Coronary Artery CTA Pitfalls
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Pitfalls in Coronary Artery CTA

Coronary Artery CTA
- High negative-predictive value (>99%)*
- Requires high quality study


High Quality Acquisition
- HR ≤ 60 bpm
- NSR
- Coronary artery dilation (nitrates)
- Proper contrast bolus & timing
- ECG-gating

DISCLOSURES

Coronary Artery CTA
- High negative-predictive value (>99%)*
- High Quality Acquisition
- Low Quality Acquisition

Objectives
- Review common pitfalls in the performance and interpretation of coronary artery CTA
- How to minimize them
Common Pitfalls

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Technical

44-yo male - Evaluate SVG patency

44-yo male - Evaluate SVG patency

Z-Axis coverage

Scout

Inadequate z-axis

Excluded saphenous vein grafts

Normal CTA z-axis
Z-Axis Coverage

- Clinical information crucial in exam setup
- Setting z-axis:
  - Scout images
  - Low dose (~80 mA) non-contrast scan

Contrast

- Error in delivery:
  - Extravasation
  - Low volume
  - Slow rate
  - Missed timing

Mixing artifact

Scanned Too Early
Ideal enhancement in the ascending aorta:

**300-350 HU**

Weininger et al. AJR 2011; 196: W260-W272

**Injection Rate**

Rate: 6 cc/s

**Injection Rate**

Rate: 8 cc/s

**Streak Artifact**

Without Saline Bolus

With Saline Bolus

**Why is this a bad scan?**

Noise
**Noise**

**Problem**
- Not enough photons to create an image

**Solution**
- Increase kVp
- Increase mA
- Increase scan time

\[ \uparrow \text{Radiation} \]

**Noise**

**Problem**
- Not enough photons to create an image

**Solution**
- Increase FOV
- Increase slice thick
- Smooth kernel

\[ \downarrow \text{Spatial Res} \]

**Noise**

**Problem**
- Not enough photons to create an image

**Solution**
- Iterative Recon

\[ \downarrow \text{Radiation} \]
\[ \uparrow \text{Spatial Res} \]

**Iterative Reconstruction**

- Coronary Artery CTA - IR vs. FBP:
  - Reduced image noise \[ \downarrow 26 - 35\% \]
  - Statistically significant increase in diagnostic segments

Leipsic et al. AJR, 2010; 195: 649-654

**Motion**

- Factors in coronary motion artifacts:
  - High HR
  - Variable HR
  - Respiratory motion
  - Scan times
Heart Rate

- Slow HR = more time in diastole

55 bpm
75 bpm

Motion

- Blur
  - Rapid HR impairs segmental diagnostic assessment

PDA  RCA  LCx

Motion - Blur

- Not always easy to identify
- May mimic pathology

HR: 81 bpm

Motion - Blur

Artifact

HR: 81 bpm

Motion - Blur

Artifact

Heart Rate control is most important factor

Phase Selection

- Reconstruct in R-R phase of least motion:
Phase Selection

- Prospective gating - 70% center, 100 ms padding on each side

Motion

- **Blur**
  - Rapid HR impairs segmental diagnostic assessment
- **Stairstep**
  - HR variability affects all vessels

Stairstep

- Phase misregistration during prospective acquisition & reconstruction

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<th>Artifact</th>
<th>Problem</th>
<th>Solution</th>
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<tr>
<td>Blur</td>
<td>Rapid HR</td>
<td>β-blockers, Faster scanning</td>
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<tr>
<td>Stairstep</td>
<td>Variable HR</td>
<td></td>
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Dual Source CTA

- Reduced scan time
- Reduced contrast volume
- Reduced radiation
- Improved spatial and temporal resolution
- Reduced need for β-blockade

Mett et al. AJR, 2007; 189: 567-573

Dual Source CTA

- 3 sec scan
- 50 cc contrast
- No β-blockade

2.1 mSv

Blooming

- Focus appears larger than it really is - obscures lumen and overestimates stenosis
- Occurs at interface of very high attenuation
  - Calcifications
  - Stents

Is this a High Grade Lesion?

Window/Level Settings

- 800/100
- 1200/200
- 1400/300
Kernel Selection

Iterative Reconstruction

Compared to FBP, iterative reconstruction:
- reduces image noise
- increases accuracy, specificity, & PPV
- reduces unnecessary follow-up exams

Renker et al. Radiology 2011; 260: 390-399

Is this a high-grade stenosis?

Renker et al. Radiology 2011; 260: 390-399

> 70%

> 70% ~ 50%
Processing

Segmentation Error

Tracking from artery into vein

Segmentation Error

Is this a real defect?

Blooming

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| Lumen obscured adjacent to calcified plaque or within stent | - Increase FOV  
- Reduce slice thickness  
- Correct window/level  
- Hard kernel  
- Iterative recon |

Segmentation

- MIPs, CPRs
- Check center lines
- Verify any abnormality on source images, additional views or phases
Segmentation Error

ECG-Editing

- Improve motion artifact associated with isolated irregular heart rate

ECG-Editing

- Resolves with centerline correction

ECG-Editing

- PVC 1
- PVC 2
Post ECG-Editing

ECG-Editing

- Improve motion artifact associated with isolated irregular heart rate
- Improve streak artifact associated with cardiac pacing leads in RCA assessment*

Conclusions
Conclusions

- Optimization of technical parameters are essential for high quality imaging
- Most common artifacts are due to motion, calcifications, or processing errors
- Dual energy CTA, iterative reconstruction, and ECG-editing can minimize pitfalls

Iterative reconstruction facilitates coronary artery CTA interpretation by:

A. Increasing spatial resolution
B. Permitting lower scan dosing
C. Reducing blooming artifact
D. All of the above