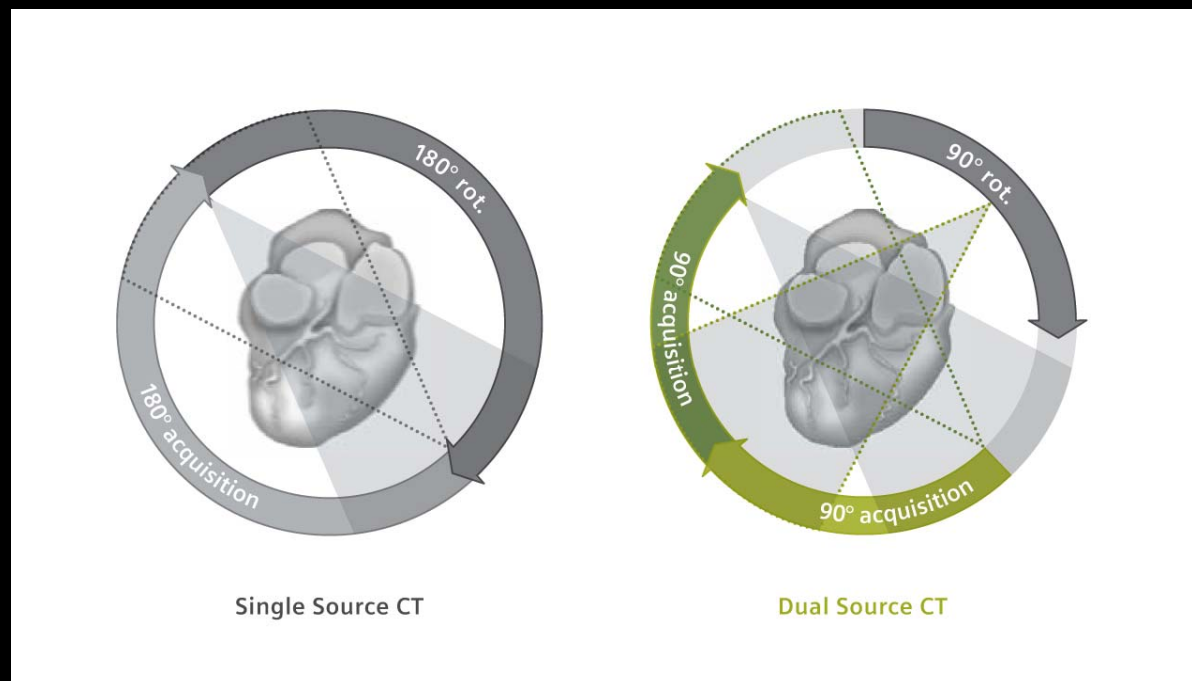
o 128-Slice, 256-Slice, 320-Slice…

o **Artifacts:**

  o Stair-step – phase misregistration, HR variability
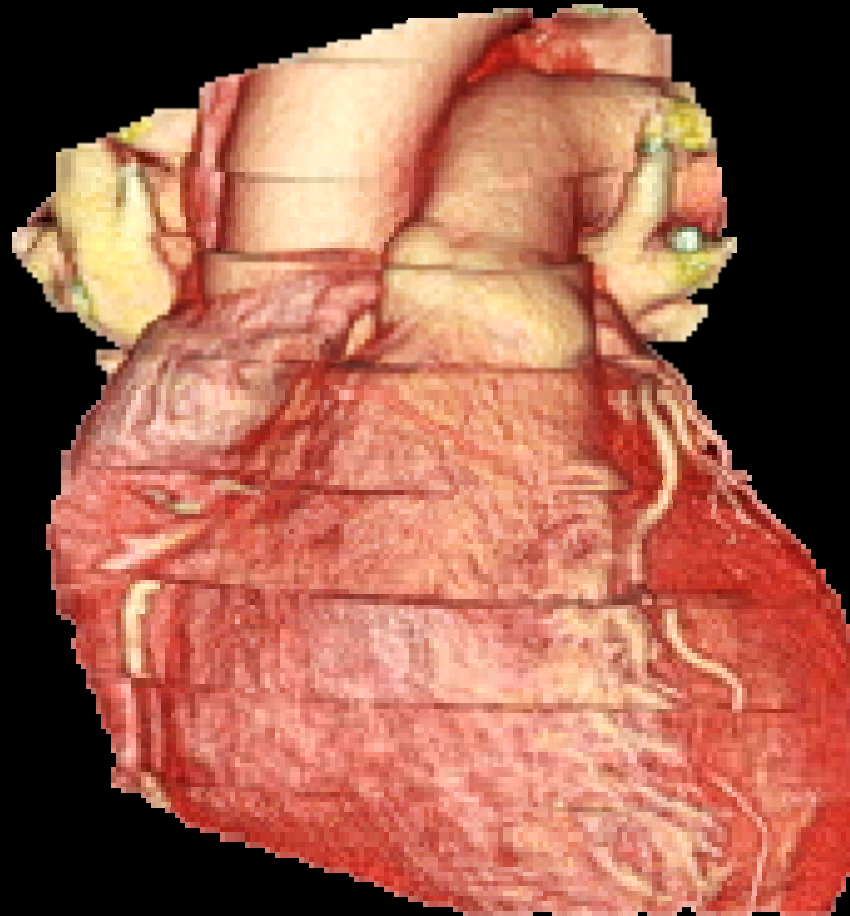
o **Artifacts:**

    o Motion – blurry images
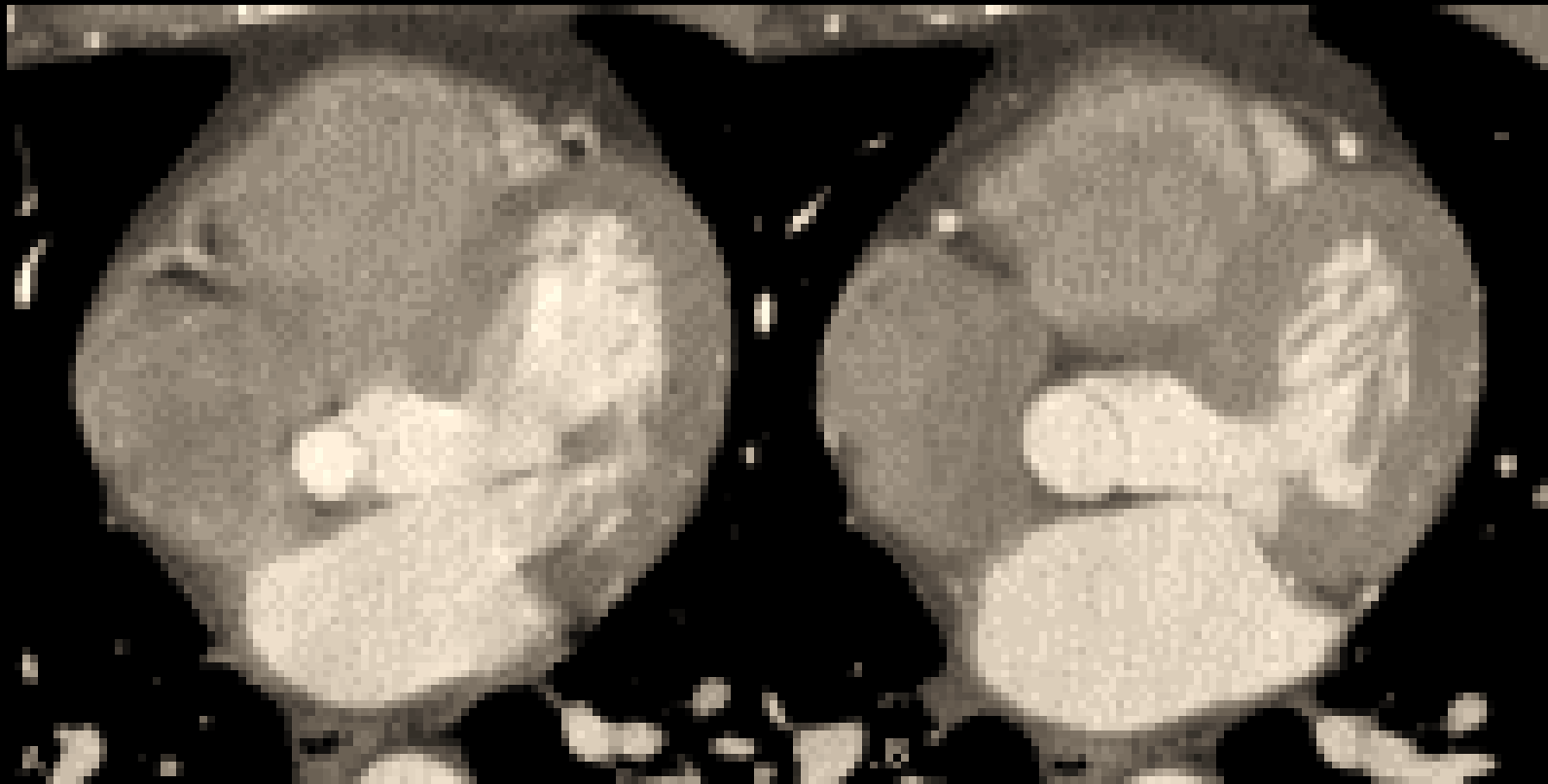
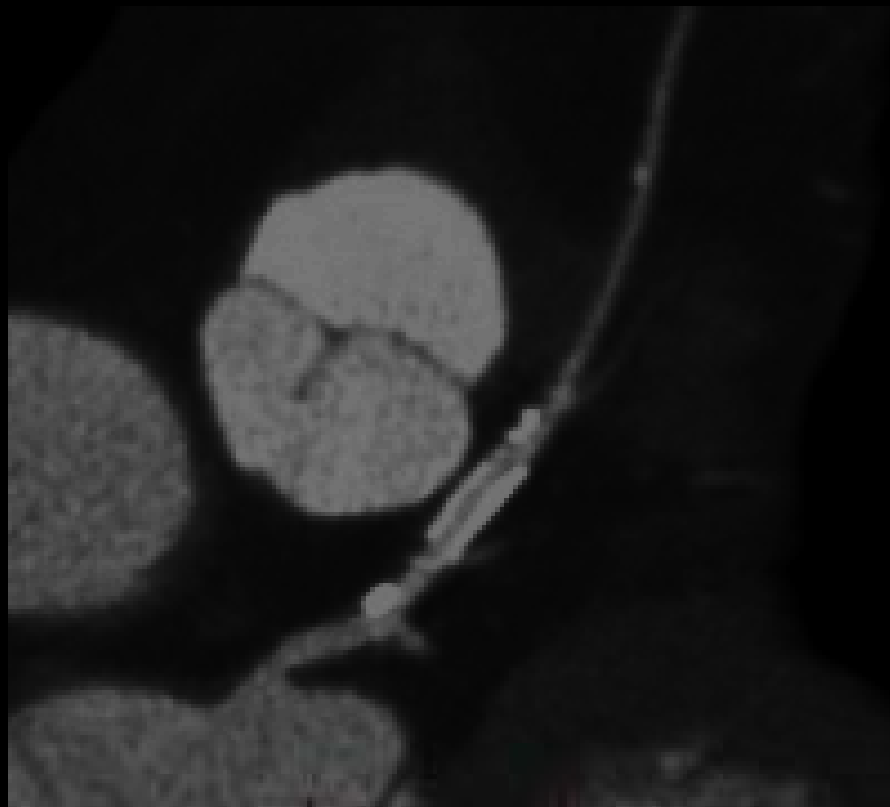o **Artifacts:**
  o Increased BMI – grainy images
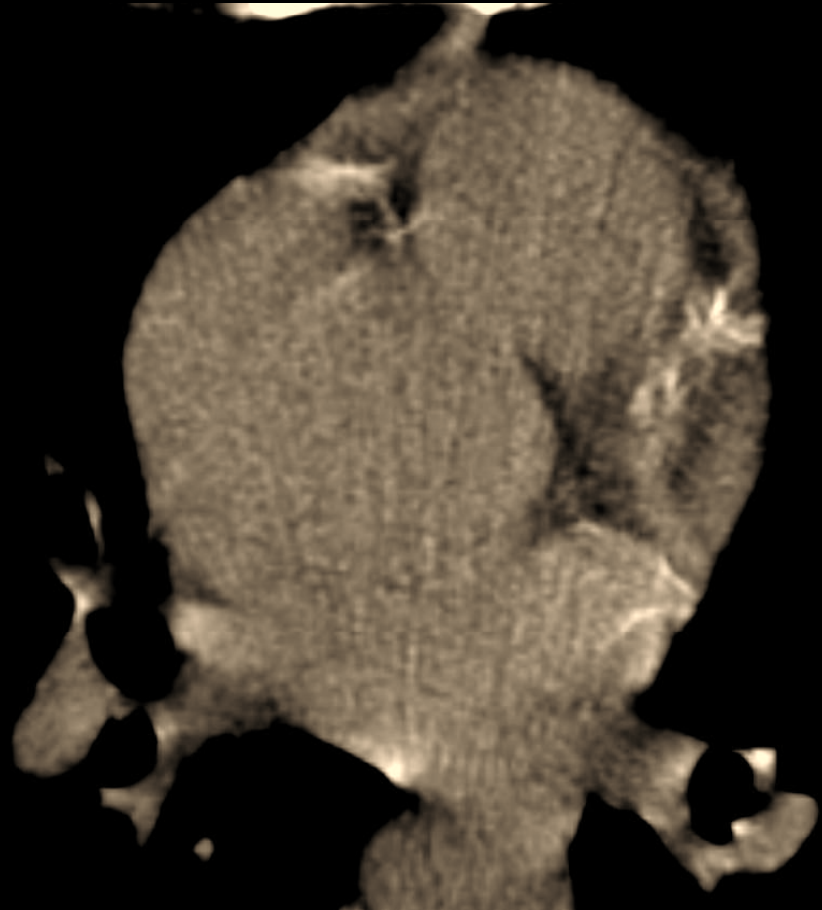
o **Artifacts:**

  o Streak – beam hardening from metal or dense contrast
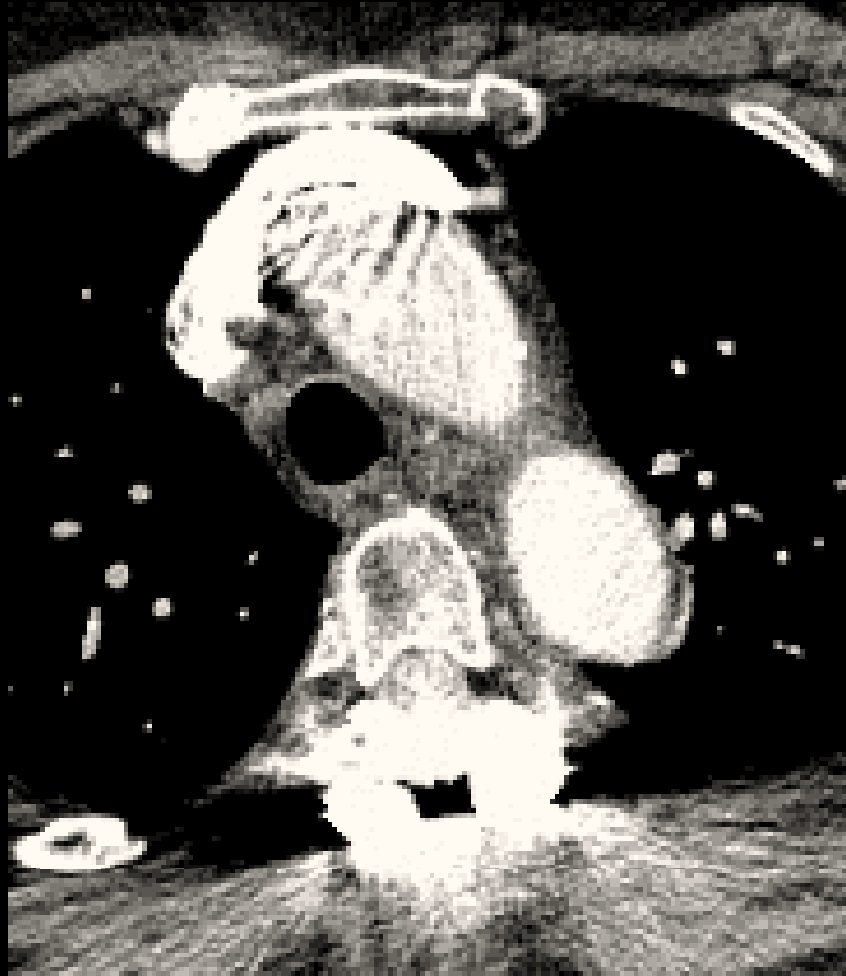
o Artifacts:

o Blooming – high contrast structures (stent, calcified plaque) appear larger than they are

Normal
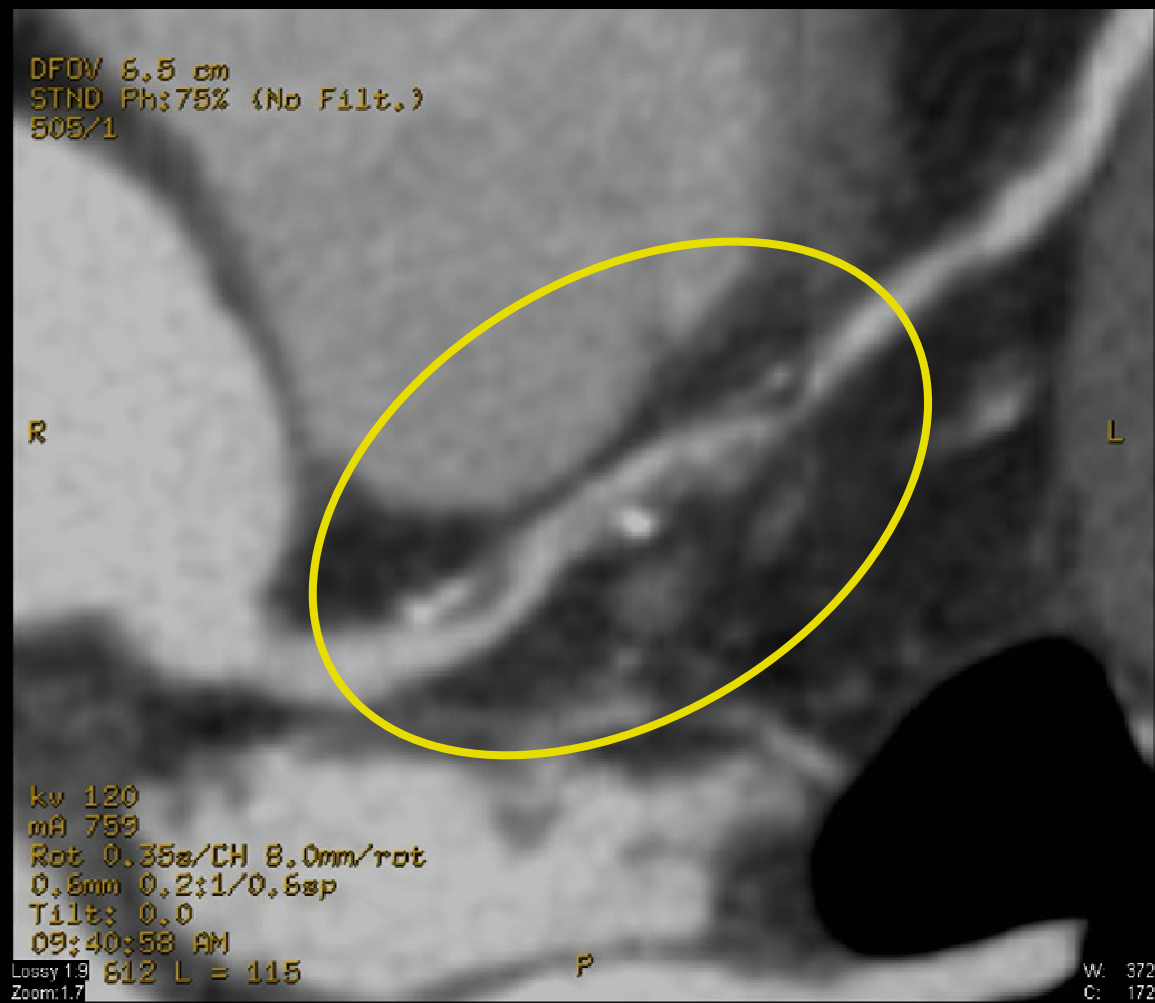
- Stenosis Grading
  - Visual assessment (like conventional coronary angiography)
  - Mild = <50% stenosis
  - Moderate = 50 – 75% stenosis
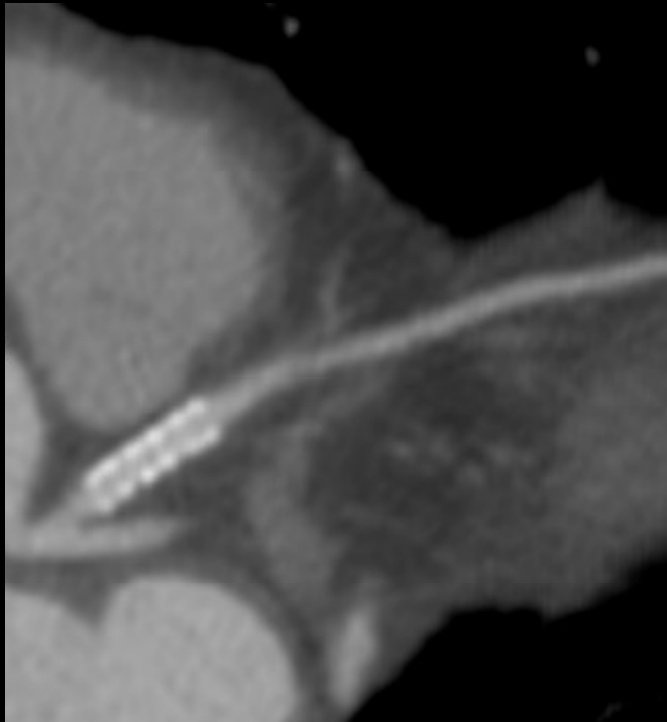 - Severe = > 75% stenosis
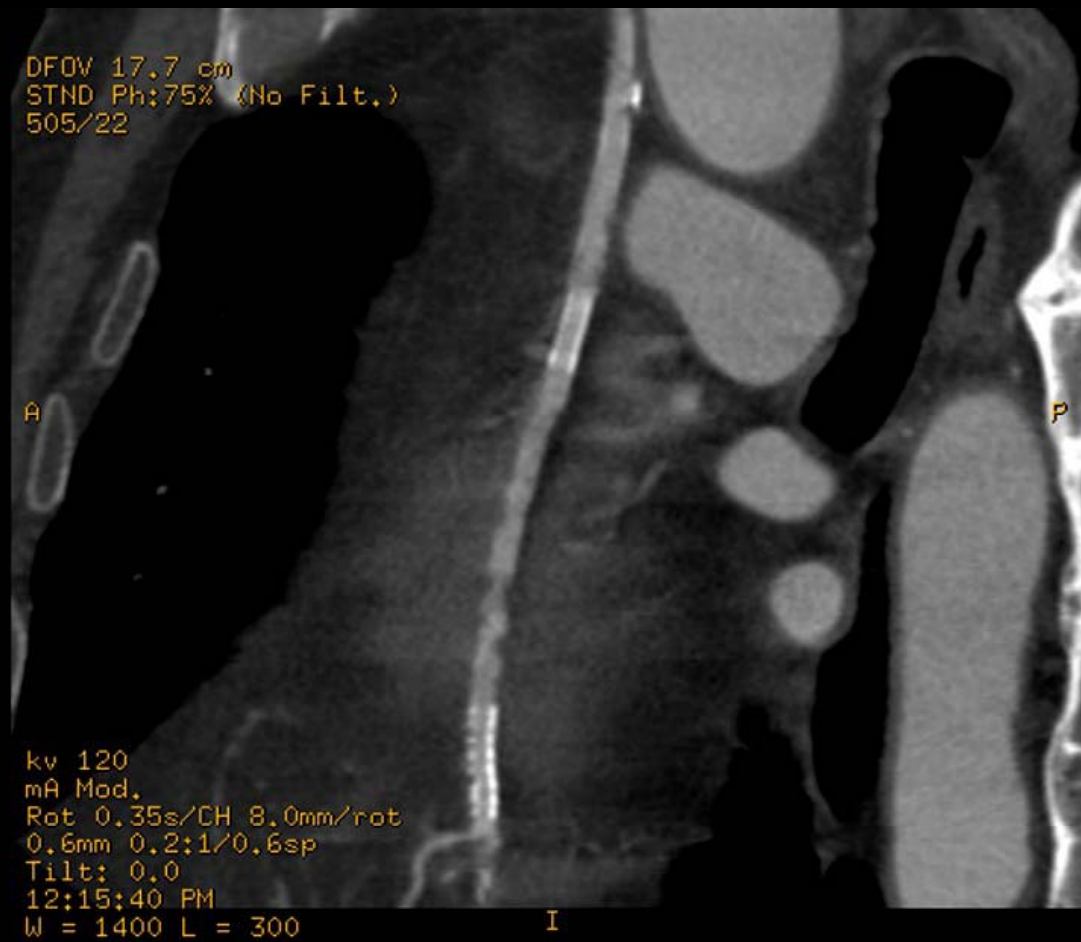 - Occluded

Mild CAD
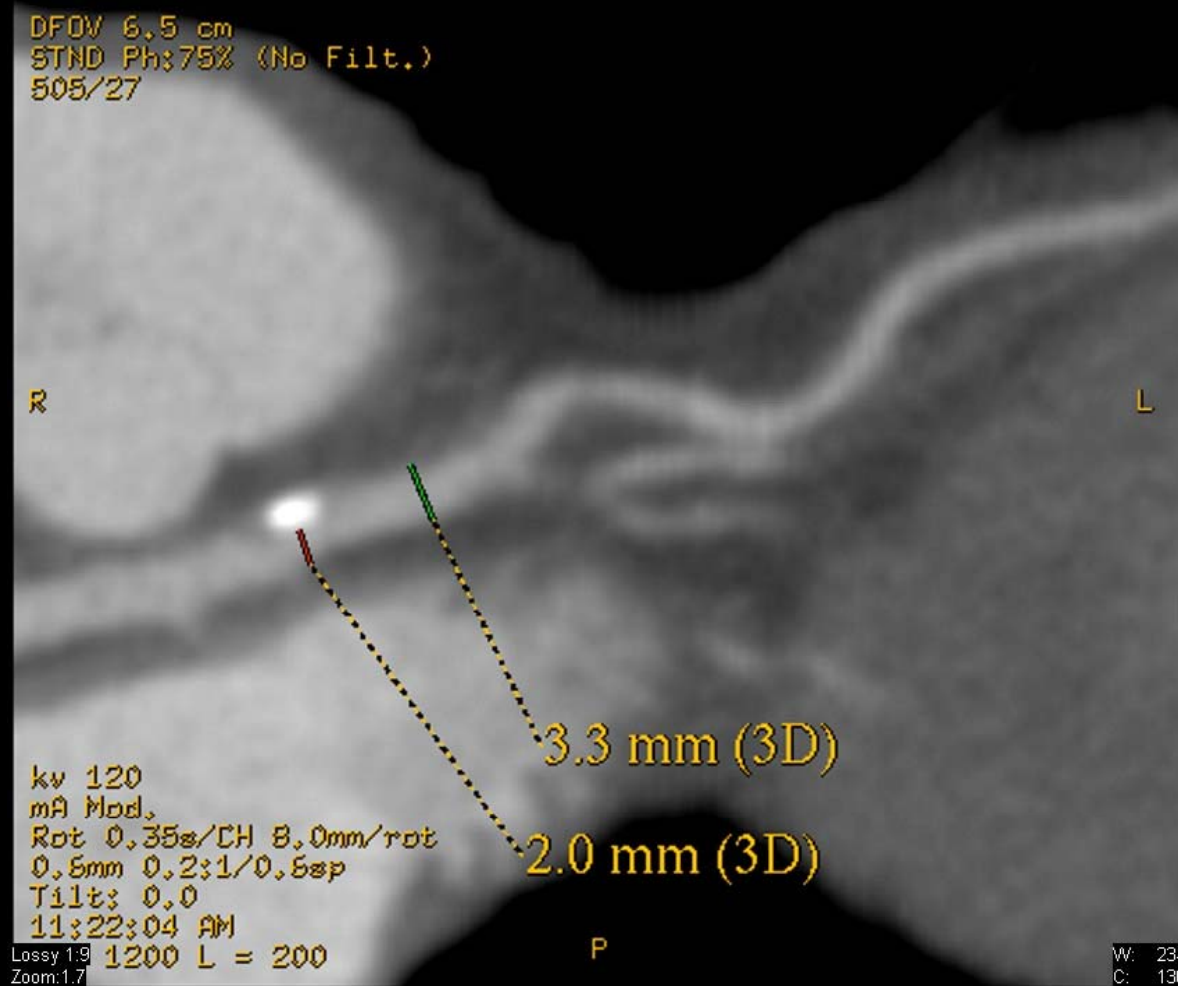
Severe CAD

Stents

CABG

- Structured reporting
  - History / Indication
  - Technique, including type and amount of contrast, and image acquisition (retrospective or prospective)
  - Coronary dominance
  - Major vessels and branches
  - Visualized lungs, upper abdomen, etc.
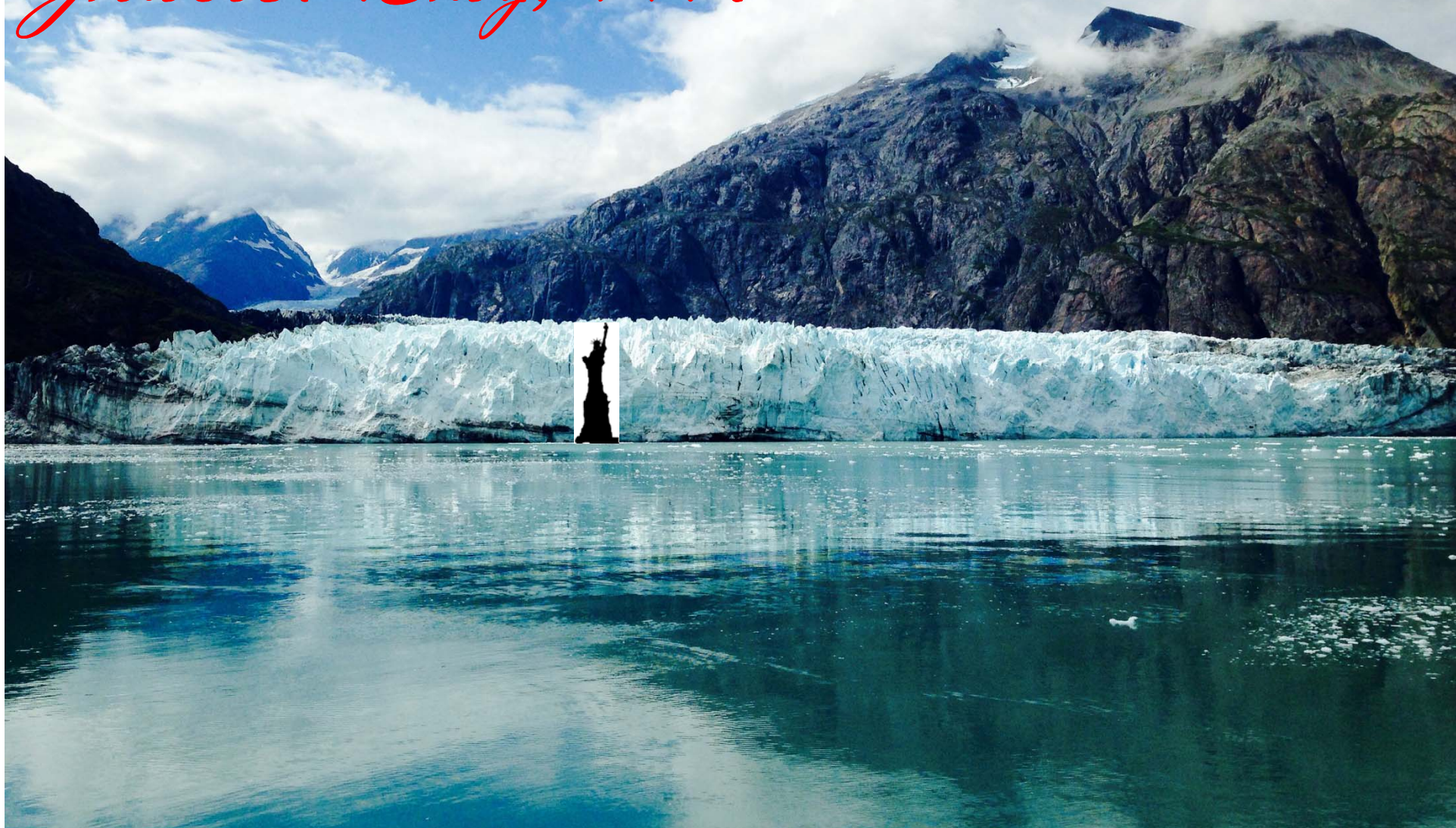 - Impression, including recommendation and follow-up

Summary

Coronary CTA:

- Non-invasive, contrast-enhanced, relatively low-dose angiogram for direct coronary evaluation, precise characterization of plaque burden and stent and CABG evaluation.

- Quick, reliable, proven, affordable and readily available for patients in Monmouth, Ocean, Atlantic and Cape May counties.

Margerie Glacier
Glacier Bay, AK

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