Correlation of DCE-MRI lung perfusion parameter maps with dual-energy CT derived iodine perfusion maps

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Clinical Background and Study Purpose:

DECT of the lungs allows the visualization of parenchymal iodine distribution, which might be considered as a surrogate of pulmonary perfusion (1). However, this selective visualization of iodine distribution in the pulmonary parenchyma is not perfusion imaging in the classical sense but rather a static display of the distribution of iodine based contrast material in the lung parenchyma as related to a previously defined scan delay. Contrast enhanced time resolved MRI perfusion imaging of the lung allows for an accurate assessment of lung perfusion (2). The purpose if this study was to investigate the correlation of dual energy CT (DECT) derived iodine maps with parameter maps derived from quantitative pulmonary perfusion MRI.

Methods and Materials:

In a prospective and HIPAA compliant study 18 patients (11 men, 7 women, age range 20-81) with pulmonary perfusion defects detected on iodine maps of dual energy CT pulmonary angiography (DE-CTPA) additionally underwent time-resolved contrast-enhanced pulmonary MRA.

MRI data were quantitatively analyzed by a pixel-by-pixel deconvolution analysis using an in-house developed software plugin (3), integrated into a standard DICOM viewer (OsiriX 3.7.1). Regional pulmonary blood flow (PBF), pulmonary blood volume (PBV) and mean transit time (MTT) were calculated in visually normal lung parenchyma as well as perfusion defects. Perfusion parameters were correlated to mean attenuation values of normal lung and perfusion defects on DECT iodine maps. Two readers rated the concordance of perfusion defects in a visual analysis using a 5-point Likert-scale (1 = no correlation, 5 = excellent correlation).

Results:

In normal pulmonary tissue the mean value for PBF was 58.8 ± 36.0 ml/100 ml/min, the PBV was 16.6 ± 8.5 ml and the MTT was 17.1 ± 10.3 s. In areas with restricted perfusion the PBF was 10.3 ± 5.5 ml/100 ml/min, the PBV was 5 ± 4 ml and the MTT was 21.6 ± 14.0 s. A statistically significant difference was found for PBF and PBV (p-value < 0.0001).

Mean attenuation values of normal parenchyma DE-CTPA iodine maps was 22.6 ± 8.3 Hounsfield units (HU) in and 4.0 ± 3.9 HU in perfusion defects (p<0.0001). No linear correlation was found between MRI perfusion parameters and attenuation values of DECT iodine maps. In the visual analysis there was a good correlation between the distribution of perfusion defects on DECT iodine maps and the parameter maps of DCE-MRI (Median score 3.6, kappa 0,45).

Conclusion:

There is a high, although not statistically significant, visual correlation of DECT iodine maps with perfusion parameter maps of DCE MRI. Further research is needed to verify whether DECT iodine maps might be used as a surrogate of pulmonary perfusion.

References:

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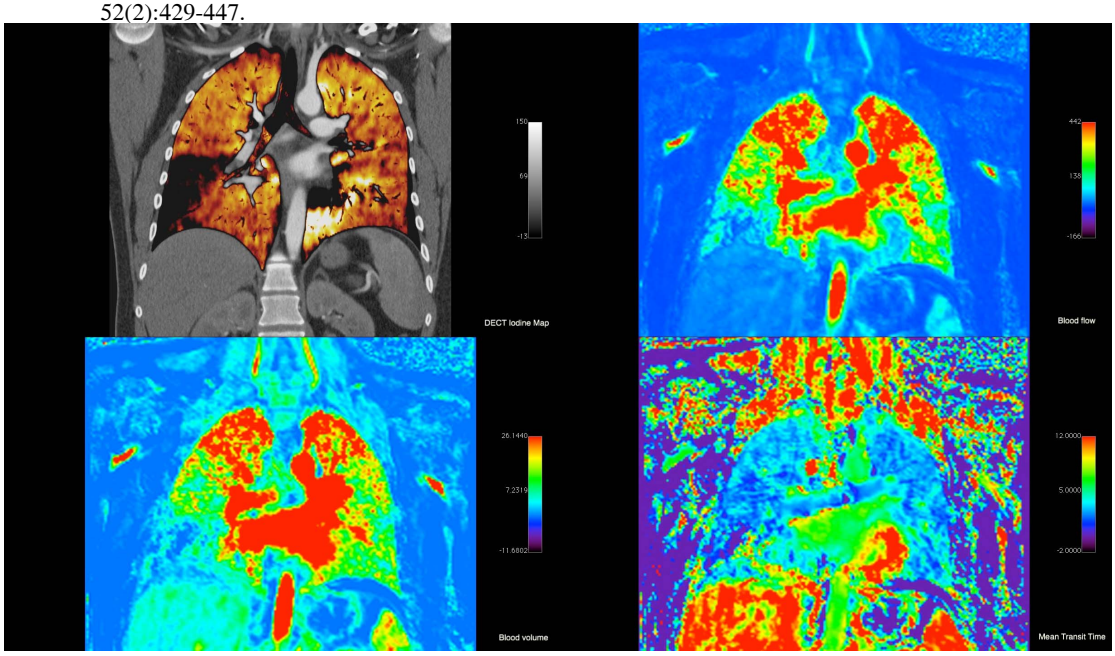
3. Sourbron S et al: Pixel-by-pixel deconvolution of bolus-tracking data: optimization and implementation. Phys Med Biol 2007, 52(2):429-447.



Correlation of perfusion deficits in a 20 year old male with pulmonary embolism. Clockwise from top left: DECT derived iodine map; Pulmonary blood flow; Pulmonary blood volume; Mean transit time