Dual Energy CT of The Heart

U. Joseph Schoepf, MD, FAHA, FSCBT-MR, FSCCT
Professor of Radiology, Medicine, and Pediatrics
Director of Cardiovascular Imaging
Disclosures

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Bracco
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Medrad
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Integrative CHD Imaging with CT

- 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
Integrative Imaging: DECT
DECT for Myocardial Ischemia

74-yo woman with chest pain and abnormal SPECT

2x64x0.6mm, 80kV/140kV 0.33 s rotation time
74-yo woman with chest pain and abnormal SPECT
Tight proximal stenosis D1

Morphology and Function: DECT

B. Ruzsics et al., Circulation 2008
74-yo woman with chest pain and abnormal SPECT

B. Ruzsics et al., Circulation 2008
DECT Postprocessing

DECT Raw Data

Merged Image (70% 140 kV and 30% 80 / 100 kV) for cCTA Analysis

140 kV Image Data

80 / 100 kV Image Data

Virtual Non-Enhanced Image

Iodine Map

VNC Tool

Final DECT Image

F. Schwarz et al., Eur J Radiol 2008
## DECT Radiation Dose

<table>
<thead>
<tr>
<th></th>
<th>16-Slice CT</th>
<th>DSCT</th>
<th>DECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation Dose</td>
<td>12 ± 3.59 mSv</td>
<td>9.8 ± 4.77 mSv</td>
<td>4.54 ± 1.87 mSv</td>
</tr>
</tbody>
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JM Kerl et al., Eur Radiol 2010
36 yo woman, DM I
ho LAD infarct
Reversible Ischemia at Rest DECT

61 yo man, atypical chest pain
DECT Can Detect Subtle Pathology

Vliegenthart et al., AJR in press
Delayed Enhancement DECT

B. Ruzsics et al., HEART 2009
Delayed First Pass LAD

B. Ruzsics et al., HEART, in press

Delayed Enhancement DECT
Delayed Enhancement DECT

Ruszcsics et al., RSNA 2009
<table>
<thead>
<tr>
<th>-1 month</th>
<th>0</th>
<th>1 week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal SPECT rest and/or stress</td>
<td>Rest DECT</td>
<td>Rest ceMRI (perfusion)</td>
</tr>
<tr>
<td>Adenosine DECT</td>
<td>Adenosine DECT</td>
<td>Adenosine ceMRI (perfusion)</td>
</tr>
<tr>
<td>Delayed DECT (sequential)</td>
<td>Delayed Enhancement (viability)</td>
<td></td>
</tr>
</tbody>
</table>

Adenosine protocol: 140 µg/min/kg

B. Ruzsics et al., AHA 2008
Adenosine Stress DECT

Reversible Ischemia
Adenosine Stress cMRI

Reversible Ischemia
### Reversible Ischemia

<table>
<thead>
<tr>
<th>Rest</th>
<th>Stress</th>
<th>Delayed</th>
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<tbody>
<tr>
<td><img src="rest.png" alt="Image" /></td>
<td><img src="stress.png" alt="Image" /></td>
<td><img src="delayed.png" alt="Image" /></td>
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</tbody>
</table>

The images above illustrate the process of reversible ischemia. At rest, the myocardium appears healthy. During stress, there is a decrease in perfusion, indicated by the arrows. In the delayed phase, the area of ischemia is no longer visible, indicating reversibility.
• Larger scan field of view (SFOV) for Dual Energy modes
• SFOV A/B-detector: 50/33 cm

Next Generation DECT
• Dual Energy with Selective Photon Shield
• Improved separation of low and high energies
• Noise reduction
• Greater dose reserve

**Next Generation DECT**
83 msec Temporal Resolution in Dual-Energy Mode

165 msec 83 msec

DECT Temporal Resolution
Next Generation DECT
Quantitative DECT Perfusion
Promising developments for DECT imaging of the myocardial blood supply and viability

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 impending
schoepf@musc.edu

Thank You!!