

Contrast-enhanced MRI of the breast at 7 and 3 T in the same patients: initial experience

Katja PINKER-DOMENIG¹, Pascal Baltzer¹, Wolfgang Bogner², Stefan Gruber², Lenka Minarikova², Olgica Zaric², Doris Leithner¹, Siegfried Trattnig², and Thomas Helbich¹

¹Dept. of Radiology, Division of Molecular and Gender Imaging, Medical University Vienna, Vienna, Austria, ²Dept. of Radiology, MR Centre of Excellence, Medical University Vienna, Vienna, Austria

Introduction

In contrast-enhanced MRI of the breast an accurate assessment of lesion morphology and enhancement kinetics is mandatory. Therefore an imaging protocol needs both a high temporal and high spatial resolution. For reasons related to SNR, the maximum achievable spatial resolution at 3T is restricted. Recently 7T scanners have entered clinical practice offering higher SNR, which can be translated in a higher spatial resolution. The aim of this study is to establish a contrast-enhanced combined high spatial and temporal resolution MR imaging protocol for the assessment of breast tumors at 7 Tesla and to prospectively compare MRI of the breast at 7T with MRI of the breast at 3T in the same patients.

Material and Methods

20 patients with breast lesions classified by mammography or sonography as BIRADS 4 and 5 were included in this prospective IRB approved study. All patients underwent 3T (Siemens Tim Trio) and 7T MRI (Siemens Magnetom) of the breast using a dedicated 4-channel breast coil. At both field strengths sequence protocol consisted of a contrast-enhanced high temporal and spatial resolution 3D T1-weighted sequence (TWIST; fat-sat; TR/TE 6.05/2.86, 11°, SI 3T: 1mm SI 7T: 0.7mm; isotropic; temporal resolution 14sec, examination time 9min). The contrast agent used was Gd-DOTA, (generic name: Gadoteratemeglumine; Dotarem®, Guerbet, France), injected intravenously as a bolus (0.1 mmol per kilogram body weight) and administered with a power injector (Spectris Solaris EP, Medrad, Pittsburgh, PA, USA) at 4 mL/s, and followed by a 20-mL saline flush. MR imaging studies were performed at least 36 hours apart. Two experienced readers trained in different institutions (r1, r2) independently assessed lesion morphology and enhancement kinetics and classified them according to BI-RADS dichotomized into: benign vs. malignant. Lesion size, localization and laterality, image artifacts, overall image quality, lesions conspicuity, depiction of lesion detail and internal lesions structure as well as diagnostic confidence were assessed on a 5-point confidence scale (1=best, 5=worst). Sensitivity and specificity values and inter-reader variability by means of kappa statistics were calculated for both readers. The histopathological diagnoses were used as the standard of reference.

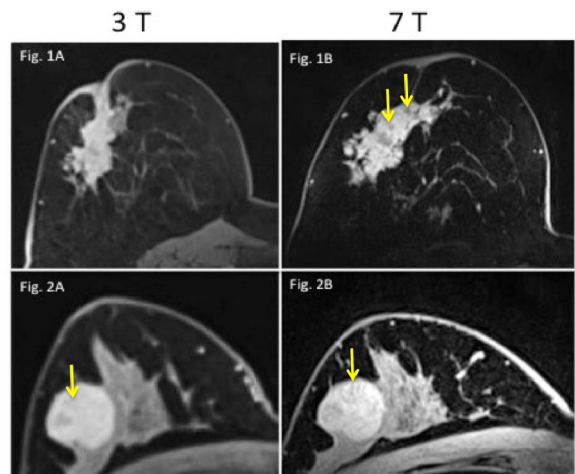


Fig.1: IDC G2, Contrast enhancing mass with irregular shape and spiculate margins (a) Internal lesions structure not visible with (a) 3T MRI are depicted by (b) 7T MRI. Fig.2: Fibroadenoma: Contrast enhancing mass with round shape and lobulated margins and non-enhancing dark septations is not as sharply demarcated with (a) 3T as with (b) 7T MRI. 7T reveals finer lesion detail.

Results

There were 12 malignant lesions (Fig.1) and 8 benign lesions (Fig.2) in 20 patients. Mean histopathological size was 24.3mm (range 8-51mm). All 20 examinations were diagnostic and not hampered by artifacts at both field strengths. In 14 of 20 lesions (70%) there was an improved lesions conspicuity and greater depiction of lesions detail and internal structure at 7T (Fig.1 and 2) allowing greater diagnostic confidence. 7T MRI of the breast had a sensitivity of 100% and a specificity of 91.7% for both readers. 3T MRI of the breast had a sensitivity of 96.2% and a specificity of 91.7%. At 3T there were one false positive and 1 false negative finding for both readers. At 7T there was one false positive finding and no false negative finding. Kappa agreement was very good with 0.87-1.

Conclusion

7T MRI of the breast is applicable in clinical practice. 7T MRI increases sensitivity as compared to 3T MRI with excellent inter-reader agreement. Due to the higher SNR offered by 7T MRI overall image quality and lesions conspicuity is improved and a greater depiction of lesions detail and internal structure is enabled. High-field imaging associated artifacts did not impair diagnostic performance of 7T breast MRI.

References

1. Pinker K, Grabner G, Bogner W, et al. A combined high temporal and high spatial resolution 3 Tesla MR imaging protocol for the assessment of breast lesions: initial results. *Invest Radiol.* 2009 Sep;44(9):553-8.
2. Korteweg MA, Veldhuis WB, Visser F, et al. Feasibility of 7 Tesla breast magnetic resonance imaging determination of intrinsic sensitivity and high-resolution magnetic resonance imaging, diffusion-weighted imaging, and (1)H-magnetic resonance spectroscopy of breast cancer patients receiving neoadjuvant therapy. *Invest Radiol.* 2011;46(6):370-6.