MR Imaging of the chest: Pulmonary lesion detection in comparison to MDCT

B. B. Frericks[1], B. C. Meyer[1], A. Huppertz[2], K. J. Wolf[1], and F. K. Wacker[1]

[1]Radiology, Charité, Campus Benjamin Franklin, Berlin, Germany, [2]Imaging Science Institute, Charité - Siemens, Berlin, Germany

Purpose:

Several technical improvements in MR imaging (MRI) such as high-performance gradient systems, phased array receiver coils, and parallel imaging techniques have introduced interesting new approaches for thoracic MRI. However, MRI of the pulmonary parenchyma for pulmonary lesion detection is still assumed to be substantially limited as compared to multi detector CT (MDCT). On the other hand, whole body MRI for staging of patients with malignant diseases is emerging which necessitates pulmonary lesion detection. The aim of this study was therefore to evaluate four different MR sequences for lung imaging during whole-body MRI and to compare their diagnostic accuracies for pulmonary lesion detection with MDCT, the current gold standard for imaging of the pulmonary parenchyma.

Patients and Methods:

Twenty-seven patients (13 women, 14 men; mean age 54±18 years) scheduled for MRI-based whole-body staging of varying primary tumors (15 lymphomas, 5 bronchial carcinomas, 3 renal cell carcinomas, 2 larynx carcinomas, 1 rectal carcinoma and 1 carcinoma of unknown primary) were included in this study. All patients were examined in a 1.5 T 32-channel whole body MR scanner (Magnetom Avanto, Siemens Medical Solutions, Germany). A MDCT (Sensation16, Siemens Medical Solutions, Germany) of the chest was performed in all patients within one week prior to or after the MRI. The MRI protocol of the chest included the following four sequences: 1. coronal respiratory-triggered (RT) T2w STIR, 2. axial multi breathhold (mbh) T2w STIR, 3. axial RT T2w TSE, and 4. contrast-enhanced (CE) 3D-VIBE. Data sets of the CT and the four MR sequences were evaluated independently and in a random order by two experienced radiologists in consensus using a commercially available workstation (Leonardo, Siemens Medical Solutions, Germany). All pulmonary pathologies detected in MR such as pulmonary nodules, infiltrates, scars or atelectases were documented and results of the different MR sequences were compared to the results of chest CT. Sensitivity (calculated on a per lesion basis), specificity and positive and negative predictive values (calculated on a per lobe basis) of the different MR sequences based on the results of the MDCT as the gold standard were calculated.

Results:

Axial mbh T2w STIR and CE 3D-VIBE were of diagnostic quality in all patients. Coronal RT T2w STIR and axial RT T2w TSE were of diagnostic quality in 26 patients, in one patient each the examinations were hampered by breathing motion artifacts. MDCT detected 212 pulmonary lesions in 68 pulmonary lobes in 16 patients. Based on CT-appearance the lesions were classified as 194 non-calcified nodules, 6 calcified nodules, 5 infiltrations, 3 apical scars, 3 bronchial carcinomas, and 1 atelectasis. On a per lesion basis the overall sensitivity of the coronal RT T2w STIR, the axial mbh T2w STIR, the axial RT T2w TSE and the axial CE 3D-VIBE were 89.6 % (181/202), 91.0 % (193/212), 90.4 % (179/198), and 86.3 % (183/212), respectively. The sensitivities of the four sequences for different pulmonary lesion sizes are shown in table 1. In figure 1 an example of is given. Specificities of the coronal RT T2w STIR, the axial mbh T2w STIR, the axial RT T2w TSE and the axial CE 3D-VIBE were 96.1 %, 94.0 %, 96.7 %, and 92.0 %, respectively. All false positive lesions measured 3 mm or less in size. Based on these data the positive and negative predictive values for the coronal RT T2w STIR, the axial mbh T2w STIR, the axial RT T2w TSE and the axial BH CE 3D-VIBE were 96.9 % and 95.1 %, 91.2 % and 96.0 %, 95.8 % and 95.6 %, and 93.6 % and 95.4 %, respectively.

Conclusions:

The results of this study indicate that pulmonary MR imaging as part of a whole-body MR imaging protocol is feasible, achieving results comparable to chest MDCT. Axial and coronal oriented STIR achieve excellent diagnostic accuracy almost similar to chest MDCT for non-calcified pulmonary lesions larger than 5 mm in diameter.

Lesion size [mm]	MDCT [n]	Cor RT STIR	Ax mbh STIR	Ax RT T2-TSE	Ax CE 3D-VIBE
>10	51	100	100	100	100
>5 - 10	49	98.0	98.0	95.1	95.9
3 - 5	70	90.2	91.4	89.6	84.3
<3	42	72.5	78.6	78.6	69.0

Table 1: Sensitivities for pulmonary lesion detection of the four different MR sequences depending on the lesion size.

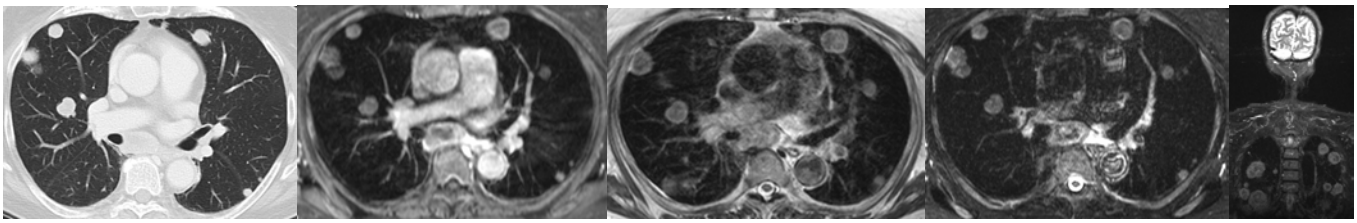

Figure 1: Axial images of a 68year old female with renal cell carcinoma with multiple pulmonary metastases. All metastases detected in MDCT (A), including a 3 mm subpleural lesion in the left upper lobe, were also detected with the different MR sequences: Axial CE 3D-VIBE (B), axial T2w TSE (B), T2w STIR (C) and coronal T2w STIR (D).