MAGNETIC RESONANCE IMAGING – TECHNIQUE OF MAJOR IMPORTANCE IN THE DIAGNOSIS OF BREAST CANCER

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Abstract: *Magnetic Resonance Imaging was introduced in 1980 in the study of breast lesions. It developed in time and, along with the introduction of the studies of intravenous paramagnetic contrast, it proved its utility and value in the diagnosis of breast lesions. The current indications of the MRI examination include: the assessment of the integrity of breast implants and tumours, the inconclusive images obtained through conventional examinations, the pre-operative evaluation of the lesion extension, pre- and post-chemotherapy evaluation. Breast MRI is an extremely valuable method in the differential diagnosis between benign and malignant lesions, with a sensitivity greater than 90% and a specificity greater than 80%.*

Cuvinte cheie: *cancer mamar, imagistică IRM, intensitatea semnalului*

Rezumat: *Imagistica prin Rezonanță magnetică a fost introdusă în studiul leziunilor mamare în anul 1980. Pe parcursul anilor s-a dezvoltat, iar odată cu introducerea studiilor cu contrast paramagnetic intravenos și-a dovedit utilitatea și valoarea în diagnosticul leziunilor mamare. Indicațiile actuale ale examinării IRM includ: evaluarea integrității implantelor și tumorilor mamare, imaginile neconcludente obținute prin examene convenționale, evaluarea preoperatorie a extensiei leziunilor, evaluare pre și post chimioterapie. IRM mamară este o metodă extrem de valoroasă în diagnosticul diferențial între leziunile benigne și maligne, cu o sensibilitate de peste 90% și o specificitate de peste 80%.*

Magnetic Resonance Imaging constitutes a technique complementary to mammography and echography. The malignant lesions can be identified through the study of the behaviour following the intravenous administration of paramagnetic contrast.(1,2) This method offers important elements in the diagnosis of the malignant breast lesions and of the relapses and it developed during the last years, becoming a valuable method for the evaluation of breast diseases. The method was introduced in the study of breast diseases in 1980, but it started to develop and prove its value starting with 1986, along with the introduction of the studies with paramagnetic contrast agent.

Magnetic Imaging Resonance is based on the properties of the H+ protons placed in a (0.2-1.5 Tesla) strong magnetic field and excited through a radiofrequency wave in order to emit a signal, which is processed on a computer and converted into an image.(3) The forming of the image implies data acquisition and respectively, reconstruction. The magnetic resonance phenomenon consists in the modification of the magnetization of the nuclei of a substance under the simultaneous action of a steady strong static magnetic field (B_0) and of an electromagnetic field (the radiofrequency wave). An alternating current in a coil creates an oscillating magnetic field, with the same frequency as that of the current which generated it. The magnetic field is directed all along the axis of the antenna; its intensity depends on the current intensity and on the number of spires of the coil. The B_0 magnetic field is horizontal in most magnets; conventionally we consider that B_0 corresponds to the O_2 axis of the orthogonal reference system. A magnetic system is resonant when it is susceptible of changing its equilibrium state and of storing energy under the influence of external stresses, with a particular frequency which corresponds to the system resonance frequency.

The forming of the image implies two phases: the selection of the tissue section or volume, and subsequently the spatial coding of the signal obtained. Both phases are based on the fact that the resonance (Larmor) frequency of the nuclei is conditioned upon the intensity of the applied magnetic field. The resonance frequency shall be variable in the different points of the space if the magnetic field shall have different values in each of these points. The paramagnetic agents, through the presence of free electrons, induce the appearance of a local magnetic field which reduces the relaxation time T_1 and less T_2 and consequently determine the increase in the contrast in the T_1-weighted sequences, translated through a hypersignal.

The malignant lesions produce angiogenesis factors which stimulate the appearance of a peripheral neovascularisation, which makes the tumour grow. In relation to the normal vascularisation, the neoformation vessels have a focal distribution, are more permeable and serve a larger interstitial space.(4) Given this vascularisation, the breast cancerous lesions can be identified through magnetic resonance due to the behaviour following the intravenous administration of paramagnetic contrast substance.(5)

The Indications of Magnetic Resonance Imaging

The routine indications of magnetic resonance imaging are represented by the assessment of the silicon prostheses (6), of the suspicions of local relapse in a treated breast, the localization of the primary malignant tumours, especially in dense breasts, the evaluation of clinical anomalies with a normal standard balance and the balance of the breast cancer extension. Furthermore, the method is useful in the assessment of the response to the neoadjuvant treatment and one discusses on its value in achieving thermocoagulation in the case

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of small dimension lesions and in identifying women with high genetic risk of breast cancer.(4) Due to the current high tendencies of conservatory surgical therapy of breast cancer, magnetic resonance imaging has become a more and more frequent indication, especially for the patients with high mammographic density.(5)

Magnetic resonance imaging is used in order to assess residual lesions after conservatory surgical interventions, with operative pieces which had positive margins. The adequate characterization of possible residual lesions must be made within one month post-surgery. The issue of the differential diagnosis between the local relapse and fibrosis remains an important indication when mammography or echography is inconclusive, and the patient refuses the biopsy. The absence of the decremental contrast medium uptake ("washing") has an excellent negative predictive value for local relapses. The fibrosis following a tumorectomy shall have a progressive capture model.(5) The MRI differential diagnosis between the benign and malignant lesions – is achieved by monitoring the behaviour of the lesion after the intravenous administration of paramagnetic contrast. The analysis of the time curves in relation to the signal intensity has been extended post-contrast in order to include not only the early phase, but also the intermediate and late phases following the administration of contrast. Thus, there can be obtained valuable information on a breast lesion through the analysis of the time-signal intensity curves. Thus, breast lesions can be classified into the following types:

Type 1a: the intensity of the lesion signal increases all along the acquisition period

Type 2a: the intensity of the lesion signal slowly diminishes in the late post-contrast phase, offering an arched aspect of the signal intensity curve

Type 3: the intensity of the lesion signal is constant after an increase in the early phase

Type 4: the intensity of the lesion signal rapidly diminishes right after it reaches the maximum intensity, due to the washing of the contrast substance

The interpretation of the curves shows that the benign lesions behave very differently in regard to the malignant ones. The distribution of these curves for the benign lesions is the following: type 1 = 83%, type 2 = 11.5%, and type 3 = 5.5%. The distribution of these curves for the malignant lesions is the following: type 1 = 8.9%, type 2 = 33.6%, and type 3 = 57.4%.Thus, the benign lesions generally have type 1 curves, whilst the malignant lesions – type 3 curves.(7,8)

This method shows a 91% sensitivity and a 83% specificity, and the diagnosis accuracy is of 86%.(8,9)

Conclusions:

1. Magnetic Resonance Imaging is an extremely valuable examination method for the diagnosis of breast diseases.
1. The studies with intravenous paramagnetic contrast have a high accuracy in the differential diagnosis between the malignant and benign breast tumours.
2. Breast MRI has multiple indications in the diagnosis of breast diseases.

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