Role of magnetic resonance imaging (MRI) and magnetic resonance spectroscopy (MRS) in differentiating post therapeutic changes from recurrent malignant breast lesions

Thesis

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Mai Fahmy Mohamed Mohamed

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List of Abbreviations

Abbr.	Full term
2D	Two dimensional
3D	Three dimensional
ANOVA	One way analysis of variance
BASING	Band-selective inversion with gradient dephasing
BCT	Breast conserving therapy
BI-RADS.	Breast Imaging Reporting and Data System
CBC	Contralateral breast cancer
CHESS	Chemical-shift selective excitation
cm	Centimetres
CSI	Chemical shift imaging
DCE-MRI	Dynamic contrast enhanced MRI
DWI	Diffusion weighted MRI
FEA	Flat epithelial atypia
FWHM	Full width at half maximum
GRE	Gradient echo sequences
HER2	Human epidermal growth factor receptor type 2
HPF	High Power field
HRT	Hormone replacement therapy
LVI	Lymphovascular invasion
M	Metastases
MIP	Maximum intensity projection

MPR	Multiplanar reformatted images
MR-CAD	MR Computer Aided Detection
MRI	Magnetic resonance imaging
MRS	Magnetic resonance spectroscopy
N	Nodes
NAC	Neoadjuvant chemotherapy
OCPs	Oral contraceptive pills
PR	Progesterone
ROC	Receiver operator characteristic
ROC	Receiver operating characteristic
ROI	Region of interest
SD	Standard deviation
SLN	Sentinel lymph node
SVS	Single voxel spectroscopy
T	Tumor
TNM	Tumor- Node –Metastasis
TRAM	Transverse rectus abdominis myocutaneous flap
US	Ultrasound
VOI	Volume of interest

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INTRODUCTION

A close follow up of patients after breast conserving therapy (BCT) is necessary because tumor recurrence ranges between 1% & 2% per year. It typically occurs 3–7 years after BCT. Early detection of local recurrence of breast cancer has been shown to significantly improve long-term survival ***(Drukteinis JS, Gombos EC, et al , 2012).***

Breast conservation surgery followed by breast radiotherapy produces changes on both physical examination and post treatment breast imaging. Detection of local tumor recurrence, as well as evaluation of the remainder of the breast tissue by conventional methods can be difficult due to post treatment alteration, especially within dense breasts; hence, repeated biopsy is often required ***(Gutierrez R , et al,2011).***

The breast conservative surgery including lumpectomy, partial mastectomy, and segmentectomy is aiming at surgical excision of the breast cancer with a surrounding margin of histologically normal breast parenchyma while conserving the patient's breast appearance and form. Breast conservative surgery is the most common

surgical option for patients with early stages of breast cancer, typically T1 or T2 ***(Neal CH ,et al, 2014).***

Chemotherapy leads to necrosis and fibrosis, which appear as a persistent density on mammogram. Similarly, calcifications associated with a carcinoma can persist even when the viable tumor cells are no longer present. Both persistent density and calcification can be incorrectly identified as carcinoma on mammogram, resulting in false positive results ***(Kaplan JB, et al , 2005).***

Moreover, mammographic evaluation within the 1st 12 months after radiation is frequently impaired by radiation induced changes. Ultrasound (US) may be of limited ability in detection of neoplastic recurrence, as it is operator dependent, and the hypo echogenicity with posterior acoustic shadowing at the site of scarring tissue can limit the proper evaluation due to their similarity to patterns seen with recurrent tumors. There is also diminished reliability of US for detection of small and non-invasive cancers, even in the untreated breasts. Extensive scarring after multiple operations or complicated healing can cause diagnostic

problems making the exclusion or the demonstration of neoplastic recurrence too difficult ***(Vilar VS, et al , 2012).***

DCE-MRI has been shown to aid significantly in detection and characterization of primary and recurrent breast cancers. The sensitivity of breast MR imaging for detection of residual and recurrent tumors in the post-operative breast is over 90%. Breast MR imaging has been shown to be useful in differentiating scar tissue from tumor recurrence regarding the non-enhancing areas which have a high negative predictive value for malignancy (88–96%) ***(Drukteinis JS, Gombos EC, et al , 2012).***

It is also a valuable technique and more specific in differentiation of post irradiation changes from recurrent carcinoma in patients who had undergone breast irradiation ***(Kaplan JB, et al ,2005).***

Magnetic resonance Spectroscopy has become an adjacent to dynamic contrast enhanced MRI (DCE-MRI) in the clinical evaluation of breast lesions. Malignant lesions are more likely to show high levels of choline-containing compounds compared to benign or normal breast tissues, and this observation may serve as the basis for differentiating

between malignant and benign breast lesions. DCE-MRI together with MR spectroscopy is known to enable the most accurate assessment of tumor response in breast cancer after neoadjuvant chemotherapy (NAC) in comparison with other conventional techniques. It is able to monitor complete, partial and poor response ***(Yi An Y, et al , 2014).***

AIM OF THE STUDY

The purpose of our study is evaluation of the new advances of magnetic resonance imaging and magnetic resonance spectroscopy in diagnosis of recurrent breast cancer after conservative surgery, chemotherapy and radiotherapy and differentiate it from post therapeutic changes