Use of 80kV, 100kV and 120kV in coronary CT angiography with prospectively electrocardiogram (ECG)-triggered spiral acquisition by dual-source CT: image quality and radiation dose

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**Purpose**

To compare the image quality (IQ) and radiation exposure using of 80kV, 100kV and 120kV tube voltage with prospectively electrocardiogram (ECG)-triggered spiral acquisition among patients referred for cardiac dual source CT exam (DSCT).

**Methods and Materials**

Totally ninety consecutive patients (with suspected or known coronary artery disease) with a stable heart rate<70 beats per minute (bpm) underwent coronary CT angiography. They were randomly divided into three groups and different tube voltage (80kV, 100kV and 120kV) were used. A dual source CT scanner was used (0.6mm collimation, 0.28s rotation time). A flying focus along the z-axis (z-sharp technology) was used to acquire data in 2×128 slices. For coronary CTA, 50 ml of contrast agent were injected, followed by a 50 ml saline, both at flow rates of 5 mL/s. Data acquisition was prospectively ECG-triggered at 60% of the R-R interval with a pitch of 3.4. Images were reconstructed with 75ms temporal resolution, 0.75mm slice thickness and 0.5mm increment. Maximal intensity projections (MIP) and multi planar reformation (MPR) images were used for image analysis. Both the image quality and radiation exposure of the three groups were evaluated. IQ was evaluated on a per-segment basis, using the 15-segment model of the Society of Cardiovascular Computed Tomography. A three point scale was used (1= excellent, 3= unevaluable). CT dose index volume (CTDlvol) and dose-length product (DLP) were provided by the scanner console. Effective radiation dose was estimated based on the DLP, using a conversion factor of 0.014 for chest CT in adults.

**Results**

A comparison of patient characteristics of the 80kV, 100kV and 120kV groups was in Table 1. There was no remarkable difference in age, gender, heart rate and body mass index (BMI) of the three groups. The mean tube current was 269.75±40.30 in 80kV group, 317±33.68 in 100kV group, 322.57±70.45 in 120kV group. The mean tube current of 80kV group was significantly lower than the other two groups. The average image quality score was 1.01±0.26 in 80kV group, 1.00±0.19 in 100kV group, and 1.14±0.38 in 120kV group. The IQ score was significantly higher for 120 kV group. No statistical difference was found between 80kV and 100kV groups (P<0.01). The rates of evaluable coronary segments showed no significant difference for the three groups (99.51%, 99.56%, 98.87%, P>0.05). The CTDlvol for the 80kV, 100 kV and 120 kV groups was 1.24±0.16, 3.09±0.33 and 5.26±1.14mGy, corresponding to an effective radiation dose of 0.31±0.04, 0.77±0.10, and 1.31±0.30 mSv respectively. There was statistical difference among them (P=0.00).
**Table 1:** Patient characteristics

<table>
<thead>
<tr>
<th></th>
<th>80kV</th>
<th>100kV</th>
<th>120kV</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients(female)</td>
<td>30 (12)</td>
<td>30 (12)</td>
<td>30 (11)</td>
<td></td>
</tr>
<tr>
<td>Age(years)</td>
<td>62.86±10.15</td>
<td>58.6±9.51</td>
<td>61.63±9.95</td>
<td>0.237</td>
</tr>
<tr>
<td>BMI(kg/m²)</td>
<td>24.17±2.34</td>
<td>25.06±2.14</td>
<td>24.33±2.96</td>
<td>0.215</td>
</tr>
<tr>
<td>HR (bpm)</td>
<td>55.54±4.65</td>
<td>55.6±4.72</td>
<td>57.23±5.35</td>
<td>0.239</td>
</tr>
</tbody>
</table>

**Fig. 1:** Example of coronary CT angiography acquired with tube voltage of 80 kV. A 53-year-old male patient with body mass index of 25.0, a heart rate of 58 bpm and effective dose of 0.30 mSv.
Fig. 2: Example of coronary CT angiography acquired with tube voltage of 100 kV. A 63-year-old female patient with body mass index of 26.0, a heart rate of 52 bpm and effective dose of 0.79 mSv.

Fig. 3: Example of coronary CT angiography acquired with tube voltage of 120 kV. A 69-year-old male patient with body mass index of 24.2, a heart rate of 60 bpm and effective dose of 0.97 mSv.
Conclusion

In our study, lower tube voltage was not specially selected for those thinner patients. The BMI of the three groups had no difference, which was close to the upper limit of the normal weight status. In patients with a low and stable heart rate (< 70bpm), use of low tube voltage reduces radiation dose to consistently below 1.0 mSv and may result in improved image quality.

References


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