Prospects for Imaging
Myocardial Perfusion with CT

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Disclosures

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Siemens
Bayer
Bracco
General Electric Healthcare
Medrad
Primary morphological vs. functional evaluation of CAD (i.e. SPECT vs. ICA, CTA)?

Early attempts at CT imaging
- Limited by experimental nature
- Limited by dedicated acquisition protocols

Hybrid Imaging (e.g. SPECT and CT)

Dual-energy CT for myocardial perfusion defects

Delayed enhancement dual-energy CT

Adenosine stress dual-energy CT

Quantitative, time-resolved perfusion assessment

Integrative CHD Imaging with CT
Solving Clinical Dilemmas...

No stenosis
- Rule-out
  - Discharge

Intermediate stenosis
- Rule-in
  - Dynamic Volumetric Stress MPI
  - DECT Stress/Rest MPI
  - Discharge

High grade stenosis
- Rule-out
  - Cathlab
EBCT: Porcine Model of Myocardial Perfusion

Perfusion CT: Animal Models

Infarct Detection with CT

CT for Myocardial Ischemia

Nikolaou K. et al., Eur Radiol 2005
Early Animal Experience with 16-Slice MDCT

Perfusion CT

Mahnken A.H. et al. Eur Radiol 2004
64-Slice CT: Porcine MI Model

“Perfusion” CT: Animal Models

Lardo A.C. et al., Circulation 2006
64-Slice CT Adenosine Stress: Canine MI Model

“Perfusion” CT: Animal Models

George R.T. et al., JACC 2006
ECG-triggered sequential shuttle mode, coverage 8 cm, acquisition in end-systole

Dynamic Time Resolved Perfusion
Stress Dynamic CT Perfusion Protocol

G. Bastarrika et al., Invest Radiol 2010
Dynamic Time Resolved Perfusion

140 µg/min/kg Adenosine Stress, Image Acquisition over 30 Seconds

G. Bastarrika et al., J Cardiovasc Comput Tomography 2010
Absolute MBF Quantification

MBF: 124ml/100 ml/min

MBF: 60ml/100 ml/min
Results: Absolute quantification

Significant difference in MBF between normal and hypoperfused myocardium (p<0.001)

Moderate correlation between absolute MBF quantification and upslope of SI over time curves (r = 0.47, p<0.01)

Moderate correlation between MBF and semiquantitative upslope for hypoperfused and normal myocardium (r = 0.41, p<0.01 vs. r = 0.43, p<0.01)
Dynamic Time Resolved Perfusion

G. Bastarrika et al., J Cardiovasc Comput Tomography 2010
Dynamic Time Resolved Perfusion
50yo man w/ chest pain
Dynamic Time Resolved Perfusion
95% RCA stenosis

Stress

Rest

Blood flow in defect: 65 cc/100 cc/ min
Blood flow in healthy myocardium: 112 cc/100 cc/ min

Rotation time: 0.28 s
Temporal resolution: 75 ms
Tube voltage: 100 kV
Prospectively triggered scans for 30 s

Ho et al., Journal of Cardiovascular Computed Tomography, Vol 5, No 2, March/April 2011
Monitoring Therapeutic Effects

Blood flow in former defect: 118 cc/ 100 cc/ min

Blood flow in healthy myocardium: 112 cc/ 100 cc/ min

Rotation time: 0.28 s
Temporal resolution: 75 ms
Tube voltage: 100 kV
Prospectively triggered scans for 30 s

Ho et al., Journal of Cardiovascular Computed Tomography, Vol 5, No 2, March/April 2011
<table>
<thead>
<tr>
<th>Discriminator</th>
<th>DECT</th>
<th>Dynamic Perfusion</th>
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<tbody>
<tr>
<td>Radiation dose</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Volume coverage</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Temporal resolution</td>
<td>+++</td>
<td>+++</td>
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<tr>
<td>Ease of acquisition</td>
<td>+++</td>
<td>++</td>
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<tr>
<td>Ease of post-processing</td>
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<tr>
<td>Structural information</td>
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<tr>
<td>Perfusion information</td>
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<td>Viability information</td>
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<tr>
<td>Quantification</td>
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Promising developments for CT imaging of myocardial perfusion and delayed enhancement

CT not the primary method for evaluation of myocardial perfusion

CTA is mainly aimed at imaging the coronaries

CT a possibly attractive modality for integrative imaging of anatomy and perfusion

Further refinements in technique (e.g. area detector CT, dual-energy CT)
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Thank You!!