Wide Area Detector CT: Update 2010

Frank Rybicki MD, PhD

Director, Cardiac CT & Vascular CT/MRI
Director, Applied Imaging Science Laboratory
Brigham and Women’s Hospital
Associate Professor, Harvard Medical School
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<tr>
<th></th>
<th>Speakers Bureau</th>
<th>Advisory Board</th>
<th>Grant Support</th>
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<td>Toshiba</td>
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CT Detector Evolution

16.2 cm

32x32 Detectors Elements
64 Slice Helical

64 Slice

Exposure

~12 - 15 mSv
Step and Shoot Prospective

- Multiple over-lapped rotations over several heartbeats
- No functional information
- Spatial and contrast variations
- The heart must be pieced together from different moments in time

64 Detector
320-Detector Row Cardiac Acquisition

- Retrospective

- Prospective

> < phase window width
Prospective ECG gating

16 cm
Outline

Cardiac Imaging

- Can practical dose reduction be data driven?
- Can a simple perfusion algorithm be validated?
- Can we extract additional useful data from a standard wide-area detector CT acquisition?

Other CV Applications

- Whole-brain imaging
- Face transplantation
- Organ perfusion
Discussion

Cardiac
Dose reduction is introduced in the context of initial evaluations of the technology, followed by methods for reducing dose while maintaining diagnostic image quality.
Perfusion CT is discussed in the context of Core320.
Contrast opacification gradients and vascular profiling represent methods for extracting additional data from wide-area detector cardiac CT.

Other Applications
Whole brain imaging without table motion can be achieved with 320 CT.
Novel applications such as face transplantation allograft imaging have been enabled by new technologies.
Applications for organ perfusion are being explored.
# 320 cardiac CT – Initial Experience

<table>
<thead>
<tr>
<th></th>
<th>BMI (kg/m²)</th>
<th>ECG-Gating</th>
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<tbody>
<tr>
<td></td>
<td>&lt;30</td>
<td>&gt;30</td>
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<tr>
<td>Mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.9 (3.1)</td>
<td>8.7 (3.7)</td>
</tr>
<tr>
<td>Range</td>
<td>4.9-15.6</td>
<td>5.2-18.1</td>
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<tr>
<td>$p$</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
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</tbody>
</table>

Pro gated patients with 60-100% phase window (n=25)
Dose = 6.8 ± 1.4 mSv

Lower Dose Imaging (100 kV)

2.6 mSv
Myocardial Perfusion

57 yo woman with hypertension and hyperlipidemia complaining of atypical chest pain

adenosine stress CT perfusion imaging

Courtesy of Richard T. George and Joao A.C. Lima, Johns Hopkins University, Division of Cardiology
Myocardial Perfusion

Rest  Stress

3 mm short axis reconstructions

Courtesy of Richard T. George and Joao A.C. Lima, Johns Hopkins University, Division of Cardiology
Contrast Opacification Gradients

A

Patient without CAD

\[ HU = -7.1033 \times \text{Distance} + 315.47 \]
\[ r^2 = 0.68 \]

\[ HU = -14.967 \times \text{Distance} + 359.39 \]
\[ r^2 = 0.74 \]
44 y.o. male, smoker, atypical CP, neg markers

CTA Lumen Rendering

Shear Stress Maps
Comparison of CTA & IVUS Derived Lumen Size / ESS Profiles

320 CT for face transplantation

36 yo man s/p midface injury after gunshot wound: loss of nasoethmoid complex, bilateral orbital floors, maxilla, palate, mandible, upper and lower lips, anterior tongue


U.S. Department of Defense W911QY-09-C-021
### 320 CT protocol – Face Transplant

<table>
<thead>
<tr>
<th>Scan Type</th>
<th>kVp</th>
<th>mA</th>
<th>Rot. Time</th>
<th>Start Sample Time</th>
<th>Acquisition Interval</th>
<th>Total Acquisition Time</th>
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<td>One Shot (Mask)</td>
<td>80 kVp</td>
<td>310 mA</td>
<td>0.75 sec</td>
<td>7 sec</td>
<td>—</td>
<td>1 sec</td>
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<tr>
<td>Dynamic</td>
<td>80 kVp</td>
<td>150 mA</td>
<td>0.75 sec</td>
<td>11-17 sec</td>
<td>2 sec</td>
<td>8 sec</td>
</tr>
<tr>
<td>Dynamic</td>
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<td>300 mA</td>
<td>0.75 sec</td>
<td>19-27 sec</td>
<td>2 sec</td>
<td>6 sec</td>
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<tr>
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<td>150 mA</td>
<td>0.75 sec</td>
<td>30-36 sec</td>
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<td>6 sec</td>
</tr>
<tr>
<td>Dynamic</td>
<td>8 kVp</td>
<td>150 mA</td>
<td>0.75 sec</td>
<td>40-60 sec</td>
<td>5 sec</td>
<td>20 sec</td>
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Effective dose <10 mSv: 1.9 mSv for head plus 7.4 mSv for neck
SVD - Relative blood volumes

Software is designated for cerebral blood perfusion - relative tissue perfusion blood volume and time to peak mapping
Renal donor CT: vascular mapping plus perfusion