Oxygen-Enhanced MRI in Patients with Pulmonary Arterial Hypertension: Feasibility and Value

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Purpose

Oxygen-enhanced MRI (oeMRI) is a rather new pulmonary imaging technique, which combines information about ventilation, perfusion and diffusion **[1-8]**. So far, there is limited experience with oeMRI in circumscribed patient cohorts **[6-8]**. We sought to determine the value of oeMRI in patients with pulmonary arterial hypertension (PAH), and its correlation with ventilation/perfusion scintigraphy (V/Q-scintigraphy).

Methods and Materials

20 PAH-patients underwent V/Q-scintigraphy, contrast-enhanced perfusion MRI and oeMRI for which we used an ECG- and respiratory-triggered T1-weighted multi-slice inversion-recovery half-Fourier-acquisition single-shot turbo-spin-echo (HASTE) sequence on a 1.5 T MR scanner. The oeMRI-data (acquisition of 4 blocks with 20 acquisitions each of alternating room air and oxygen inhalation) were evaluated describing the relative signal enhancement, i.e. the signal increase of the lung after inhalation of pure oxygen. Analyzing the oeMRI data, each lung was segmented, and six lung areas per patient (except one patient who only had one lung) were qualitatively evaluated by two reviewers for both the MRI and scintigraphy data. Additionally the circumscribed relative signal enhancement in the observed true positive defect areas (RSE_{defect}) was measured and compared with the relative enhancement of the whole lung ($RSE_{overall}$).

Results

In 16/20 patients (80%), oeMRI was successful and qualitatively sufficient, showing a mean signal increase of the lung of at least 5%. In the 93 lung areas available for analysis, ventilation scintigraphy showed 12 diseased and 81 healthy lung areas, and perfusion scintigraphy showed 58 diseased and 35 healthy areas. Sensitivities and specificities of oeMRI as compared to VQ scans were as follows: oeMRI vs. ventilation scintigraphy 100% and 74% (Tab. 1); oeMRI vs. perfusion scintigraphy 47% and 83% (Tab. 2).
The comparison of the defect areas with the whole lung showed that the mean difference of the absolute values between RSE_{defect} and $RSE_{overall}$ was 4.2 % (median 3.0%). Therefore the relative signal enhancement in defect areas was averaged 43.8 % (median 32.8 %) lower compared to the rest of the lungs.

Table 1: oeMRI vs. V-scintigraphy

	V-scinti positive	V-scinti negative	Σ
oeMRI positive	12	21	33
oeMRI negative	0	60	60
Σ	12	81	93

Table 2: oeMRI vs. Q-scintigraphy

	Q-scinti positive	Q-scinti negative	Σ
oeMRI positive	27	6	33
oeMRI negative	31	29	60
Σ	58	35	93

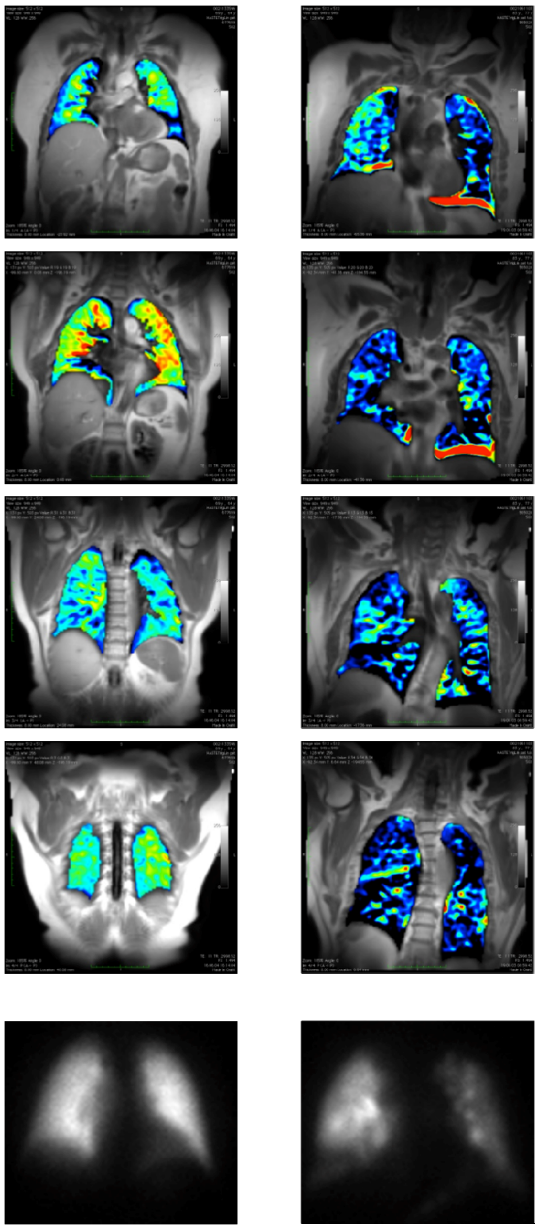

Figure 1: oeMRI and V-scintigraphy of healthy lungs (left) and diseased lungs (right)

Conclusion

oeMRI is feasible in PAH-patients, yielding a high agreement when comparing it to ventilation scintigraphy. If the signal difference between defect and healthy lung is about 44 %, a reliable visual detection of the defect areas is possible. A combination of oeMRI and perfusion MRI may substitute scintigraphy as a technique without ionizing radiation, but requires further improvements in robustness of the acquisition.

References

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