High resolution whole-body MRI applications at 1.5 Tesla and 3 Tesla: a comparative study

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PURPOSE

To analyze the impact of altered magnetic field properties on image quality and potential artifacts when an established whole-body MRI (WB-MRI) protocol at 1.5 Tesla is migrated to 3 Tesla

METHOD AND MATERIALS

15 volunteers underwent non-contrasted WB-MRI on two 32-channel-scanners at 1.5 Tesla and 3 Tesla with the use of parallel imaging (PAT). Coronal T1-weighted TSE- and STIR-sequences at four body levels with dedicated sagittal imaging of the whole spine was performed. Additionally, axial HASTE-imaging of the lung and abdomen, T1-w / T2-w-TSE- / GRE- and EPI-sequences of the brain were performed, followed by T2-weighted TSE-respiratory-triggered imaging of the liver **(Tab. 1)**. Both data sets were compared by two independent readers and image quality as well as artifacts were qualitatively rated with a five-point scale. Quantitative grading for image quality and artifacts was defined as means and standard deviation.

RESULTS

Overall image impression was qualitatively both rated as "good" at 1.5 and 3 Tesla for T1-w-TSE- and STIR-imaging of the whole body and spine. Significantly better quantitative image quality grading values were found for WB-STIR- and T2-w-TSE imaging of the liver and brain at 1.5 T (U-Test; $p<0,05$). Better image homogeneity and less dielectric effects were observed at 1.5 T for T1-w-TSE- and STIR-WB-MRI ($P<0,05$), yet observed differences had no significant impact on diagnostic value **(Fig. 1)**. Motion artifacts, Gibb's ringing and image distortion was not significantly different, but showed a tendency for worse quantitative grading at 3 T. Susceptibility artifacts were higher for the T1-w-GRE-sequence of the brain at 3 T, compared to the TSE-sequence at 1.5 T (ns) without significant impact on diagnostic value. Overall scan time was reduced at 3 T (40:28 min) compared to 1.5 T (45:44 min).

CONCLUSION

WB-MRI is feasible at 3 Tesla and has comparably good image quality to 1.5 Tesla. 3 Tesla WB-MRI shows significantly more artifacts with a mild to moderate influence on image assessment. Overall scan time is further reduced at 3 T with the use of PAT at constant image resolution.

		1.5 Tesla		3 Tesla	
Sequence	**Image plane**	**Matrix / Resolution (mm^3)**	**Acquistion time (min)**	**Matrix / Resolution (mm^3)**	**Acquistion time (min)**
STIR-WB	cor	384 / 1.8 x 1.3 x 5.0	9:43	384 / 1.8 x 1.3 x 5.0	6:40
HASTE-abdomen	cor	384 / 1.4 x 1.3 x 5.0	0:38	384 / 1.4 x 1.3 x 5.0	0:33
HASTE-lung	ax	320/ 1.3 x 1.2 x 6.0	0:44	320 / 1.3 x 1.2 x 6.0	0:42
T2w-fs-SE-liver	ax	320 / 1.6 x 1.2 x 5.0	3:41	320 / 1.6 x 1.2 x 5.0	3:41
T1w TSE-WB*	cor	384 / 1.7 x 1.3 x 5.0	10:30	384 / 1.7 x 1.3 x 5.0	7:53
T1w TSE-spine	sag	384 / 1.0 x 1.0 x 3.0	7:46	384 / 1.0 x 1.0 x 3.0	6:15
STIR-spine	sag	384 / 1.0 x 1.0 x 3.0	7:22	384 / 1.0 x 1.0 x 3.0	7:00
T1w SE-brain	ax	320 / 0.7 x 0.7 x 5.0	3:11		
T1w GRE-brain**	ax			320 / 0.7 x 0.7 x 5.0	3:17
T2w SE-brain	ax	512 / 0.5 x 0.5 x 5.0	3:11	512 / 0.5 x 0.5 x 5.0	2:52
EPI-brain	ax	192 / 1.2 x 1.2 x 5.0	0:56	192 / 1.2 x 1.2 x 5.0	1:35
Total			**45:44**		**40:28**

Tab. 1: Whole-body MRI sequence protocols on 1.5 Tesla and 3 Tesla. *In the 3 T protocol alternatively a SE-sequence was applied for coronal imaging of the head/neck region. **T1-w axial imaging of the brain was performed with a Flash-2D GRE sequence.

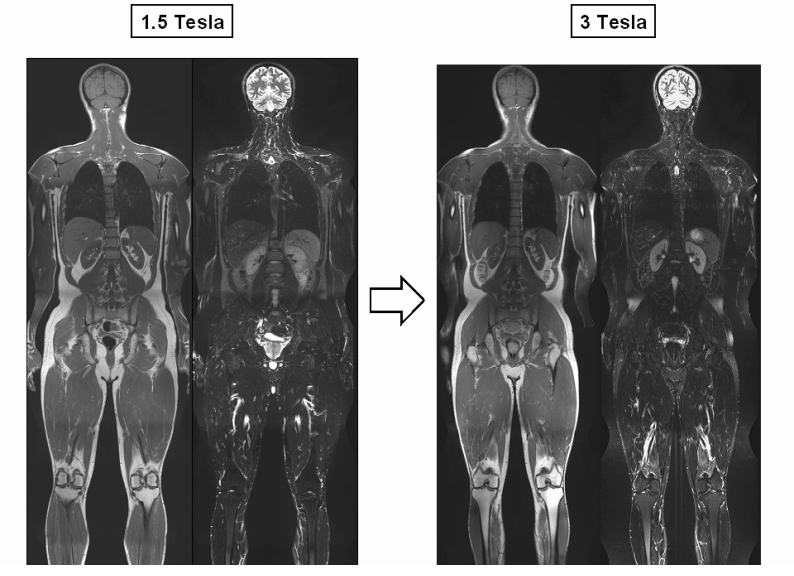

Fig. 1: T1-w-TSE and STIR-WB-MRI of 33-year old male on a 1.5 Tesla and 3 Tesla 32-receiver channel scanner with the use of PAT. In WB-STIR at 3 Tesla mild pulsation artefacts are found in the thorax and lower extremities, as well as mild fat supression inhomogeneity of the lumbar subcutaneous fat tissue.