Pitfalls to Avoid: Cardiac CT

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Disclosures

• 3DR Advisory Board Member
10 Pitfalls to Avoid

1. Inappropriate patients
2. Breathing artifact
3. Fast heart rates
4. Inappropriate R-wave triggers
5. Inappropriate phase for evaluation
10 Pitfalls to Avoid

6. Noisy images
7. Incorrect amount of contrast
8. False trigger of scan
9. Failure to utilize ECG editing
10. Dose reduction
Appropriateness guidelines

ACCF/SCCT/ACR/AHA/ASE/ASNC/SCAI/SCMR

2010 Appropriate Use Criteria for Cardiac Computed Tomography

A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the Society of Cardiovascular Computed Tomography, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the American Society of Nuclear Cardiology, the Society for Cardiovascular Angiography and Interventions, and the Society for Cardiovascular Magnetic Resonance

1. Appropriate patients

- Without known CAD
  - Symptomatic, Asymptomatic, or new CHF
- Pre-op for non-coronary cardiac surgery
- Prior test results
- After revascularization
- Adult congenital heart disease
- Cardiac structure and function
Pretest probability of CAD

Table A. Pretest Probability of CAD by Age, Sex, and Symptoms

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
<th>Typical/Definite Angina Pectoris</th>
<th>Atypical/Probable Angina Pectoris</th>
<th>Nonanginal Chest Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td>40–49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very low</td>
</tr>
<tr>
<td>50–59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td>&gt;60</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
</tr>
</tbody>
</table>

- Low < 10%
- Intermediate 10-90%
- High > 90%
Non-acute symptomatic

- ECG interpretable AND can exercise
  - Intermediate

- ECG uninterpretable OR unable to exercise
  - Low and Intermediate
Acute symptomatic

- Low and Intermediate

- Not ECG or biomarker positive for acute MI
  - Normal ECG and cardiac biomarkers
  - ECG uninterpretable or Non-diagnostic
  - Equivocal cardiac biomarkers
New onset CHF

- LV dysfunction
- Low and intermediate
Asymptomatic risk

- ATP III guidelines
- High risk - >20% risk over 10 years (MI and death)
  - Clinical Coronary Heart Disease (CHD)
  - Symptomatic carotid artery disease
  - Peripheral arterial disease
  - AAA
- Intermediate - 10-20% 10 years risk
- Low - <10% 10 year risk
ATP III risk calculator

Asymptomatic

- Calcium scoring

- Coronary CTA
  - Low global risk - Family Hx of premature CAD
  - Intermediate global risk
Pre-op non-coronary cardiac surgery

Intermediate perioperative risk

- No active cardiac conditions
  - Unstable angina
  - Decompensated heart failure
  - Significant arrhythmias
  - Severe valvular disease

1 or more clinical risk factors
- H/o ischemic heart disease
- H/o compensated or prior heart failure
- H/o cerebrovascular disease
- Diabetes
- Renal insufficiency
Prior testing

- Normal ECG stress with continued symptoms
- Normal stress imaging with new or worsening symptoms
- Discordant ECG stress and stress imaging results
- Equivocal stress imaging
After revascularization

- CABG
  - Symptomatic patient- evaluate graft patency
  - Localize grafts prior to redo

- Stent
  - Asymptomatic patient with LM stent
Adult congenital heart disease

- Anomalous coronary arteries
- Other thoracic vessel anomalies
- Complex congenital heart disease
Cardiac structure and function

- Inadequate noninvasive imaging
- Coronary vein mapping
- Pulmonary vein anatomy
- Pericardial anatomy
- RV function or morphology- ARVC
2. Breathing artifact
3. Fast heart rates

85 bpm and 75% reconstruction
3. Fast heart rates

85 bpm and 60% reconstruction
3. Fast heart rates

- Prefer <65 bpm
  - Oral β-blocker- 1 hr prior to scan (50-100mg)
  - And/or IV β-blocker (max 25mg)
  - Or calcium channel blocker
- Sublingual nitro (2 tabs) about 5-6 min prior to scan
3. Fast heart rates
4. R-wave triggers

- Noise
- T waves too high
- Good
5. Best phase for evaluation
5. Best phase for evaluation

Prospective

Retrospective
6. Noisy images
7. Contrast

- Concentration
  - 300, 320, or 370

- Flow rate
  - 4-7 mL/sec [5]

- Wt/BMI based vs Fixed Volume

- Phases
  - 2 phase- (contrast + saline)
  - 3 phase- (contrast + contrast/saline + saline)
7. Contrast

(Scan time + post trigger delay) * Injection Rate = Volume

Ex (64): (11 sec scan + 4 sec delay) * 5 mL/sec = 75 mL
Ex (256): (4 sec scan + 5 sec delay) * 5 mL/sec = 45 mL
7. Contrast
8. False trigger
ROI size and streak

Mean HU = 245

Mean HU = 50
9. ECG Editing - Delete
9. ECG Editing- Disable
10. Radiation dose

- ECG tube modulation
- 100 kVp (≥80 kVp)
- Prospective trigger
- Iterative reconstruction
- High pitch ECG triggered spiral
Retrospective gated

- ECG tube modulation
  - up to 50% dose reduction

- 100 kVp
  - 120 to 100 kVp 40% dose reduction
  - 120 to 80 kVp 70% dose reduction

- Iterative reconstruction
  - 30-50% additional dose reduction
Prospective triggered

- “Step and shoot” and “Flash”
  - > 80% dose reduction

- 100 kVp
  - 120 to 100 kVp 40% dose reduction
  - 120 to 80 kVp 70% dose reduction

- Iterative reconstruction
  - 30-50% additional dose reduction
kVp effect

80 kVp
HU = 958

100 kVp
HU = 588

120 kVp
HU = 357
Iterative reconstruction

More computer intensive
Reduces noise allowing good image quality at reduced dose

SD=63
SD=35
SD=22
Iterative reconstruction

Now improve spatial resolution?
10. Dose parameters
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Thank you!

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