Abdominal 320-detector row CT: Capability for small vasculature assessment

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Purpose

Recently, a new generation of CT systems with 320-detector rows (Area-detector CT, ADCT) has become clinically available, and enabled to perform volumetric imaging.

With this system, a complete volume data set covering the entire heart and/or brain can be acquired at a single rotation, and several investigators have discussed the utility of ADCT for cardiac and brain imaging [1-5].

there have been no reports concerning whole abdominal imaging using ADCT.

To evaluate the capability of 320-slice volume multidetector row CT (Area-detector CT: ADCT) with wide volume scan (step-and-shoot scan) protocol for assessment of small abdominal vasculature in comparison with 64-multidetector row CT (64-MDCT) with helical scan protocol.
Methods and Materials

**Patient population**

Total of 60 patients underwent contrast-enhanced abdominal CT for preoperative assessment between September 2008 and August 2009.

30 patients (17 male, 13 female; mean 72.9 yrs) suspected to have lung cancer underwent ADCT using wide volume scan (step-and-shoot scan) protocol with several rotations of "volume scan mode".

The other 30 patients (16 male, 14 female; mean 68.2 yrs) suspected to have renal cell carcinoma underwent 64-MDCT using helical scan protocol.

The study was approved by the local ethics committee and informed consent was obtained from all patients.

**Data acquisition**

• ADCT (Aquilion One, Toshiba Medical System, Japan)

  a 0.35 second gantry rotation speed, a tube voltage of 120kVp, a tube current of 400mA, 200-320x0.5mm

  80ml of contrast-media (iopamidol-370 mg I/ml, Bayer Schering Pharma, Osaka, Japan) and 20 ml of saline was administered at rate of 3.0 ml/sec

  The scanning protocol consisted of unenhanced and the three delay times of 40, 70, and 150 seconds after the injection

  All four scans were extended from the diaphragm to the pelvic floor

• 64-MDCT (Aquilion, Toshiba Medical System, Japan)

  a 0.5 second gantry rotation speed, a tube voltage of 120kVp, a tube current of 350mA, 64x0.5mm, beam pitch 0.94

  90ml of contrast-media (iopamidol-370 mg I/ml) and 20 ml of saline was administered at rate of 3.0 ml/sec

  The scanning protocol of 64-MDCT consisted of unenhanced and triphasic contrast enhanced scans during arterial, corticomedullary, and nephrographic, phases
The start delay was from 25 to 30 seconds (using "smart prep" system) for the arterial phase, 60 seconds for the corticomedullary phase, and 120 seconds for the nephrographic phase.

The unenhanced scan and nephrographic phases were extended from the diaphragm to the biacetabular line. Scans during arterial and corticomedullary phases were taken from the diaphragm to the bifurcation of the aorta.

**Data analysis**

Two experienced abdominal radiologists (14 and 8 years of experience in abdominal CT) independently assessed the visualization of 1) bilateral inferior epigastric, 2) hepatic subsegmental, 3) mesentric marginal (Griffith point) and 4) bilateral inferior phrenic arteries, on arterial-dominant phase images (40 seconds after the injection of the contrast medium on ADCT, 25 to 30 seconds after the injection of the contrast medium on 64-MDCT), by a 5-point grading scale: 5, definitely present; 4, probably present; 3, possible present; 2, probably absent; and 1, definitely absent.

**Statistical analysis**

Interobserver agreement for image quality between the readers was assessed for each vessel by using Kappa statistic.

Visualization scores for each vessel were compared between the two protocols by using Mann-Whitney U-test.

For the comparison of continuous variables between the two protocols, unpaired-t test was used.

P values of less than 0.05 were considered to indicate statistical significance.
Results

Patient characteristics

<table>
<thead>
<tr>
<th></th>
<th>ADCT group</th>
<th>64-MDCT group</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>Mean±SD</td>
<td>55.0±10.5</td>
<td>57.5±9.2</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>37~83</td>
<td>39~75</td>
</tr>
<tr>
<td>Body max index (kg/m2)</td>
<td>Mean±SD</td>
<td>22.3±3.6</td>
<td>22.7±2.4</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>16.7~29.1</td>
<td>16.7~29.8</td>
</tr>
<tr>
<td>CTDI vol.e (mGy)</td>
<td>Mean±SD</td>
<td>107.3±18.5</td>
<td>100.2±16.6</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>70.6~146.3</td>
<td>82.0~150.6</td>
</tr>
</tbody>
</table>

Kappa Value

<table>
<thead>
<tr>
<th></th>
<th>#DCT group</th>
<th>64-MDCT group</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt inferior epigastric</td>
<td>0.73</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>Lt inferior epigastric</td>
<td>0.61</td>
<td>0.64</td>
<td></td>
</tr>
<tr>
<td>Hepatic subsegmental</td>
<td>0.74</td>
<td>0.82</td>
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<tr>
<td>Mesentric marginal</td>
<td>0.84</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>Rt inferior phrenic</td>
<td>0.93</td>
<td>0.86</td>
<td></td>
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<tr>
<td>Lt inferior phrenic</td>
<td>0.82</td>
<td>0.88</td>
<td></td>
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<tr>
<td>Overall</td>
<td>0.85</td>
<td>0.86</td>
<td></td>
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</tbody>
</table>

Visualization scores

<table>
<thead>
<tr>
<th></th>
<th>ADCT group</th>
<th>64-MDCT group</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rt inferior epigastric</td>
<td>3.97±0.41</td>
<td>3.03±0.67</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Lt inferior epigastric</td>
<td>4.03±0.41</td>
<td>3.17±0.65</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Location</td>
<td>Mean ± SD 1</td>
<td>Mean ± SD 2</td>
<td>p-value</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>Hepatic subsegmental</td>
<td>4.87±0.35</td>
<td>4.73±0.52</td>
<td>0.3</td>
</tr>
<tr>
<td>Mesentric marginal</td>
<td>4.40±0.72</td>
<td>3.77±0.90</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Rt inferior phrenic</td>
<td>4.63±0.56</td>
<td>4.70±0.60</td>
<td>0.47</td>
</tr>
<tr>
<td>Lt inferior phrenic</td>
<td>4.47±0.12</td>
<td>4.50±0.13</td>
<td>0.73</td>
</tr>
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</table>
**Fig. 0:** 76-year-old female in ADCT group. Coronal reconstructed 320-detector row CT images with step-and-shoot scan protocol clearly shows bilateral inferior epigastric arteries.

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Fig. 0: 62-year-old female in ADCT group. Coronal reconstructed 320-detector row CT images with step-and-shoot scan protocol clearly shows mesenteric marginal artery (Griffith point).

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Fig. 0: 62-year-old female in ADCT group. Coronal reconstructed 320-detector row CT images with step-and-shoot scan protocol clearly shows mesenteric marginal artery (Griffith point).

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Conclusion

ADCT with step-and-shoot scan protocol offers excellent vascular images and can be used for small abdominal vasculature assessment in routine clinical practice.

In the future, volumetric cine and perfusion imaging on the abdominal organs using "dynamic volume scan" mode of ADCT is expected.
References


Personal Information

Abdominal 320-Detector Row CT: Capability for Small Vasculature Assessment

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