The Value of Diffusion Weighted MRI in the Detection and Diagnosis of Breast Mass Lesions in Correlation with Dual Energy Contrast Enhanced Digital Mammography

Thesis

Submitted for Partial Fulfillment of MSc . Degree in Radiology

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2013

Acknowledgement

Praise is to ALLAH who exalted in knowledge whom he wills but above those who have knowledge there is one more knowing; the cherisher and sustainer of all what is in heaven and what is on earth. To HIM is the goal and to him is the return of all.

I would like to express my deepest gratitude to **Professor Dr. Maha Helal**, *Professor of Radiology, National Cancer Institute, Cairo University to whom I am deeply in debited. Her masterful teaching, continuous support, critical insight, enthusiastic encouragement and invaluable advice and criticism on every level are the cornerstones of this work. To me she is an idol. She is truly an example to follow.*

Words could not express my great appreciation and respect to **Professor Dr. Rasha Kamal** *Professor of Radiology, , Faculty of Medicine ,Cairo-University, for her kindness, patience, consideration and precious assistance. and concern throughout this work, providing this thesis with her scientific experience and constructive supervision.*

I am also very grateful to **Dr. Eman Gouda** *Assistant Professor of Pathology Cairo-University, for her guidance and care that allowed the suitable performance of this work.*

I am deeply thankful to the women's imaging unit and MRI unit operators at the National Cancer Institute, for their cooperation

Iam also deeply grateful for my husband **Dr. Ahmed Al Sayed** *for his assistance, support and patience*

Last, but not least, I would like to express my respect, appreciation and thanks to my family, especially my **mother** *and my* **sister** *the most precious thing in my life for their understanding, patience and encouragement.*

Abstract

Breast cancer is the most common malignant tumor among women. The purpose of all diagnostic modalities in breast cancer is early detection and proper diagnosis, which has its major impact on further management and prognosis.

Dual Energy CEDM proved to have a higher diagnostic accuracy for the detection of breast carcinoma compared with mammography alone and with mammography interpreted in association with ultrasound

DW MRI in the breast is a new imaging technique. It has the advantage that It is simple, fast and non invasive with no need to use contrast media and it provides information that reflects tissue cellularity which can be used in diagnosis and evaluation of breast lesions .

In our study using combined qualitative analysis of DWIs and quantitative analysis of ADC values we concluded that results of DW MRI are approaching that of contrast enhanced MRI and better than Dual– energy CEDM in diagnosis of breast lesions

DW MR imaging can be used as a reasonable alternative technique to contrast-enhanced imaging

Key words: MR- ADC- DWI- CEDM- Mammography- Breast Mass

CONTENTS

LIST OF ABBREVIATIONS:

ACR	American College of Radiology
ADC	absolute diffusion coefficient
AEC	automatic exposure control
AGD	average glandular dose
BI-RADS	Breast Imaging Reporting and Data System
CAD	Computer Aided Detection
CC	cranio caudal
CEDM	contrast-enhanced digital mammography
DCE-MRI	dynamic contrast enhanced magnetic resonance imaging
DCIS	ductal Carcinoma in situ
DWI	diffusion weighted image
FOV	Field of view
GFR	glomerular filtration rate
IDC	INVASIVE DUCT CARCINOMA
LCIS	lobular Carcinoma in situ
MLO	medio lateral oblique
MRI	Magnetic resonance imaging
NCI	National Cancer institute
RF	radio frequency
ROC	Receiver Operating Characteristic Curve
ROI	region of interest
SI-Time	signal intensity - time curve

SNR	Signal to noise ratio
STIR	short T1 inversion recovery
TDLU	Terminal ductal lobular unite
TE	Time of echo
TNM	Tumor, nodes, metastases
TR	time of repitition
SPAIR	spectral attenuated inversion recovery

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INTRODUCTION

Breast cancer is one of the most common types of cancer. Despite advances in mammography, at least one in four malignant tumors remains undetected using screening mammography alone ***[Pisano et al 2005]***

Ultrasound is a complementary technique to mammography, especially for dense breasts and is part of the standard of care in diagnostic procedures. Manual US examinations are time-consuming , operator dependant and findings have to be characterized during the procedure with limited possibility of a second independent evaluation of already captured images ***[Kolb et al ,2002]***

Taking advantage of the inherent capabilities of image processing in digital mammography, advanced applications may bring additional clinical and cost benefits to the current standard of care. Among these applications, contrast-enhanced digital mammography (CEDM) may specifically open the door to detection of angiogenesis in the mammography suite ***[Dromain et al ,2011]***

Dual-energy CEDM has a higher diagnostic accuracy for the detection of breast carcinoma compared with mammography alone and with mammography interpreted in association with ultrasound. CEDM may be useful for the assessment of the extent of disease as well as the clarification of equivocal lesions. These results encourage further investigations to define the place of CEDM among the other breast imaging methods in particular in comparison to breast MRI***[Dromain et al ,2011]***

Magnetic resonance imaging (MRI) is a highly sensitive procedure, but indications for a breast MRI are necessarily stringent due to the time and cost involved. However, there are several well-established clinical criteria for MRI of the breast, such as to differentiate between a scar and recurrent cancer, to evaluate cancers of unknown primary origin with metastases indicating breast malignancy, to do screening in high risk populations and to determine preoperative tumor extent or Staging ***[Diekmann et al ,2009]***

Diffusion-weighted imaging provides a novel contrast mechanism in magnetic resonance (MR) imaging and has a high sensitivity in the detection of changes in the local biologic environment. A significant advantage of diffusion-weighted MR imaging over conventional contrast material–enhanced MR imaging is its high sensitivity to change in the microscopic cellular environment without the need for intravenous contrast material injection. ***[Woodhams et al 2011]***

However, the incorporation into clinical decision making of information gleaned from diffusion-weighted breast imaging has been slow compared to the use of information obtained from diffusion-weighted imaging of other organs. One reason is that the diagnostic role of diffusion-weighted imaging in breast imaging hasnot been incorporated into the already established Breast Imaging and Reporting Data System lexicon ***[American College of Radiology. BI-RADS atlas. Reston, Va: American College of Radiology, 2003].***

Contrast material–enhanced breast MR imaging is currently accepted as the most sensitive imaging technique for the diagnosis and staging of breast cancer. However, several studies have noted that conventional

breast MR imaging, including T2-weighted imaging and contrast-enhanced T1- weighted imaging, is limited in terms of specificity in the assessment of breast tumors ***[Ghai et al , 2005]***

Consequently, there has been considerable interest in the development of adjunct MR imaging methods to improve the specificity of dynamic contrast-enhanced breast MR imaging, and diffusion-weighted breast imaging is being investigated for its potential to improve breast disease diagnosis at the cost of a small increase in examination time. ***[Woodhams et al 2011]***

Approaches to the assessment of diffusion-weighted breast imaging findings include assessment of these data alone and interpretation of the data in conjunction with T2-weighted imaging findings. In addition, the analysis of apparent diffusion coefficient (ADC) value can be undertaken either in isolation or in combination with diffusion-weighted and T2-weighted imaging. ***[Woodhams et al 2011]***

The apparent diffusion coefficient (ADC), derived from non-invasive, in vivo diffusion-weighted magnetic resonance imaging (DW MRI), is increasingly being included .The ADC reflects the Brownian intra and extracellular motion of water molecules in biological tissue and thus provides information about the tumor microenvironment Several potential applications for the ADC in breast cancer have been suggested and studied; including detection, characterization, differentiation of tumors as well as evaluation of neoadjuvant treatment response ***[Nilsen et al ,2013]***

Aim of work

The aim of this study is to correlate the results of DWI MRI and the calculated ADC value with the contrast enhanced digital mammography to determine the specificity of DWI in detection and diagnosis of breast lesions , to reach a cut off value for differentiating malignant and benign lesion and to investigate the possibility of DWI MRI replace the contrast imaging .