**THE COLLEGE OF
RADIOGRAPHERS**
INDUSTRY PARTNERSHIP SCHEME
SUPPORTING RADIOGRAPHY RESEARCH
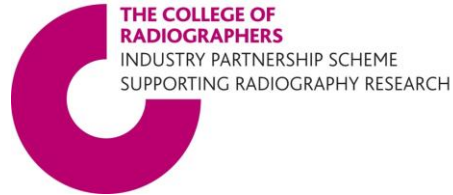
# College of Radiographers Industry Partnership Research Grants

## Final Report

| 1. Principal Investigator | Chris Everitt |
|---|---|
| 2. Project Title | A feasibility study into the accuracy of un-enhanced magnetic resonance imaging of pulmonary arteries (uMRPA) in the diagnosis of pulmonary embolism |
| 3. Amount of Grant | £1,984.75 |

**4. Did you spend the money as indicated in your proposal (if not why)?**

Yes

**5. Did you reach your intended project outcomes (if not why)?**

No, insurmountable difficulties in recruitment, timely MRI scanner access and radiological reporting difficulties

**6. What are your significant findings?**

With the reduced scanned participant numbers, the tested sequences did not accurately demonstrate PE (as diagnosed by CT).

**7. Have you submitted the work for publication (if so where)?**

No

**8. Have you presented the work at a national/international event (if so where)?**

No

**9. Please provide an executive summary of your work (two sides of A4 maximum)**

# A feasibility study into the accuracy of unenhanced magnetic resonance imaging of the pulmonary arteries in the diagnosis of pulmonary embolism

By Chris Everitt

As the risk of fatality from an undiagnosed PE is far worse than that posed by anti-coagulation/thrombolytic treatment, then investigations that over-estimate the presence of thrombus are preferable to those that under-call. Excellent sensitivity combined with good specificity is the ideal, which lung scintigraphy has for high and low probability patients but not for those considered to be at moderate risk.

A significant minority of patients, with clinically suspected PE, are contra-indicated for CTPA. Currently, these patients will either have a CTPA (with the increased risks to themselves of contrast agent complications or potential radiation complications to a developing fetus), or a lung scintigraphy ventilation/perfusion scan (poorer accuracy for moderate risk patients and radiation dose). Unenhanced MRI has excellent soft tissue characterization properties and no clinical safety issues (excluding strong magnetic fields).

The purpose of this study was to evaluate the effectiveness of three unenhanced MRI techniques in identifying acute pulmonary embolism (PE) and how they compare to lung scintigraphy.

Three sequences were chosen: T2w balanced steady-state free precession (b-SSFP), both as 2D single slice breath-hold and volumetric free-breathing acquisition, and T1w Direct Thrombus Imaging (DTI). These sequences have been previously investigated, with good results but have not entered mainstream use. Equipment improvements have encouraged reappraisal.

5 (of 10) participants, proven positive for PE by 16 slice CTPA, were scanned within 32 hours of their CTPA. Images were blind read, randomly on a per-sequence basis, followed by consensus reading, by an MRI cardio-thoracic radiologist. Agreement, sensitivity and specificity statistics were generated on a per-embolism basis.

All MRI sequences suffered artefacts not reported in previous studies and did not equal previous study results. 74 thrombi were found on CTPA: 2D b-SSFP identified 20 (27% sensitivity, 94% specificity, **K** 0.22, 63% fair agreement), 3D b-SSFP 16 (22%, 99%, **K** 0.2, 62.5% fair agreement respectively), T1 DTI 32 (43%, 99%, **K** 0.43, 72.5% moderate agreement). Better results were achieved by all sequences for the lobar vessels.

## Conclusion

Is unenhanced MR of the pulmonary arteries worth pursuing? Yes - as stated by all groups investigating CTPA versus lung scinitgraphy: any cross-sectional imaging technique will provide valuable morphological information regarding other disease processes that lung scintigraphy cannot produce. This study demonstrated effusions, atelectasis and right heart distension by the various MR techniques, although alternative pathologies were not being directly assessed.

The results from the research so far have failed to meet the study goals. In fact, the results have questioned the validity of some previous papers. At the moment, it is clear from the results that specialised sequences are not necessarily amenable to adaptation for bodyzones outside of the area originally intended for use. The steady-state free precession sequences have contrast flaws that are not readily appreciable on dedicated cardiac scanning but which are significant in small vessel imaging. The black blood (DTI) sequence is also good in the heart chambers but suffers from inhomogeneities and in-plane saturation effects when used across the whole of the thorax. However, this sequence produced encouraging results and may produce better accuracy after modification, to warrant further study. Normal distal segmental and subsegmental vessels will always be an ambitious goal for unenhanced MRI to identify: by their lack of MR signal returning tissue and MRI's poor spatial resolution. But these problems are continually being improved on by product development, so reviewing previously poor performing techniques is always relevant with each equipment upgrade. Minimizing the ionizing radiation and iodinated contrast dose to any contra-indicated patient is as important for their care as achieving a diagnostic examination: being able to offer an effective alternative to CTPA is a goal worth striving for.