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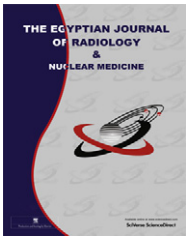

ORIGINAL ARTICLE

Magnetic resonance spectroscopy in recurrent breast masses following conservative surgery and radiation therapy

Enass M. Khattab [a,*], Ghada Abdulmonaem [a], Ahmed Zain El-Abden Al-Attar [b]

[a] *Radiology Department, Faculty of Medicine, Zagazig University, Egypt*
[b] *Radiotherapy Department, Faculty of Medicine, Zagazig University, Egypt*

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KEYWORDS

Magnetic resonance spectroscopy (MRS);
Recurrent breast masses;
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Abstract *Purpose:* The purpose of our study was to assess the value of functional magnetic resonance spectroscopy (1H MRS) in evaluating patients with recurrent cancer breast after breast conservative therapy (BCT) and radiation therapy by the presence of the choline-containing compounds (Cho) as a marker of malignancy.
Patients and methods: Twenty-six patients were included in the study all the patients were subjected to previous BCT and associated radiation therapy. All of them were suspected to have tumor recurrence by clinical examinations, periodic mammographic examination and or ultrasonography. All the patients were submitted to dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) followed by magnetic resonance spectroscopy (MRS) at 1.5 T MRI machine.
Results: Local recurrence was confirmed by histopathology in 19 patients, MRS detected 18 patients with sensitivity of 94.7%, false positive was seen in one patient in whom histopathology revealed inflammatory mastitis (specificity 85.7%). One patient was false negative diagnosed by histopathology as ductal carcinoma in situ (DCIS) with negative predictive value of 85.7% and overall accuracy of 92.3%.

* Corresponding author. Radiology Department, Zagazig University Hospital, Egypt. Tel.: +20552354747.
E-mail address: enasskhattab@hotmail.com (E.M. Khattab).

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Conclusion: In our study breast MRS using choline (Cho) integral was accurate in evaluating patients with recurrent breast masses after BCT and radiation therapy. It reaches a high level of diagnostic performance.

1. Introduction

1H MRS 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 (1). Choline-containing compounds are the major components of cell membrane required for structural stability and cell proliferation (2). Many studies have shown that Cho peak is elevated in neoplastic tissues. The increased Cho in neoplastic tissues may be due to increased membrane turnover by replicating cells (1). At 1H MRS the choline-containing metabolites resonates at 3.2 ppm (more specifically, between 3.14 and 3.34 ppm) that contribute to the total choline-containing (tCho) peak (3). The underlying mechanisms for the elevated level of choline-containing compounds in breast cancer have been extensively investigated. Since choline level represents a proliferative marker, many biological factors may affect its concentration within the tumor (1).

It has been reported that the degree of elevated choline-containing compounds is related to the grade of the tumor, with higher levels in high-grade than in low-grade lesions (4,5). The relationship between the presence of choline-containing compounds and other commonly analyzed breast cancer biomarkers, such as estrogen receptor, progesterone receptor and human epidermal growth factor receptor 2 (HER-2 receptor), was less studied (6).

Aim of this study is to evaluate the role of 1H MRS in detecting cancer recurrence in patients after conservative surgical treatment and local radiation therapy.

2. Patients and methods

In this study 26 female patients were examined in the period between July 2010 and May 2011 at Zagazig University hospitals. All the patients underwent conservative surgical treatment of breast cancer. All the patients were suspected to have either tumor recurrence or post operative complications at the site of the surgery at least 6 months after the end of radiation therapy. They all underwent a breast evaluation, performed by the breast radiologist with mammography, associated with an ultrasound examination. Recurrence was suspected either by ultrasound or by mammography, or by both examinations. When a malignant lesion was suspected (by ultrasound and/or mammographic Breast Imaging Reporting and Data System BIRADS IV or V), the patient underwent a contrast enhanced breast magnetic resonance mammography (MRM) and magnetic resonance spectroscopy (MRS). All the patients underwent fine needle aspiration biopsy (FNAB), core biopsy or excisional biopsy and histopathological reports were correlated with our data. The sensitivity, specificity, accuracy, positive and negative predictive values of 1H MRS in detection of recurrent disease or post surgical/post radiation therapy sequels were calculated

2.1. Examination technique

The MRI study was performed using a 1.5-T whole-body MR imaging and spectroscopic system (MR achieva) Philips medical systems using a bilateral standard phased array breast coil. The imaging protocol consisted of high-resolution precontrast T1 and T2 weighted images, bilateral DCE-MRI, and MRS. Examinations were done in axial, sagittal and coronal sequences, precontrast T1-weighted images were acquired using a spin-echo pulse sequence Fast Spin Echo T2-weighted imaging with fat suppression (TR/TE 100/4000–6000); the field of view was adjusted to cover the breast (260–320 mm) with slice thickness of 4 mm, and an acquisition matrix of 256×192, FVO of 35 and number of excitations 2. A three dimensional (3D) bilateral dynamic images were obtained.

2.2. 1H MRS protocol and analysis

After completing the DCE-MRI, the acquisition of MR spectrum was performed using the localized single-voxel technique with the point-resolved spectroscopic sequence (PRESS). The spectroscopic voxel was placed on the post injection subtraction images. The voxel size ranged from 4.2 to 8.0 cm^3. It was carefully positioned to cover the enhanced lesion on the subtraction images and avoid contaminations with the surrounding tissues. The water suppression was performed by using a point-resolved spectroscopy or PRESS with three pulse chemical shift selective CHESS. The fat signal was independently attenuated by using frequency selective lipid suppression technique. The PRESS acquisition sequence parameters were as follows: TR/TE = 1200/270; flip angle, 90°; 512 measurements. The sequence acquisition time was 12 min. This relatively long TE (270 ms) was chosen to increase the visibility of the Cho resonance because of the longer T2 of Cho in comparison with that of lipids (3). The absolute Cho levels were quantified by using a Gaussian line-shape fitting model and the unsuppressed water signal was used as an internal reference (7).

3. Results

Twenty-six patients with recurrent breast masses following surgical treatment and radiation therapy were included in this study, four patients underwent lumpectomy alone, 10 patients underwent lumpectomy with axillary dissection and 12 patients underwent quadrectomy with axillary dissection. Their ages ranged from 31 to 68 years with mean age 48.5 years. All our patients were subjected to conventional mammography, ultrasonography and dynamic contrast enhanced MRI (DCE-MRI)