Computer-aided detection (CAD) for Breast MRI at 3.0T: A comparison between four observers with different levels of experience.

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Introduction

The use of MRI for the evaluation of breast lesions is increasing. With a sensitivity of between 88% and 92% it is a more sensitive method than conventional mammography or ultrasound for the detection of breast cancer. The reported specificity at 1.5T is 72%, with a 95% confidence interval of pooled-weighted specificity estimates of 67-77% in a recent meta-analysis[1]. A second drawback of breast MRI is the significant time needed for image processing and interpretation. Also, the number and experience-level of breast MRI-trained radiologists is not yet as high as for conventional mammography. Computer-aided detection (CAD) algorithms have been developed that automate processing and analysis functions usually performed manually by MRI technologists and radiologists. These systems have the potential to improve efficiency of breast MRI and to reduce the number of false positive diagnoses[2]. Automation may improve consistency and detection rate, but also provides new analysis methods, such as kinetic curve-threshold, not available with manual interpretation. Compared to 1.5T, current MRI systems operating at 3.0T offer a higher signal-to-noise ratio and allow higher-spatial-resolution imaging without affecting overall images acquisition time or the temporal resolution of the dynamic contrast-enhanced series. It is expected that enhancing breast masses can be more accurately characterized at 3.0T than at 1.5T[3].

Purpose

This study was performed to compare the consistency and accuracy of 3.0T breast MRI interpretation, between manual- and fully automated-kinetic analysis, for four observers with different levels of experience in reading breast MRI.

Methods

We retrospectively analyzed the data from a total of 426 consecutive women who underwent contrast-enhanced high-spatial resolution 3.0T breast MRI. Women who underwent breast MRI not for clinical indications but for research purposes were excluded from this study (n = 71). In addition, 278 patients were excluded because histology was not obtained, and 4 were excluded for MRI technical reasons. Sixty five consecutive patients with a total of 71 biopsy- or surgically-proven lesions were included. Initial manual MR interpretation was done by an experienced breast radiologist on an Advantage Workstation (Philips Viewforum, Best, The Netherlands), which allows assessment of enhancement kinetics via ROI placing. All MRI examinations were subsequently processed with CADstream (Confirma, Inc., Kirkland, WA), a commercially available computer-aided detection system. CAD datasets were interpreted by four readers, two experienced breast radiologists, a 3rd year resident and a 1st year resident. Interpretations for this study were done retrospectively with a minimum interval of 2 months between manual and CAD analysis, allowing all observers to be blinded to the pathological outcome. MR images were evaluated according to the MRI-BIRADS lexicon criteria. Lesions size, number of lesions and localization in the breast, were systematically assessed using a BIRADS-score sheet for each lesion. In addition, for each lesion, automated analysis of kinetic enhancement was evaluated separately at both 50% and 100% thresholds.

Results

The evaluation of the accuracy of CAD threshold-enhancement was based on 49 malignant and 22 benign lesions. The evaluation of the diagnostic accuracy of the four different readers was based on the same data set, with the exclusion of all 23 BIRADS-6 lesion. Exclusion of known cancers was necessary because readers were blinded to the pathological results but not to patient history. Using threshold-enhancement alone, the sensitivity and specificity of CAD were 97,9% and 86,4% respectively for the 50% threshold, and 97,9% and 90% respectively for the 100% threshold (see table 1). Manual interpretation showed a sensitivity of 84,6% and a specificity of 68,8%. For the same two radiologists the mean sensitivity and specificity for CAD-based interpretation was 90,4% and 81.3% respectively. The difference in specificity was significant at $p<0.05$. Between all four CAD readers the sensitivity varied from 84,6% to 92,3% and the specificity varied from 75,0% to 81,3%. By one-way ANOVA no significant differences were found between the two experienced breast radiologists and the two residents together, or between any of two readers separately with the use of CAD.

Table 1. *Diagnostic accuracy based on CAD analysis of lesion enhancement at 50% and 100% thresholds (n=71 lesions; 49 malignant, and 22 benign lesions)*

	Sensitivity	Specificity
CAD 50%	97,9%	86,4%
CAD 100%	97,9%	90,0%

Table 2. *Diagnostic accuracy for all four readers. (n=42 lesion; 26 malignant and 16 benign lesions)*

	Sensitivity	Specificity
Radiologist; Manual	84,6%	68,8%
Radiologist 1; CAD	88,5%	75,0%
Radiologist 2; CAD	92,3%	87,5%
Residents 1; CAD	88,5%	93,8%
Residents 2; CAD	84,6%	81,3%

Conclusions & Discussion

For 3.0T breast MRI, the use of a CAD-system for the analysis of enhancement-kinetics can significantly improve the discrimination between benign and malignant lesions compared to manual analysis of enhancement-kinetics. There was no significant difference in diagnostic accuracy using CAD between the readers with different levels of experience. With respect to interpreting the very high sensitivities reported here for CAD-based analysis based solely on thresholding of enhancement kinetics, it should be noted that a selection-bias was introduced by only including data from patients with core- or excision-biopsy-proven lesions.

References:

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