

## Efficacy of 3D whole-lung single breath-hold contrast enhanced pulmonary MRA for detection of pulmonary embolism: comparison to CTA

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**Target audience:** Clinical scientists and radiologists interested in protocol optimization for pulmonary MRA.

**Purpose:** To determine the efficacy of CT angiography (CTA) and MR angiography (MRA) for the detection of pulmonary embolism (PE) [1].

**Methods:** 20 patients were enrolled prospectively to compare CTA to MRA for the detection of PE. MRA studies were performed within 48 hours of the clinically indicated CTA exam. All MRA exams were acquired at 1.5T (HDxt or MR450w, GE Healthcare, Waukesha, WI) using an 8- or 12-channel torso phased array coil. The imaging protocol consisted of pre-contrast, arterial-phase and immediate delayed-phase 3D CE-MRA (TR/TE 2.9/1.0ms, FOV = 34x27cm, slice thickness = 2.0mm, 140-160 slices, flip angle = 28°, BW = ±83kHz, 256x192 matrix). Contrast enhanced datasets were acquired at end-expiration following the injection of 0.1mmol/kg of gadobenate dimeglumine (Multihance) diluted in saline to a total of 30ml injected at a flow rate of 1.5ml/sec, and followed by a 30ml saline chaser injected at the same rate.

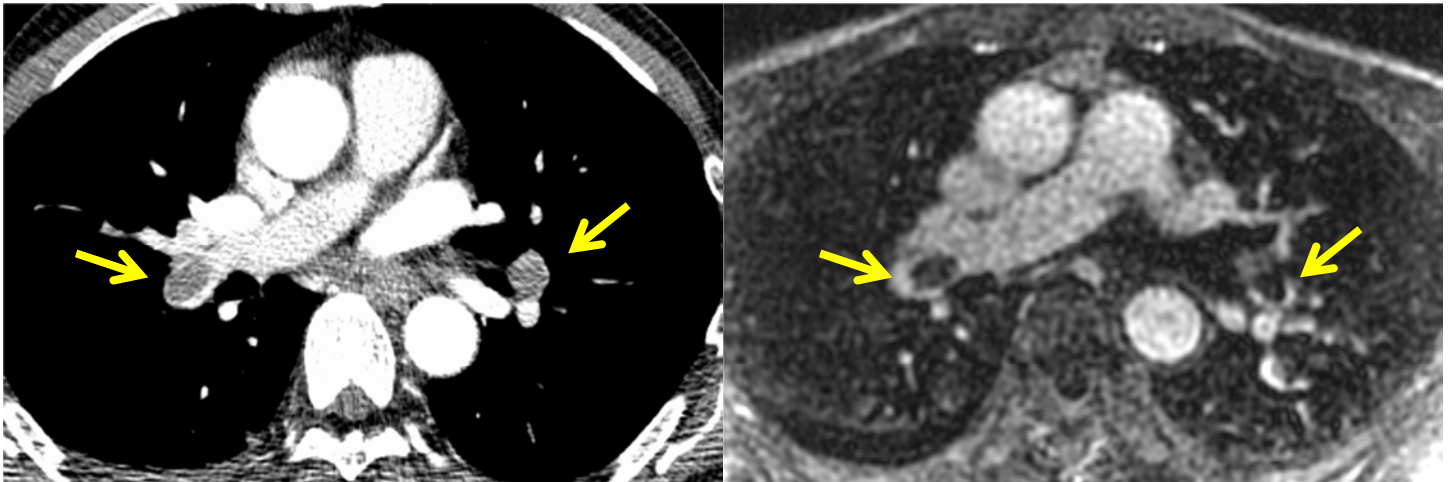
MRA exams were read in a blinded fashion by two experienced cardiovascular radiologists to determine the presence and location of pulmonary emboli. Statistical evaluation of test efficacy and observer agreement was performed using the CTA datasets as the reference standard. Patient level sensitivity and specificity were generated for each radiologist's ability to determine the presence of PE and the lobar location. Cohen's kappa values were also calculated.

**Results:** Of the 20 enrolled patients, two were excluded due to study discontinuation or technical failure. 18 studies were evaluated. A total of 12 patients showed evidence of PE in at least one lobe by CTA. Reader 1 demonstrated a sensitivity of 100% and specificity 55%, Reader 2 had sensitivity and specificity of 86% and 82% respectively. In comparison to 5 false positive results there were no false negative results on a patient level but in 2 of 24 on a lobar level. Inter reader agreements by means of Cohen's Kappa value was moderate with  $k=0.571$ .

**Discussion:** Numerous recent publications highlight the lower efficacy of Pulmonary MRA for the detection of PE when compared to CTA. Initial results of this ongoing study show promising data with no false negative results at the patient level. MRA seems to be oversensitive; this may be due to the presence of Gibb's ringing artifacts in segmental pulmonary arteries that were misinterpreted as PE.

**Conclusion:** The efficacy of MRA may lag that of CTA. However, continued development and evaluation is warranted given the high safety profile of MR, and may be appropriate in younger patients who are sensitive to exposure from ionizing radiation, in those patients with allergies to iodinated contrast agents, or as a follow up method in patients already diagnosed with PE. Finally, additional reader experience and the ability to identify PE-mimicking artifacts should also improve the accuracy of MRA.

**References:** [1] Stein PD, et al., Gadolinium-enhanced magnetic resonance angiography for pulmonary embolism: a multicenter prospective study (PIOPED III). *Ann Intern Med* 2010;152(7):434-443, W142-433.



Example of a patient suffering from pulmonary embolism with clots in the right and left main pulmonary artery (arrows). Note the excellent correlation between CT (left) and MRI (right) for detection of PE.