Role of MRI in Interventional Breast Procedures

ESSAY
Submitted for Partial Fulfillment of Masters Degree in
Radio-diagnosis
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2016

TABLE OF CONTENTS

Page

Dedication

To my parents, brothers and wife.

Acknowledgements

FIRST AND FOREMOST, I would like to thank **ALLAH** the almighty.

Words could not express the feeling of gratitude and respect I carry to ***Prof Dr. Sameh Mohamed Abd el Wahab, Professor of Radio-diagnosis, Ain Shams University*** for his true concern, continuous advice, and encouragement which allowed completion of this work.

Special thanks ***to Dr. Ahmed Mohamed Hussein, Lecturer of Radio-diagnosis, Ain Shams University*** for his guidance, helpful advice , constructive supervision of this work ,valuable input and undeniable support.

It is my pleasure to express my deep appreciation to my professors and colleagues in the Radiology Department, Ain Shams University for their help, guidance and unlimited kind support.

My special thanks and deep appreciation for my family to whom I am overwhelmingly indebted to.

List of Abbreviations

ACS	American Cancer Society
ADC	Apparent Diffusion Coefficient
AJCC	American Joint Committee on Cancer
BSE	Breast Self-Examination
BRCA1	Breast Cancer Gene 1
BRCA2	Breast Cancer Gene 2
CBE	Clinical Breast Examination
CBS	Breast Conservative Surgery
CN	Core Needle
CuSO4	copper sulphate
DCIS	Duct Carcinoma In Situ
DWI	Diffusion Weighted Imaging
ER+	Estrogen Receptor Positive
FN	False Negative
FNA	Fine Needle Aspiration
FOV	Field-Of-View
FP	False Positive
Gd-DTPA	Gadolinium Diaminotetra-ethyl penta-acetic acid
HER2	Human Epidermal Growth Factor Receptor 2
IDC	Invasive Ductal Carcinoma
IHC	Immunohistochemical Methods
ILC	Invasive Lobular Carcinoma
ITC	Isolated Tumor Cell Clusters
LCNB	Large-core Needle Biopsy
LCIS	Lobule Carcinoma In Situ
MIP	Maximum Intensity Projection
MPR	Multi-Planar Reconstruction
MRI	Magnetic Resonance Imaging
MRM	Magnetic Resonance Mammogram
MR-VAB	MR-guided vacuum-assisted biopsy

NAC	Nipple-Areola Complex
NMLE	Non-Mass Like Enhancement
NOS	Not Otherwise Specified
PR+	Progesterone Receptor Positive
ROC	Receiver Operator Curve
ROI	Region Of Interest
SE	Spin Echo
TE	Echo Time
TN	True Negative
TP	True Positive
TR	Repetition Time
UICC	Union for International Cancer Control
VABB	Vacuum Assisted Breast Biopsy
WL	Wire Localization

List of Figures

Introduction

Until there exist more accurate identification of risk factors, low risk chemopreventive agents and more effective treatment for breast cancer, the single most important determinant in reducing mortality from breast cancer is early detection through appropriate screening with accurate localization and tissue diagnosis. Every effort should be made to diagnose breast cancer in the earliest stage. Until now, the three corner stones in breast cancer screening are breast self-examination (BSE), clinician performed clinical examination (CBE) and mammography with ultrasonography ***(Orel et al, 1995)***.

Interventional radiology is a branch of radiology that include all invasive procedures or minimally invasive diagnostic and therapeutic performed using radiological guidance(ultrasound, fluoroscopy, computed tomography and magmatic resonance imaging).Its goal is to achieve results equal or better than the corresponding surgery with less risk, fewer complications and lower costs. It is an emerging discipline in many fields, often indispensable in both diagnostic and therapeutic-surgical phases ***(G. Giuseppetti et al, 2014).***

Current research is focused on the suitability of MRI as a screening modality in conjunction with mammography in high risk populations. The limitations of MRI include its high cost, unsuitability for some patients (those who are obese, have pacemakers or have renal failure), the potential for unnecessary biopsies, lack of portability and the length of time required for imaging ***(Rim A et al, 2008)***.

Specificity of MRI tends to be lower than mammography. In a study of 1,909 women in the Netherlands the authors noted that screening MRI led to twice as many unneeded additional examinations and three times as many unneeded biopsies as with screening with mammography ***(Elmore et al, 2005)***.

A significant weakness of current breast magnetic resonance imaging (MRI) is that calcifications cannot be detected or characterized with this technique. While almost all invasive breast cancers will show enhancement with intravenous gadolinium injections, a substantial number of cases of pre-invasive cancer called "ductal carcinoma in situ (DCIS)" may not enhance with this contrast agent. In fact, 10% of DCIS cases diagnosed with mammography will not be diagnosed with MRI because of lack of enhancement. The absence of enhancement in the abnormality on contrast enhanced breast MRI along with the presence of calcifications on mammography does not exclude DCIS and biopsy may be necessary depending on the mammographic appearance of these calcifications. However, not all cases have micorcalcfications and not all cases are detected with mammography ***(Noseworthy et al, 2011)***.

However the benefits of MRI greatly outweigh its disadvantages. It is the study of choice for evaluating breast implants for rupture ***(Hams et al, 1994)***.

It is also helpful in evaluating the breast in different clinical and pathological scenarios, where mammography and ultrasonography will not be of prime help. This will be discussed in the following chapters.

MRI appears very promising in screening high-risk patient and patients with a new diagnosis. The role of MRI in breast cancer screening and diagnosis will continue to be evaluated and defined ***(Spear et al, 2011)***. With this development arises the need of being able to perform MRI-guided breast interventions whether diagnostic or therapeutic.