

## Imaging of brain metastases of bronchial carcinoma with 7 Tesla MRI

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### Background and Purpose:

The purpose of this study was to determine whether susceptibility-weighted and contrast-enhanced 7 T MRI is superior to 1.5 T MRI in the depiction of brain metastases of bronchial carcinomas.

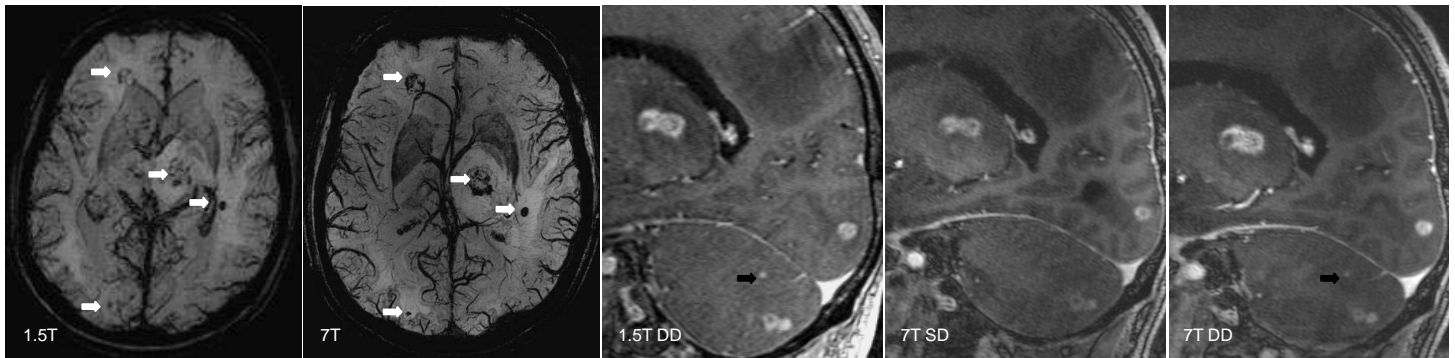
### Methods:

Twelve patients with known intracranial brain metastases of histologically proven bronchial carcinomas underwent 7 T MRI (Magnetom 7T) and 1.5 T MRI (Magnetom Espree, both Siemens Healthcare, Erlangen, Germany). 7 T images were performed by using an 8-channel transmit/receive head coil (Rapid Biomed, Wuerzburg, Germany). For 1.5 T imaging, a 12-channel receive-only head coil supplied by the vendor was used. The interval between both examinations was no longer than three days in all patients. Minimum intensity projections (MIP) of a 1.5 T SWI sequence (TR/TE = 49/40 ms, flip = 15°, voxel size = 0.9x0.9x2.0 mm<sup>3</sup>) were compared to 7 T SWI MIPs (TR/TE = 27/15 ms, flip = 15°, voxel size = 0.4x0.4x1.5 mm<sup>3</sup>) in 12 patients without contrast media.

A contrast-enhanced 3D T1-weighted (w) sequence (MPRAGE) at 1.5 T with the following sequence parameters (TR/TE = 1910/3.07 ms, flip = 10°, voxel size = 1x1x1 mm<sup>3</sup>) was compared with a 7 T MPRAGE sequence (TR/TE = 2500/1.54 ms, flip = 6°, voxel size = 0.7x0.7x0.7 mm<sup>3</sup>). Double-dose Gd-DTPA at 1.5 T and single-dose Gd-DTPA at 7 T were performed in 12 patients after 10 minute delay and double-dose Gd-DTPA at 7 T was performed in 6/12 patients after another 10 minute delay. Image analysis of both sequences was performed by two radiologists in consensus. The number of intracranial microhemorrhages on SWI MIPs and the number of contrast-enhanced metastases in T1-w images were compared at both field strengths in three size ranges ( $\leq 2$  mm, 3-5 mm,  $\geq 6$  mm).

### Results:

In all 12 patients the more highly resolved 7 T SWI allowed the identification of 87 versus 67 microhemorrhages in brain metastases compared to the 1.5 T SWI sequence, especially those smaller than 2 mm size. Across all patients, the 0.7 mm isotropic 7 T T1-w sequence with single dose Gd-DTPA depicted 195 versus 240 enhanced brain metastases in the 1 mm isotropic 1.5 T T1-w sequence with double dose Gd-DTPA. After doubling the contrast dose in six patients the 0.7 mm isotropic 7 T T1-w sequence depicted the same number of brain metastases as the 1 mm isotropic 1.5 T T1-w sequence with double dose Gd-DTPA.



**Figure:** Microhemorrhages in brain metastases are depicted in more detail on 7 T SWI MIP images (white arrows) compared to 1.5 T SWI MIP images (left image). Hence, small subcortical metastases can easily be discriminated from cortical venous vessels or artifacts at 7 T. 1 mm isotropic T1-w images at 1.5 T and 0.7 mm isotropic T1-w images at 7 T show small brain metastases (black arrows, right images) in similar number after contrast enhancement with double dose (DD) of Gd-DTPA. After contrast enhancement with single dose (SD) of Gd-DTPA micrometastases were not depicted on 7 T T1-w images (2<sup>nd</sup> image from the right).

### Conclusions:

Our preliminary results indicate that double-dose contrast enhancement is beneficial for the detection of brain metastases at 7 T. The higher achievable spatial resolution and the higher sensitivity for susceptibility effects of the 7 T SWI sequence allow the identification of more microhemorrhages in brain metastases compared to the 1.5 T SWI sequence.