MALIGNANT BREAST TUMOURS: ROLE OF MRI IN PREDICTING HISTOPATHOLOGICAL GRADING

Thesis

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Abstract

Introduction: Magnetic Resonance Imaging (MRI) is an established supplemental technique to mammography and ultrasonography for evaluation of breast lesions. DWI is quantified using the Apparent Diffusion Coefficient (ADC) value which is the measurement of the mean diffusivity of water in tissues along three orthogonal directions.

Aim of the Work: The aim of this study is to investigate the relationship between DWI findings (represented by ADC values) and the dynamic contrast enhanced MRI findings (including functional parameters and morphological criteria) with the histopathological grade of malignant breast tumours.

Patients and Methods: 25 patients (age >30 years) were enrolled in this study. All patients were referred either from the screening clinic or the outpatient clinic of Eldemerdash Hospital with clinically suspicious findings and the abnormality was detected by mammography and/or ultrasound.

Results: Twenty five female patients were included in this study, their age > 30 years. Histopathological analysis revealed all 25 lesions to be invasive ductal carcinomas not otherwise specified. Grading of included carcinomas was as follows: 3 lesions (12.0%) were grade I, 14 lesions (56.0%) were grade II and 8 lesions (32.0%) were grade III.

Conclusion: That makes DWI the best non-invasive tool available to predict grades of breast carcinoma.

However, further larger and more detailed studies are still needed to fully understand the role MR imaging in distinguishing different histological grades of breast cancer.

Keywords: Malignant Breast Tumours, MRI, ADC, Predicting histopathological grading

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List of Abbreviations

ACR	American College of Radiology
ADC	Apparent diffusion coefficient
BI-RADS	Breast Imaging Reporting and Data System
DCE-MRI	Dynamic contrast enhanced magnetic resonance imaging
DCIS	Ductal carcinoma in situ
DWI	Diffusion weighted imaging
ER	Estrogen receptor
FOV	Field of view
FLASH	Three dimensional fast low angle shot sequence
FSPGR	Fast spoiled gradient recalled echo
GRE	Gradient echo
HER-2	Human epidermal growth factor receptor 2
IDC	Invasive duct carcinoma
ILC	Invasive lobular carcinoma
LCIS	Lobular carcinoma in situ
MIP	Maximum intensity projection
MRI	Magnetic resonance imaging
PR	Progesterone receptor
ROI	Region of interest
SI	Signal intensity
STIR	Short time inversion recovery
T2WI	T2 weighted image

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Introduction

Magnetic Resonance Imaging (MRI) is an established supplemental technique to mammography and ultrasonography for evaluation of breast lesions **(Macura et al., 2006).**

Dynamic contrast enhanced breast MR imaging is currently accepted as the most sensitive imaging technique for diagnosis of breast cancer. It provides important information not only on the morphology of the lesion but also on the functional aspect reflected by the pattern of uptake of the contrast medium. Integration of both kinetic and morphological features is important for accurate diagnosis **(Macura et al., 2006).**

However it provides no direct information about tumour cellularity, which is known to be an important index of tumour grade. Consequently, there has been an increasing interest in the development and the use of diffusion-weighted breast imaging for its potential to improve the diagnosis of breast lesions at the cost of a small increase in the examination time **(Woodhams et al., 2011).**

Diffusion-weighted MR imaging (DWI) has recently been integrated into the standard breast MRI in addition to images obtained from dynamic contrast enhanced MRI. It is a non-invasive technique that has a high sensitivity for detection of changes in the local biological environment, without the need for intravenous contrast material injection **(Woodhams et al., 2011)**.

DWI is quantified using the Apparent Diffusion Coefficient (ADC) value which is the measurement of the mean diffusivity of water in tissues along three orthogonal directions. ADC value can be affected by cellularity of the tissue, fluid viscosity, and membrane permeability. Several potential applications for DWI and ADC value have been suggested and studied; including detection, characterization, and differentiation of breast lesions **(Petralia et al., 2011).**

Aim of the Work

The aim of this study is to investigate the relationship between DWI findings (represented by ADC values) and the dynamic contrast enhanced MRI findings (including functional parameters and morphological criteria) with the histopathological grade of malignant breast tumours.

Anatomy of the Breast

Anatomical features of the breast:

The mature breast lies cushioned in adipose tissue between the subcutaneous fat layer and the superficial pectoral fascia, the main bulk of the tissue of the breast is concentrated in its upper quadrant, which is thus the most usual site for both breast cancer and most benign breast pathologies **(Ellis et al., 2010).**

The nipple is usually situated at the level of the fourth intercostal space in men and nulliparous females but its position is inconstant when the breasts are pendulous **(Ellis et al., 2010).**

The adult female breast has two components; these are the epithelial elements responsible for milk formation and transport, namely the acini and ducts, and the supporting tissue (Muscle, fascia and fat). The epithelial elements consist of twenty or more lobes. Each lobe drains into a mammary duct, each of which ends separately at the nipple. The lobe consists of lobules, the number of which is very variable **(Ellis et al., 2010).**

Each lobule is a collection of between ten and a hundred acini grouped around, and converging on a collecting duct. Each acinus is a sphere of cells capable of milk secretion, draining into terminal duct. It is the confluence of the terminal ducts which gives rise to a collecting duct. Looking at the breast from the front, the major mammary ducts lie behind the areola. The lobules occupy the more peripheral part of the breast **(Blans et al., 2009).**

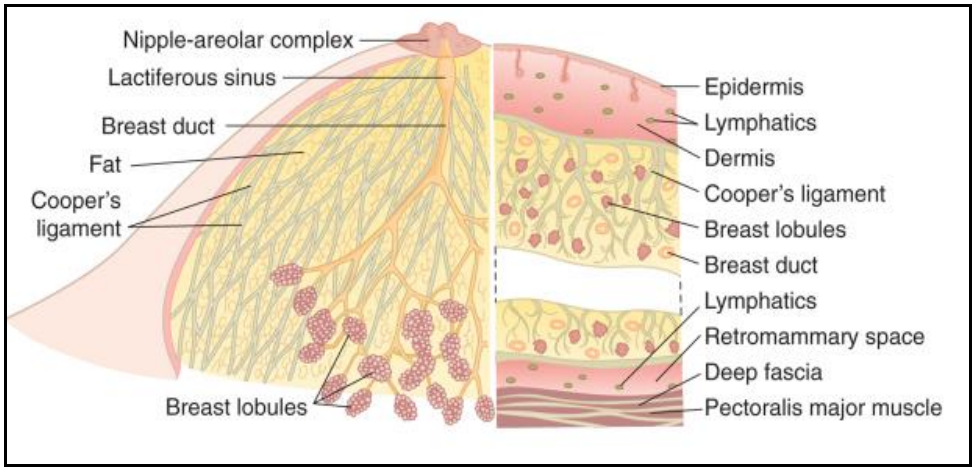

Fig: (1): Cut away diagram of a mature resting breast **(Blans et al., 2009).**

The areola contains involuntary muscle arranged in concentric rings as well as radially in the subcutaneous tissue. The areolar epithelium contains numerous sweat glands and sebaceous glands, the latter of which enlarge

during pregnancy and serve to lubricate the nipple during lactation (montgomery's tubercles) (**Chummy et al.,2011).**

The epithelial lining of the lobule consists of superficial luminal A cells, which are involved in milk synthesis. Basal or B cells, also called“ chief cells” have stem cell activity. Myoepithelial cells constitute the third type. Within each terminal duct lobular unit is a special stroma that is less dense than the general stroma of the breast **(Parks et al., 2010).**

Axillary tail of spence is a prolongation from the outer part of the gland which passes up to the level of the 3rd rib in the axilla, where it is in direct contact with the main lymph nodes of the breast (anterior axillary nodes). This process of breast tissue gets into the axilla through an opening in the axillary fascia, known as the foramen of Lange. It follows that the axillary tail is under the deep fascia, and not, like the rest of the breast, superficial to this layer. When it enlarges it may be mistaken for a lipoma **(Parks et al., 2010).**

Support of the breast:

Breast is supported by fibrous tissue strands (the suspensory ligament of Cooper) connecting the deep fascia with the dermis, when atrophic, they allow the organ to

drop, when contracting from fibrosis around a carcinoma, they cause pitting of the skin **(Ellis et al., 2010).**

The deep layer or membranous layer, of the superficial fascia covers the deep aspect of the breast and is separated by a layer of filmy areolar tissue from the underlying fascial coverings of pectoralis major and serratus anterior **(Ellis et al., 2010).**

The areolar layer forms the retromammary or submammary space and enables the normal breast to move freely over the underlying muscles **(Parks et al., 2010).**

The axilla is defined as a pyramidal space having an apex, a base, and four walls. The apex is a triangular space bordered by the clavicle, the upper border of the scapula, and the first rib, which is sometimes called the cervicoaxillary canal. The base consists of the axillary fascia beneath the skin of the axillary fossa **(Ellis et al., 2010).**

The anterior chest wall is composed of three muscles (the pectoralis major, the pectoralis minor, and the subclavius) and the clavipectoral fascia, which envelops the muscles and fills the spaces between them ,The posterior wall is formed by the scapula and three muscles: the subscapularis, the latissimus dorsi, and the teres major ,The