بسم الله الرحمن الرحيم

وَقُل رَّبِّ زِدْنِي عِلْمًا

صدق الله العظيم

سورة طه – آية ١١٤

CHARACTERIZATION OF BREAST MASSES BY NEW MRI MODALITIES (MR SPECTROSCOPY , MR DIFFUSION AND MR PERFUSION)

Essay

Submitted for partial fulfillment of
Master Degree in Radio-diagnosis
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2014

تحديد خصائص تكتلات الثدي باستخدام الوسائل الحديثة في التصوير بالرنين المغناطيسي

(التحليل الطيفي والتصوير الانتشاري والإرواء)

رسالة تمهيدية مقدمة من الطبيبة

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Acknowledgement

*First and above all, Thanks to **ALLAH**, who is always helping me in all my life. To HIM is the goal and to him is the return of all.*

*Grateful thanks and my deepest gratitude to **Professor Dr. Hesham Mahmoud** Professor of Radiodiagnosis , Faculty of medicine. Ain Shams University , for his great help and assistance, kind heart, and for giving me the honor of being his candidate, working under his supervision, guided by his experience and true concern. And I will always remain grateful for him .*

*I would like to express my deepest gratitude to **Dr.Amir Louis** Lecturer of Radiodiagnosis , Faculty of medicine Ain Shams University, for his patience and care throughout this work .*

*Words could not express my great appreciation, and my feeling of gratitude, thanks and respect to my **dears parents**, my **dear husband**, and **my family** especially my brother **Dr. Abdulsalam Alkelany** , my son and daughters ,for their grateful help ,powerful support, and motivation to work harder.*

Finally, I would like to thank all members of the radiology department , Ain Shams University .

Dedicated

FOR

Sake of Allah

My Dear Father

My Dear Mother

My Dear husband

My dear son and daughters

My dear sisters And brothers

&

Prof Dr. ***Hesham Mahmoud***

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List of Abbreviation

Abb.	Meaning
ACC	Adenoid cystic carcinoma.
ACR	American Cancer Society.
ADC................	Apparent Diffusion Co-efficient.
ASL	Arterial spin labeling.
BASING	Band selective inversion with gradient dephasing.
BIRADS	Breast imaging reporting and data system.
BMI	Body mass index.
BRCA	Breast cancer antigen.
CAD	Computer aided detection.
CHESS	Chemical shift selective excitation.
CM	Contrast media.
CN	Core needle.
Cho	Choline.
CSI	Chemical shift imaging.
CT....................	Computed Tomography.
DCE	Dynamic contrast enhancement.
DCIS	Ductal carcinoma in situ.
DES	Diethylstilbestrol.
DWI................	Diffusion-weighted Imaging.
EPI..................	Echo planar Imaging.
FAIR...............	Flow-sensitive alternating inversion recovery.
FISPG	Fast spoiled gradient recalled echo.
FLASH	Fast low-angle shot pulse sequence.
FNA	Fine needle aspiration
FOV	Field of view.
FSPGR	Fast spoiled gradient recalled echo.
Gd	Gadolinium.
GRE................	Gradient recalled echo.

Abb.	Meaning
GFR	Glomerular filtration rate.
H1-MRS.........	Proton MR spectroscopy.
IDC	Invasive ductal carcinoma.
ILC	Invasive lobular carcinoma.
IV	Intra venous.
LCIS	Lobular carcinoma in situ.
Max................	Maximum.
Min.	Minimum.
MIP	Maximum intensity projection.
MPR	Multi planar reconstruction images.
MRA	Magnetic Resonance angiography.
MR-CAD	Magnetic Resonance Computer Aided Detection.
MRI	Magnetic Resonance Imaging.
NCI	National cancer institute.
NSF	Nephrogenic systemic sclerosis.
PPV	Positive predicted value
PRESS...........	Point Resolved Spectroscopy Sequence.
rBF..................	relative blood flow.
rBV	relative blood volume.
RF	Radiofrequency.
rMSD.............	relative maximum signal drop.
ROI	Region of interest.
SE....................	Spin-echo.
SPGR	Spoiled gradient recalled echo.
SSRF	Spatial spectral radiofrequency.
STEAM	Stimulated echo method.
STIR	Short T inversion recovery.
SVS	Single voxel spectroscopy.
T......................	Tesla.

Abb.	Meaning
t cho	Choline peak.
TDLU	Terminal ductal-lobular unit.
TE	Echo time
TNM	Tumor, Nodes, Metastases.
3 TP	3 time point.
TR...................	Relaxation time.
U.S	Ultrasonography.
VAD	Vacuum assisted device.

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Introduction

Breast cancer is one of the most common cancers among women . the National Cancer Institute estimates 232 340 new cases of breast cancer in 2013. Although the most current statistics from the Centers for Disease Control and Prevention report the incidence of breast cancer has decreased by 0.9% per year from 2000 to 2009, among women there is still a need to diagnose breast cancer as efficiently and effectively as possible. Early detection is one of the best means of increasing survival rates; therefore , it is important to investigate new modalities to aid in the detection of breast cancer **(Lowe, 2013) .**

Several studies have explored a multi-parametric approach to breast imaging that combines analysis of traditional contrast enhancement patterns and lesion architecture with novel methods such as diffusion, perfusion, and spectroscopy to increase the specificity of breast MRI studies **(Sinha , 2009) .**

While mammography remains the primary modality for breast cancer detection, there is a growing trend to incorporate other imaging modalities in the detection and evaluation of breast cancer. Because of the growing overlap between modalities, radiologic technologists from a variety of backgrounds may find it helpful to have a basic understanding of magnetic resonance imaging (MRI) and its role in breast imaging **(Lowe , 2013) .**

Diffusion-weighted MRI shows some potential for increasing the specificity of breast lesion diagnosis and is even more promise for monitoring early response to therapy. MRS also has great potential for increasing specificity and for therapeutic monitoring . A limited number of studies have evaluated perfusion imaging based on first-pass contrast bolus tracking , and these clearly identify that vascular indices have great potential to increase specificity. Recent advances in MRI , MRS , and automated image analysis have increased the utility of breast MR in diagnosis , screening , management, and therapy monitoring of breast cancer **(Sinha , 2009) .**

Proton MR Spectroscopy (MRS) allows noninvasive molecular analysis of biologic tissue **(Sardeneli , 2009)** .It shows excellent specificity in the detection of breast lesions. Choline is generally undetectable in normal breast tissue, increased levels of Choline compounds in a tumor, is thought to be an indicator of the activity of that tumor, suggesting that it is malignant. This eliminates the need for biopsy, reduce patient morbidity, and save unnecessary cost and time for both the patient and the medical staff. MR Spectroscopy can also be used to gauge the effect of chemotherapeutic agents in patients with locally advanced breast cancer **(Huang et al , 2004)** and for early detection of recurrent breast cancer based on metabolic profiles by using the combination of two advanced analytical methods NMR (Nuclear Magnetic Resonance) and Mass Spectrometry **(Asiago et al , 2010) .**

In recent years, yet another method, one that uses dynamic T2-Weighted first-pass perfusion imaging, has been proposed. Unlike normal tissues, perfusion in tumors is intense and fast. Differences in cell density are also important. Cancer cells are more crowded than normal ones. Contrast agents, therefore, slowly fill up the larger empty spaces in normal tissues, compared to fast fill up of the lower extracellular volume fraction for cancerous ones. That is the concept of MR Perfusion imaging, which if performed immediately after dynamic contrast enhanced T1-Weighted imaging, can be used to differentiate between benign and malignant tumors with a high degree of certainty **(Kvisted et al , 2000) .**

However, MR Spectroscopy and MR Perfusion, have false negative results in the diagnosis of malignant breast disease. To overcome their fallacies, combining both techniques has been studied. The results of these studies showed them to have 100% specificity in the detection of breast malignancy, with the total imaging time being less than 40 minutes, and the total dosage of contrast medium, being no more than 0.2mmol per kilogram body weight **(Huang , 2004)** .

Aim of the work

The aim of this study is to emphasize the role of new MRI modalities : MR diffusion , MR perfusion and MR spectroscopy in characterization of breast masses , and the incremental value of combining two or more of these modalities in the early detection of breast cancer and in the improvement of diagnosis accuracy .