Dose and image quality in CT pulmonary angiography: Comparison of Dual-Source CT, third generation Dual-Energy CT and conventional 64-slice spiral CT

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Purpose

To compare radiation dose and image quality of turbo high-pitch dual-source computed tomography (DSCT), dual-energy CT (DECT) and conventional single-source spiral CT (SSCT) for pulmonary CT angiography (CTA) on a 3rd generation dual-source CT, respectively a 64-slice CT system.

Methods and Materials

Prospectively a total of 120 patients matched for sex, age, and body-mass-index were identified for this study and divided in three groups of 40 patients each. CTDIvol, DLP, subjective image quality as assessed by two readers (five-point scale: 1 = excellent; 2 = good; 3 = moderate; 4 = poor; 5 = non-diagnostic), measured CT attenuation (HU) in three central and peripheral levels, background noise (BN) and calculated signal-to-noise-ratio (SNR) were compared.

CT protocol settings of each patient group were chosen according to the manufacturer's recommendations:

- Group 1: For conventional 64-slice SSCT the parameters were: 120 kV tube voltage, 150 mAs, 2x32x0.6 mm collimation with z-flying focal spot, 0.33 seconds gantry rotation time, and 300 mm/s table speed at a pitch factor of 1.4.
- Group 2: For single-energy DSCT the following parameters were used: 100 kV tube voltage, 150 mAS, 192x0.6 mm collimation, 0.25 seconds gantry rotation time, and 400 mm/s table speed at a pitch factor of 1.55.
- Group 3: For DECT acquisition the parameters were: 90 kV tube voltage (A tube) / 150 kV tube voltage (B tube), 300 mAs (A tube) / 150 mAs (B tube), 192x0.6 mm collimation, 0.25 seconds gantry rotation time, and 200 mm/s table speed at a pitch factor of 0.55. The dual-energy FOV was limited to 35.5 cm because of the smaller x-y axis coverage of the B detector.

Results

Mean CTDIvol and DLP were significantly lower (CTDIvol: 1 vs. 3: $p<0.001$; 2 vs. 3: $p=0.002$ / DLP: 1 vs. 3: $p<0.001$; 2 vs. 3: $p<0.001$) in group 3 (4.49±1.48 mGy / 161±55 mGycm) compared to group 1 (7.45±2.72 mGy / 252±96 mGycm) and group 2 (6.46±3.72 mGy / 228±136 mGycm).

Subjective image quality was rated good to excellent in >91% (110/120) with an interreader agreement of 90.3%.

The three protocols did not significantly differ in subjective image quality.

While group 3 presented with higher BN levels (1 vs. 3: $p=0.003$; 2 vs. 3: $p=0.026$), background noise was similar between group 1 and group 2. The SNR was highest in group 2 (1 vs. 2: $p<0.002$; 2 vs. 3: $p<0.001$) and similar between groups 1 and 3.

Conclusion

The use of third generation DECT in 90/Sn150 kV configuration allows for significant dose reduction in pulmonary CTA while providing excellent image quality and potential additional information by means of iodine perfusion maps (Figures 1 - 3).

Images for this section:

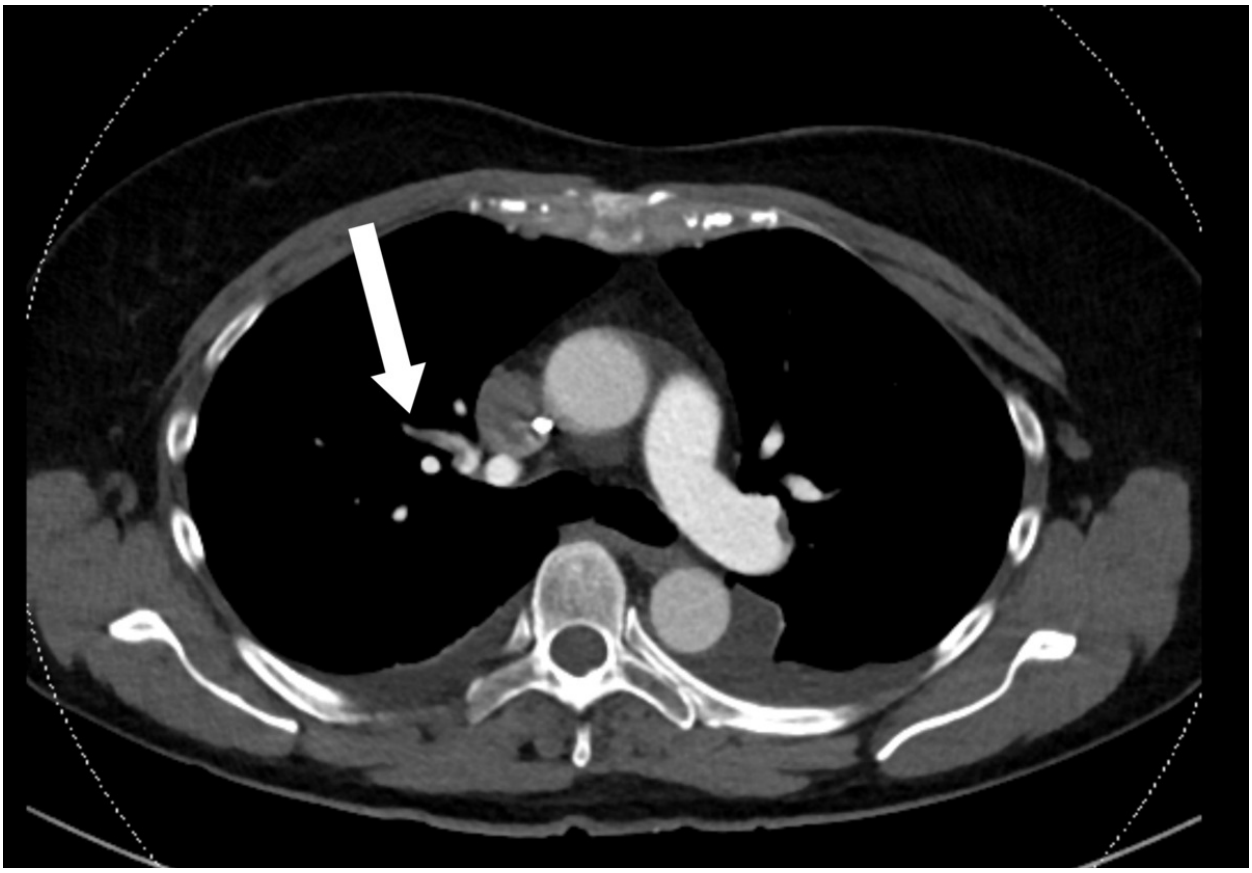

Fig. 1: Axial blended virtual 120 kV angiographic image indicates segmental PE (arrow).

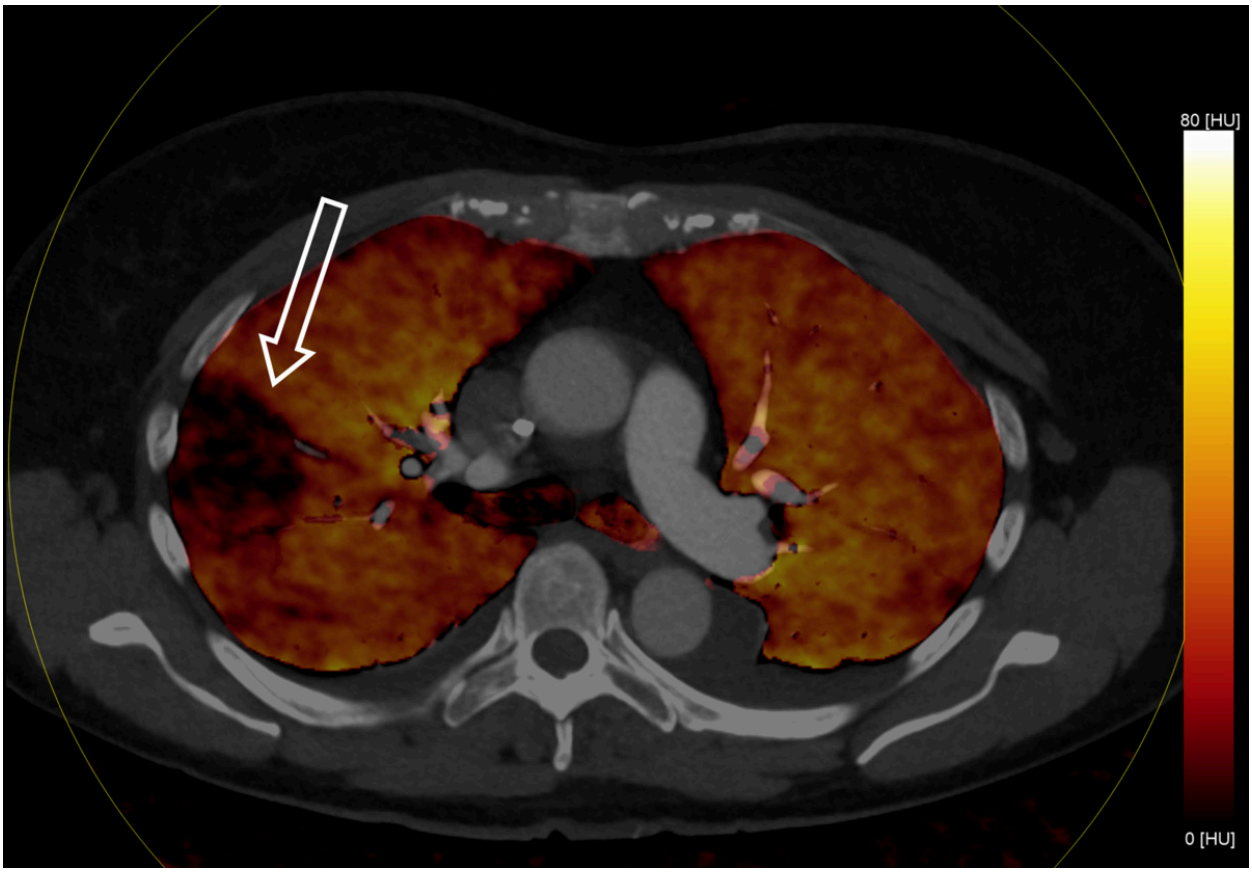

Fig. 2: Axial reconstruction visualizes wedge-shaped perfusion defect in the color-coded iodine map (open arrow).

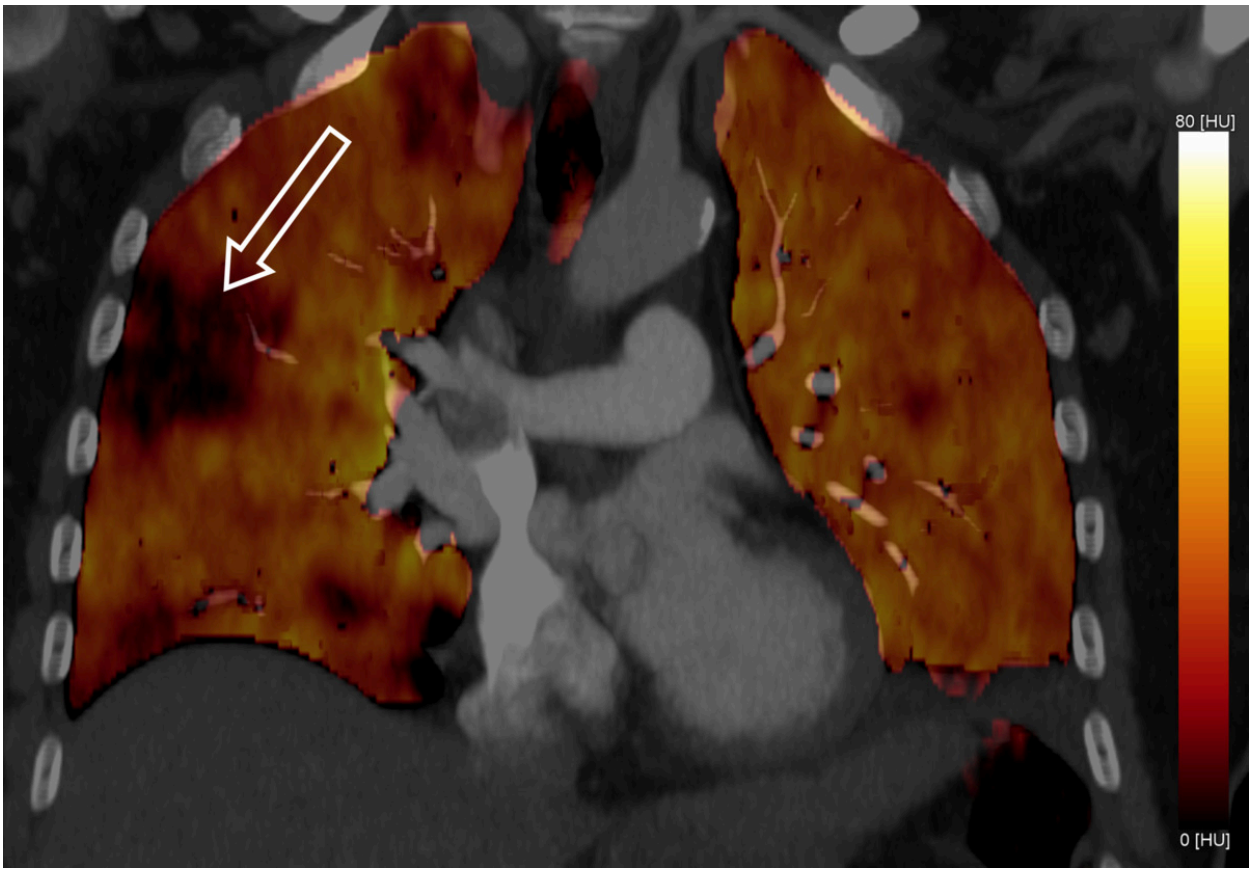

Fig. 3: Coronar reconstruction visualizes wedge-shaped perfusion defect in the color-coded iodine map (open arrow).

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