UNIVERSITY OF MEDICINE AND PHARMACY TÂRGU-MUREŞ

FACULTY OF MEDICINE

THE ROLE OF MAGNETIC RESONANCE MAMMOGRAPHY IN THE DIAGNOSIS OF BREAST LESIONS

-Abstract-

PhD student: Ioan Alin Nechifor-Boilă

Scientific coordinators: Prof. Dr. Angela Borda, Prof. Dr. Mircea Buruian

Introduction

Dynamic Contrast-Enhanced Magnetic Resonance Mammography (DCE-MRM) is a newly introduced method for breast imaging, with reported sensitivities up to 100%. However, its specificity is largely variable (65-93%) according to different authors. In an effort to improve DCE-MRM specificity in breast cancer diagnosis, Diffusion Weighed Imaging with Background body signal Suppression (DWIBS) could represent a potential candidate.

DWIBS is a new Magnetic Resonance Imaging (MRI) sequence that quantifies the diffusion of water molecules in tissues. Thus, tissues with high cellularity (e.g. breast cancer) exhibit an increased restriction in water diffusion which is depicted as high signal intensity on DWIBS images. As DWIBS images have a low resolution, poor lesion visibility can be a serious issue that can influence interpretation. Also, by background signal suppression the anatomical landmarks are removed, making lesion mapping challenging. A potential method for improving the quality of DWIBS images can be the fusion between DWIBS and an anatomical sequence (e.g. T2), similarly to the fusions used in PET/CT imaging.

Literature data on the use of DWIBS/T2 images in MRI is scarce and the results are inconclusive. To the best of our knowledge, there are no prior studies on the use of DWIBS/T2 fusions in MRM, the existing ones being focused on other pathologies (recurrent pelvic malignancies, etc).

My thesis is composed of two studies, the first one being dedicated to assessing the role of DWIBS and its dual interpretation system in MRM, while the second one is dedicated to determining the clinical efficiency of DWIBS/T2 fusions in breast cancer diagnosis.

1. Clinical efficiency of Diffusion Weighted Imaging with Background Body Signal Suppression in Magnetic Resonance Mammography – choosing a qualitative or a quantitative approach

The **aim** of this study was to assess the diagnostic efficiency (in terms of sensitivity, specificity, positive and negative likelihood ratios) of both qualitative and quantitative DWIBS in a retrospective cohort study.

Methods: We performed a registry-based study at the Department of Radiology, Lyon Sud Hospital. All consecutive MRM examinations from 02.2010 to 02.2011 were reviewed. DWIBS was interpreted blindly, both qualitatively (lesion characteristics and signal) and quantitatively (Apparent Diffusion Coefficient-ADC). The ADC cut-off value was determined using Receiver Operating Characteristics (ROC) curve analysis. Clinical

efficiency indicators were calculated using either the pathological examination or the disease status after a minimum 6 months follow-up as gold standard.

Results: The lot consisted of 78 women, with a mean age of 50,3 +/- 14 years and a total of 112 breast lesions. Qualitative DWIBS found 73 suspicious and 39 benign lesions, while the gold standard (pathological diagnosis/follow-up) reported 56 benign and 56 malignant ones. Qualitative DWIBS showed a sensitivity of 84% (95%CI:71,7-92,3) and a specificity of 53,37% (95%CI:39,76-67,05), while the corresponding values for DCE-MRM were 98% (95%CI:93,62-99) and 41,07% (95%CI:28,11-55,04), p<0,0001. Qualitative DWIBS revealed a positive likelihood ratio of 1,81 and a negative one of 0,52 while for DCE-MRM the corresponding values were 1,66 and 0,05, respectively. ROC curve analysis revealed the best performance for quantitative DWIBS at an ADC of $1,1*10^{-3}$ mm^2/s, resulting in a sensitivity of 71,4% and a specificity of 76,8%.

Conclusion: DWIBS is a new and improved diffusion technique with a dual and efficient interpretation system applicable in clinical settings. Moreover, its use as a complement to DCE-MRM offers a large potential for improving MRM clinical efficiency in breast cancer diagnosis.

2. Diffusion Weighted Imaging with Background Body Signal Suppression/T2 Image Fusion in Magnetic Resonance Mammography for Breast Cancer Diagnosis

The **aim** of the study was to evaluate the clinical efficiency (in terms of sensitivity, specificity, positive and negative likelihood ratios) of the DWIBS/T2 image fusion in breast cancer diagnosis, compared to DCE-MRM.

Methods: We retrospectively analyzed 50 consecutive DCE-MRM examinations with DWIBS sequence from the archives of the Department of Radiology, Lyon Sud Hospital, (02.2010-02.2011), summing up to 64 breast lesions. Fusions were created using the Osirix software from the DWIBS images (b=1000 s/mm^2) and their T2 correspondents. Interpretation was performed using a custom interpretation protocol, adapted from the BI-RADS system. The final histopathological examination or a minimum 6-months follow-up served as gold standard.

Results: Out of the 64 examined breast lesions, 35(54.7%) were classified as malignant by DCE-MRM and 24(37.5%) cases by the DWIBS/T2 image fusions, respectively. Thus the DWIBS/T2 fusion had a Sensitivity of 62.5%(95%CI:35.4-84.8) and a Specificity of 70.8%(95%CI:55.9-83.3) while DCE-MRM had a higher Sensitivity: 87.5%(95%CI:61.6-98.4) but a lower Specificity: 56.2%(95%CI:41.1-70.5). The DWIBS/T2 fusion revealed a positive likelihood ratio of 2,14 and a negative one of 0,53 while for DCE-MRM the corresponding values were 1,99 and 0,22, respectively.

Conclusion: The DWIBS/T2 image fusion is a new and inovative imaging technique with an improved specificity when compared to DCE-MRM. Created on an user-friendly imaging software, the DWIBS/T2 image fusion is an accessible and highly reproducible method of enhancing DWIBS by associating anatomical information from T2. Its use as a complement to DCE-MRM can offer the specificity needed to improve breast cancer detection rates on MRM and subsequently advance towards a new non-contrast MRM examination.

Keywords: Magnetic Resonance Mammography, DWIBS, T2, fusion, Breast neoplasms, Mammography.