ROLE OF COMBINED MR SPECTROSCOPY AND MR PERFUSION OF THE BREAST IN CHARACTERIZING BREAST MASSES

Essay

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By

Hanaa Hassan Hassan Mohamed

M.B.B.CH, Cairo University

SUPERVISORS

Dr. Fatma Mohamed Awad

A. Professor of Radio diagnosis

Faculty of Medicine

Cairo University

Dr. Noha Hossam El Din Behairy

A. Professor of Radio diagnosis

Faculty of Medicine

Cairo University

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Abstract

MRI has been confirmed as an essential tool for examination of the breasts because of its remarkably higher sensitivity with the use of enhancement material for breast carcinoma than that of ultrasound and mammography. MRI demonstrates its virtues in the research of occult cancers, where mammography and ultrasound can either detect nor assess the cancer extension ; DCE MR imaging has very high sensitivity for breast cancer diagnosis but its specificity is rather unsatisfactory.

Key word

Radiology- CHARACTERIZING-MRI- MR SPECTROSCOPY- MR PERFUSION

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List of Abbreviations

Cho	Choline
DCIS	Ductal Carcinoma In Situ
Gd	Gadolinium
1H MRS	Proton Magnetic Resonanse Spectroscopy
IBC	Inflammatory Breast Carcinoma
IDC (NOS)	Intra Ductal Carcinoma (not otherwise specified)
ILC	Intra Lobular Carcinoma
IV	Intra venous
Lac	Lactate
LCIS	Lobular Carcinoma In Situ
LDf	Lipid peak
Lip	Lipid
MRI	Magnetic resonance Imaging
MRS	Magnetic resonance Spectroscopy
Ppm	Part Per Million
Ppv	Positive Predictive Value
PRESS	Point Resolved Spectroscopy Sequence
RF	Radio-frequency
ROI	Region of interest
SNR	Signal to noise ratio.
SVS	Single Voxel Spectroscopy
tCho	Choline peak
TE	Time of echo
TR	Time of repetition

Introduction:

Breast cancer is the commonest cancer in women worldwide with an estimated 1.4 million cases in 2008.the rates have been increasing steadily and there is every indication that they will continue to do so over the next few decades. [1] In the last several years, various imaging modalities including X-Ray mammography, MRI, PET and ultrasound have been used to detect and diagnose breast cancer. [2]

Conventional mammography is known to have high false positive rates in the detection of breast malignancy (60-80%), resulting in unnecessary biopsies being performed. In recent years, MR techniques have shown strong potential to improve the sensitivity and specificity in the diagnosis of breast cancer. Dynamic contrast enhanced MR imaging has demonstrated high sensitivity in the detection of suspicious breast lesions [3].

Proton MR Spectroscopy (MRS) allows non invasive molecular analysis of biologic tissue. **[4]** 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 **[5]** 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 MS (Mass Spectrometry).**[6]**

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. The immature blood vessels of malignant tumors differ from normal vessels by being “much leakier” (i.e. having higher permeability). 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 [7].

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% speci icity 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 0.2 mmol per kilogram body weight [8].

Aim of work:

To detect the value of combined MR Spectroscopy and MR Perfusion in the characterization of breast masses.

Key Words:

Breast tumors, MR imaging, MR Spectroscopy, MR Perfusion.

Anatomy of the breast

Introduction

The breast overlies the second to sixth ribs on the anterior chest wall. It is hemispherical with an axillary tail and consists of fat and a variable amount of glandular tissue. It is entirely invested by the fascia of the chest wall, which splits into anterior and posterior layers to envelop it. The fascia forms septa called coopers ligaments, which attach the breast to the skin anteriorly and the fascia of pectoralis posteriorly. They also run through the breast, providing a supportive framework between the two fascia layers .The pigmented nipple projects from the anterior surface of the breast. It is surrounded by the pigmented areola and its position is variable, but it usually lies over the fourth intercostal space in the non-pendulous breast . Figure 1 [9]

The internal architecture of the breast is arranged into 15-20 lobes ,each of which is drained by a single major lactiferous duct that opens on to the nipple .Each lobe is made up of several lobules ,each of which drains several acini .The lobules drain via a branching arrangement of ducts to the single lobar duct .Each lobule drains several acini-these are blind saccules into which milk is secreted during lactation .The glandular tissue of the acini and the ductal tissue draining them comprise the breast parenchyma. The fat surrounding the Parenchymal structure and the fibrotic framework of the breast constitute the stroma .The relative abundance of parenchyma and stroma varies according to age and other factors. [9]

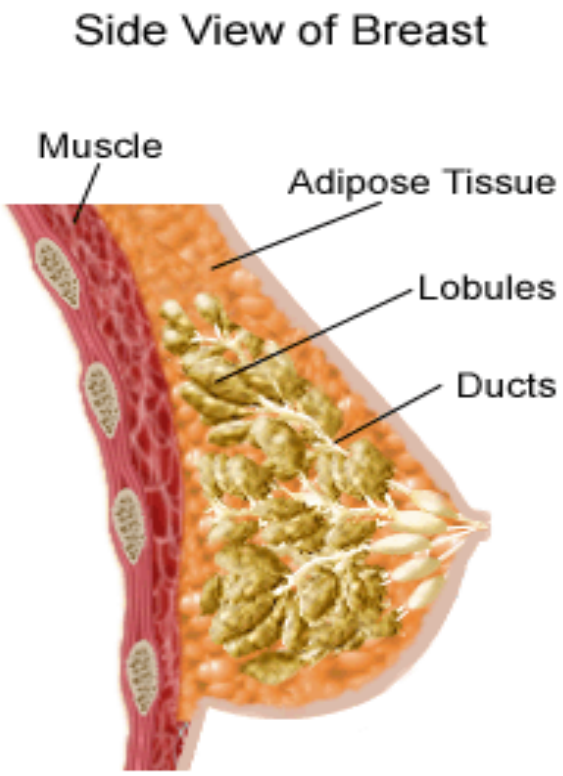

Figure (1): Normal breast anatomy[9]

Blood Supply

The blood supply of the breast is a rich anastomotic network derived from the axillary, internal thoracic (or internal mammary in the old nomenclature) and intercostal arteries [10]

The largest vessels arise from the internal thoracic artery, the perforating branches of which pierce the chest wall adjacent to the sternal edge in the first to fourth intercostal spaces. The vessel in the second space is usually the largest of these [10]