Utility of Diffusion Weighted MR in Differentiation between Benign and Malignant Breast Lesions

Thesis

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✍ **Amira Samy Mohammed**

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List of Abbreviations

Abbr.	Full-term
ADC	**:** Apparent diffusion coefficient
ALH	**:** Atypical lobular hyperplasia
BIRADS	**:** Breast imaging and reporting data system
CC	:Cranio-Caudal
DCE	**:** Dynamic contrast enhanced
DCIS	**:** Ductal carcinoma in situ
DWI	**:** Diffusion-weighted imaging
DW-MRI	**:** Diffusion weighted magnetic resonance imaging
FOV	**:** Field of view
IBC	**:** Inflammatory breast cancer
IDC	**:** Invasive ductal carcinoma
LCIS	**:** Lobular carcinoma insitu
LN	**:** Lobular neoplasia
MLO	**:**Medio-lateral oblique
MPG	**:** Motion-probing gradient
MRI	**:** Magnetic resonance imaging
NOS	**:** Not otherwise specified

NPV **:** Negative predictive value

NST **:** No special type

PPV **:** Positive predictive value

RF **:** Radiofrequency

ROC **:** Receiver-operating characteristic

ROI **:** Region of interest

SD **:** Standard deviation

SNR **:** Signal to noise ratio

SPSS : Statistical package for social science

SSRF **:** Spatial-spectral radiofrequency

STIR **:** Short inversion time inversion recovery

T **:** Tesla

TDLU **:** Terminal duct lobular unit

US **:** Ultrasound

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Introduction

Breast cancer is a common malignancy and cause of cancer death. Despite improvements in the detection of breast cancer with the widespread application of mammography and ultrasonography, differentiation between benign and malignant breast lesions remains a difficult diagnostic problem ***(Min et al., 2015).***

Breast cancer is now a significant cause of worldwide morbidity and mortality. Further, the increasing rate of breast cancer continues to be a major area of concern for both clinicians and researchers. Increased awareness in the affected population leads to more frequent physical examinations and diagnostic imaging procedures which results in earlier diagnosis and hence improved prognosis ***(El Fiki et al., 2015).***

The majority of the lesions that occur in the breast are benign. It is important to recognize benign lesions and distinguish them from breast cancer. Breast MRI may be used to distinguish between benign and malignant lesions, reducing the number of breast biopsies done to evaluate a suspicious breast mass ***(Wax, 2009).***

Conventional MRI of the breast is mainly based on the combined analysis of the morphological data and enhancement kinetics of the lesions. This gives information about tumor

physics, vascularity, and vascular permeability. It provides high sensitivity yet with moderate specificity for breast cancer, with overlap between benign and malignant lesions ***(Ibrahim et al., 2015).***

Due to the low specificity of the conventional MRI, an additional feature is needed to characterize suspicious lesions in order to decrease the number of invasive breast procedures ***(Peter et al., 2008).***

Diffusion-weighted MRI (DW-MRI) is an advanced MRI technique, which emerged in the mid-1980s and allows the mapping of in-vivo water diffusion processes in a non-invasive manner; it can delineate the microscopic anatomy of a target tissue or organ. It has a higher sensitivity and specificity in detecting suspicious breast disease at a minimum size of 1 cm than regular MRI. It can provide digital biomarker measurements of tissue properties that are highly relevant to the assessment of tumor progression or responses ***(Cai et al., 2014).***

Diffusion is the result of thermal fluctuations with a random pattern and this is often referred to as ‘‘Brownian motion’’. Diffusion-weighted imaging (DWI) is the primary modality that is used to evaluate acute cerebral infarction. DWI has recently been widely used to evaluate other organs such as the ovaries, pancreas, prostate, liver and breast ***(Abdulghaffar and Tag-Aldeen, 2013).***

Recent studies have shown a high accuracy rate in the differentiation between malignant and benign breast lesions using DW-MRI and Apparent Diffusion Coefficient (ADC) measurements. The measured ADC values were significantly lower in malignant lesions compared with benign lesions. Malignant breast tumors show a high amount of cellular structure (due to the intensity of the tumor tissue), resulting in low ADC values for the lesions ***(Şahin and Arıbal, 2013).***