

## Oxygen-enhanced MRI of the lung at 3 Tesla: Feasibility and T1 relaxation times

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**Introduction:** Oxygen-enhanced MRI (O<sub>2</sub>-MRI) of the lung allows spatially resolved visualization of oxygen diffusion from the alveoli into the capillaries of the lung [1–4]. The purpose of this study was to demonstrate the feasibility of O<sub>2</sub>-MRI of the lung at a field strength of 3 Tesla and to determine the T1 relaxation time of lung tissue at 3 Tesla during inhalation of room air and oxygen.

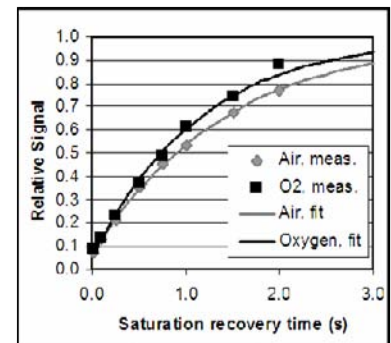
**Subjects and Methods:** 3 healthy volunteers were examined with a non-selective saturation recovery (SR) half-Fourier single-shot turbo spin echo (HASTE) sequence (TE = 15 ms, minimum TR depending on delay  $T_{SR}$  between saturation pulses and readout, slice thickness 10 mm, 128×128 matrix, field of view 40×40 cm<sup>2</sup>) implemented on a 3 T whole-body scanner (Magnetom Tim Trio, Siemens Medical Solutions, Germany). Parallel imaging (acceleration factor: 2) with the GRAPPA algorithm was used to reduce the TE and the minimum TR. Coronal SR images with  $T_{SR}$  = 10, 100, 250, 500, 750, 1000, 1500, and 2000 ms were acquired within a single breath hold in end-expiration. These measurements were repeated 5 times during inhalation of room air and 5 times during inhalation of pure oxygen. T1 relaxation times were calculated by an exponential fit (cf. Fig. 1) using the mean intensity of lateral lung regions excluding signal from large vessels; in addition, T1 was determined in the liver and in the spleen. Difference images of acquisitions with room air and oxygen were calculated for all  $T_{SR}$ .

**Results:** The mean T1 values of lung tissue found for the volunteers were (1281±124) ms during inhalation of room air and (1102±135) ms during inhalation of oxygen, i.e. oxygen breathing reduced T1 by 14 %, as presented in Table 1. Maps of the relative signal difference of acquisitions during inhalation of oxygen and room air at different SR times are shown in Fig. 1.

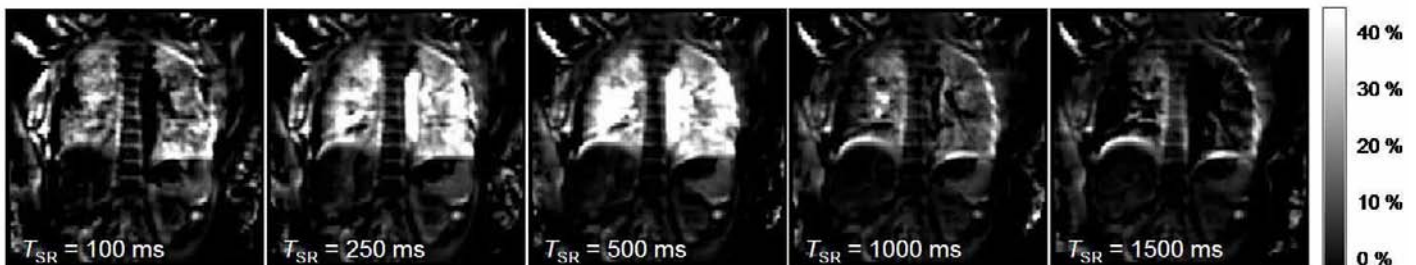
**Conclusion:** Although lung MRI at 3 Tesla is complicated by increased susceptibility effects in the lung tissue and by reduced T2\* relaxation times, our results demonstrate that O<sub>2</sub>-MRI of the lung using a saturation-prepared HASTE sequence is feasible. The determined T1 relaxation times are comparable to those described for 1.5 Tesla [4, 5], i.e., increased T1 values as reported for many other tissues [6] were not observed. Further measurements on more volunteers are required to validate these first results.

**Table 1:** T1 relaxation times of different tissues during inhalation of air and oxygen.

T1 (ms) @ 3 T	Vol. #1, 33 y	Vol. #2, 37 y	Vol. #3, 34 y	Mean (Std. dev.)	Rel. difference
Lung, air	1420	1181	1242	1281 (124)	-14.0%
Lung, O <sub>2</sub>	1144	951	1212	1102 (135)	
Liver, air	869	881	989	916 (71)	0.2 %
Liver, O <sub>2</sub>	866	869	1019	918 (87)	
Spleen, air	1189	1095	1195	1159 (56)	-8.0 %
Spleen, O <sub>2</sub>	1067	1010	1122	1066 (56)	



**Figure 1:** T1 relaxation after saturation, measurement data and exponential fit (volunteer #1).



**Figure 2:** Maps of relative signal increase at different saturation recovery times  $T_{SR}$  (volunteer #3).

### References:

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