**International Journal of Medical Imaging**
2022; 10(4): 44-48
http://www.sciencepublishinggroup.com/j/ijmi
doi: 10.11648/j.ijmi.20221004.11
ISSN: 2330-8303 (Print); ISSN: 2330-832X (Online)

# Diagnostic Value of Dynamic Contrast-Enhanced MRI Combined with Molybdenum Target X-ray in Non Mass Enhanced Lesions of Breast

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## To cite this article:

Jiao Wang, Zengkui Wang. Diagnostic Value of Dynamic Contrast-Enhanced MRI Combined with Molybdenum Target X-ray in Non Mass Enhanced Lesions of Breast. *International Journal of Medical Imaging*. Vol. 10, No. 4, 2022, pp. 44-48. doi: 10.11648/j.ijmi.20221004.11

**Received**: September 25, 2022; **Accepted**: October 12, 2022; **Published**: October 24, 2022

**Abstract:** Background: Breast cancer occupies the first place in the incidence of female malignant tumors, and has a tendency of becoming younger, and the proportion of non-mass breast cancer in young people is higher. In non-mass like breast lesions (NMLE), which lack typical imaging and are rich in pathological forms, there is often misdiagnosed. It has become an urgent problem to select the correct imaging method, improve the diagnostic accuracy, increase the probability of breast preservation, and improve the quality of life and life span of patients. Objective: To investigate the differential value of the combination of dynamic contrast-enhanced (DCE) MRI and X-ray mammography in diagnosing benign and malignant breast lesions presented as non-mass-like enhancement (NMLE). Methods: A retrospective analysis was carried out on DCE-MRI and X-ray mammography data of 82 patients with NMLE confirmed by surgical pathology. Results: 1) Among the 82 cases of NMLE, 35 cases were benign masses and 47 cases were malignant tumors. 2) There were statistically significant differences between patients with NMLE in distribution, enhanced characteristics of lesions and ADC values; while there were no statistically significant differences in types of TIC. 3) The sensitivity, positive predictive value and negative predictive value of the combination of DCE- MRI and X-ray mammography to NMLE was increased. Conclusions: There are great values of the combination of DCE-MRI and X-ray mammography in diagnosing benign and malignant breast lesions presented as NMLE.

**Keywords:** Dynamic Contrast-Enhanced MRI, X-ray Mammography, Non-Mass-Like Enhancement, Differential Diagnosis, Combined Application

## 1. Introduction

The American Society of Radiology introduced the concept of non-mass like enhancement (NMLE) lesions in the MRI breast imaging report and data system in 2003 [1], and revised and updated it in 2013 [2], which refers to a kind of lesions that do not have mass characteristics on MRI enhanced images. Since normal glands and adipose tissue are often mixed in NMLE lesions, the detection rate of mammography is low, and it is difficult to diagnose clinically [3], which often leads to missed diagnosis and missed optimal treatment opportunity. With its rich examination methods and high-resolution soft tissue, it has important application value in the clinical diagnosis of NMLE lesions [4-6]. The data of DCE-MRI and mammography in 82 cases of NMLE confirmed by pathology were analyzed retrospectively, focusing on the differential value of DCE-MRI and mammography in the diagnosis of benign and malignant NMLE lesions.

## 2. Data and Methods

### *2.1. Clinical Data*

A total of 843 patients with breast DCE-MRI and molybdenum target X-ray in our hospital from July 2015

to December 2020 were retrospectively analyzed. Finally, 82 patients with NMLE and confirmed by operation and puncture pathology were collected, all female patients, aged 22 -73 years old, with an average of 43.7 years old. Among them, 47 cases were in the malignant group, and 35 cases were in the benign group. Inclusion criteria: (1) Patients with NMLE were judged by the consistency of two senior physicians on DCE-MRI images; (2) Patients with non-lactating and pregnant women did not use estrogen; (3) Premenopausal women received breast examination 1 week before menstruation; (4) Patients had not received any clinical treatment before mammography and MRI examination.

### *2.2. Inspection Method*

#### *2.2.1. MRI Examination Method*

Siemens Magnetom spectra 3.0T magnetic resonance scanner and 4Ch_BI_Breast special coil are used. The patient's head is taken to the prone position, and the breasts droop naturally. Routine scanning cross-sectional SE-T1WI (TR 6.8 ms, TE 2.96 ms, slice thickness 1.3mm), SE-T1WI fat suppression (TR 3650 ms, TE 50 ms, slice thickness 4.0 mm). The Ep2d_diff_3b_spair sequence was used for DWI, and the b values were 50 s/mm$^2$ and 800 s/mm$^2$. The T1-fl3d-spair sequence was used for dynamic enhancement scanning, TR 4.89 ms, TE 1.82 ms, layer thickness 1.4 mm, and there was no interval scanning. A total of 9 phases were scanned repeatedly, and the scanning time of each phase was 56 s. The first phase was scanned before administration. From the end of the first phase scanning, Gd-DTPA contrast agent was injected intravenously at a dose of 0.2 ml/ kg and an injection rate of 2ml/s.

#### *2.2.2. Breast Molybdenum Target X-ray Examination*

GE DS breast molybdenum target machine was used, conventional head foot position, internal and external oblique photography, automatic exposure conditions.

#### *2.2.3. Methods of Mammography*

GE DS typed mammography camera was used for routine cephalopod position and internal and external oblique position photography. X-ray manifestations of the lesions were observed under automatic exposure conditions.

### *2.3. Image Analysis*

Breast molybdenum target X-ray and MRI images are read by two senior doctors with rich experience in breast diagnosis using double-blind method, and finally make consistency judgment. DCE-MRI images are analyzed through the mean cure function of post-processing software. ADC values are measured on the ADC map automatically generated by the workstation. The region of interest is selected according to the size of the lesion, and the real part of the lesion is selected, Try to avoid necrotic and cystic areas. According to BIRADS standard [7], observe the distribution characteristics, enhancement characteristics, tic curve type, ADC value, etc.

### *2.4. Statistical Analysis*

SPSS 19.0 statistical software was used to conduct X2 and independent sample t tests on the distribution characteristics, enhancement characteristics, TIC curve types, ADC values of DCE-MRI in NMLE lesions. $P<0.05$ was considered as statistically significant. With pathological results as the "gold standard", the sensitivity, specificity, positive predictive value and negative predictive value of mammography, DCE-MRI and their combined application in the diagnosis of NMLE malignant lesions were calculated respectively.

## 3. Results

### *3.1. Histopathological Type*

82 patients were single lesions, the pathological results are shown in Table 1. Benign lesions 35 cases (42.7%), malignant lesions 47 cases (57.3%). Benign lesions were mainly mammary gland diseases and mammary inflammation, and malignant lesions were mainly invasive ductal carcinoma and ductal carcinoma in situ.

***Table 1.*** *Histopathological types of NMLE lesions.*

| Pathological type | Number of cases | Proportion (%) |
|---|---|---|
| Benign | | |
| Adenosis | 14 | 17.1% |
| Cystic hyperplasia | 6 | 7.3% |
| Mastitis and abscess | 11 | 13.4% |
| Ductal papilloma | 4 | 4.9% |
| Malignant | | |
| Invasive ductal carcinoma | 17 | 20.7% |
| Invasive lobular carcinoma | 8 | 9.8% |
| Ductal carcinoma in situ | 19 | 23.2% |
| Ductal papillary carcinoma | 2 | 2.4% |
| Paget's disease | 1 | 1.2% |

### *3.2. DCE-MRI Findings of NMLE Lesions*

DCE-MRI distribution, enhancement, tic curve and ADC value of NMLE lesions. See Table 2. Univariate analysis showed that there were significant differences in segmental distribution, diffuse distribution, uniform enhancement and cluster ring enhancement of NMLE lesions (P values were 0.002, 0.020, 0.030 and 0.014 respectively). There was no significant difference between benign and malignant of TiC curve type distribution of NMLE lesions ($P > 0.05$). The average ADC value of NMLE benign lesions groups was $(1.39 \pm 0.26) \times 10^{-3}$ mm$^2$/s, the mean ADC value of malignant lesion group was $(1.07 \pm 0.22) \times 10^{-3}$ mm$^2$/s, the difference was statistically significant ($t = 5.143$, $P = 0.000 < 0.05$).

***Table 2.*** *DCE-MRI Manifestations of NMLE Lesions.*

| | Benign group (n=35) | Malignant group (n=47) | X2 | P value |
|---|---|---|---|---|
| Distribution characteristics | | | | |
| Restricted area | 10 | 9 | 1.001 | 0.317 |
| Segmentality | 6 | 24 | 9.949 | 0.002 |
| Catheter sample | 4 | 5 | 0.013 | 0.910 |
| Diffuse | 15 | 9 | 5.447 | 0.020 |
| Strengthening method | | | | |
| Uniform strengthening | 8 | 3 | 4.687 | 0.030 |
| Non-uniform strengthening | 13 | 16 | 0.084 | 0.771 |
| Clustered annular strengthening | 6 | 20 | 5.982 | 0.014 |
| Clustered reinforcement | 8 | 8 | 0.435 | 0.510 |
| TIC curve type | | | | |
| Type I | 8 | 12 | 0.078 | 0.780 |
| Type II | 16 | 25 | 0.449 | 0.503 |
| TypeIII | 11 | 10 | 1.085 | 0.298 |
| ADC value×$10^{-3}$$mm^2$/s | 1.39±0.26 | 1.07±0.22 | t=5.143 | P=0.000 |

### *3.3. Mammography Findings of NMLE Lesions*

In this group, 71 patients with NMLE lesions showed distortion of gland structure, localized asymmetric dense shadow and multiple micro calcifications on molybdenum target X-ray, and 11 cases had no positive findings. Among them, 18 cases showed malignant calcification, including gravel calcification, needle tip calcification and cluster calcification, and 3 cases showed focal distortion of gland structure and star like changes.

### *3.4. Comparison of Diagnostic Efficacy*

Breast molybdenum target X-ray, DCE-MRI and their combined application in the diagnosis of breast NMLE malignant lesions are shown in Table 3, Table 4.

***Table 3.*** *Comparison of diagnostic efficacy of mammography, DCE-MRI and their combination in breast NMLE malignant lesions.*

| Inspection method | Qualitative image method | Pathological results | | Sensitivity | Specificity |
|---|---|---|---|---|---|
| | | malignant | Benign | | |
| Mammary molybdenum target X-ray | malignant | 21 | 2 | 44.6 | 94.3 |
| | Benign | 26 | 33 | | |
| Dynamic enhanced MRI | malignant | 41 | 8 | 87.2 | 77.1 |
| | Benign | 6 | 27 | | |
| Mammary molybdenum target | malignant | 44 | 8 | 93.6 | 77.1 |
| X-ray+Dynamic enhanced MRI | Benign | 3 | 27 | | |

***Table 4.*** *Comparison of diagnostic efficacy of mammography, DCE-MRI and their combination in breast NMLE malignant lesions.*

| Inspection method | Qualitative image method | Pathological results | | Positive predictive value | Negative predictive value | Accuracy |
|---|---|---|---|---|---|---|
| | | malignant | Benign | | | |
| Mammary molybdenum target X-ray | malignant | 21 | 2 | 91.3 | 55.9 | 65.9 |
| | Benign | 26 | 33 | | | |
| Dynamic enhanced MRI | malignant | 41 | 8 | 83.7 | 81.8 | 82.9 |
| | Benign | 6 | 27 | | | |
| Mammary molybdenum target | malignant | 44 | 8 | 84.6 | 90.0 | 86.6 |
| X-ray+Dynamic enhanced MRI | Benign | 3 | 27 | | | |

## 4. Discussion

### *4.1. Application Value of Mammography in Diagnosis of Benign and Malignant NMLE*

Breast molybdenum target X-ray of NMLE lesions can show distorted gland structure, localized asymmetric dense shadow and multiple micro calcifications [8] Calcification is an important sign in the diagnosis of breast cancer. Especially for non mass type breast cancer, malignant calcification is usually the only diagnostic standard. In this study, 18 cases (85.7%) were diagnosed as malignant lesions by mammography based on malignant calcification, showing gravel like calcification, needle tip calcification and cluster calcification, which is consistent with the characteristics of breast malignant calcification reported in the literature [9]. the mammography of the other three cases of malignant lesions correctly diagnosed showed focal distortion of gland structure and star like changes. All 21 cases of malignant lesions in this group were accurately judged according to the above two manifestations. Compared with MRI, the detection rate of NMLE malignant lesions by mammography is lower. The reasons are as follows: (1) Some dense mammary glands affect the display of lesions; (2) some lesions are located in the deep layer of glands, and the overlap of glands affects the display of lesions; (3) some NMLE malignant lesions are negative on mammography target X-ray; (4) the positive rate

is reduced due to the influence of diagnostic level.

### *4.2. The Value of DCE-MRI in the Diagnosis of Benign and Malignant NMLE Lesions*

DCE-MRI mainly analyzes the distribution characteristics and internal enhancement characteristics of NMLE lesions [10]. According to BI-RADS-MRI standard, the distribution characteristics of lesions in this study can be divided into regional like distribution, segmental like distribution, ductal like distribution and diffuse like distribution. The enhancement characteristics of NMLE lesions can be divided into uniform enhancement, uneven enhancement, cluster ring enhancement and cluster ring enhancement. Studies show that segmental like distribution and cluster ring enhancement often indicate malignant lesions [7, 11, 12]. Among them, cluster ring enhancement is considered to be a landmark diagnosis of malignant lesions, suggesting intraductal lesions and/or micro infiltration, and tumor cells involving the ductal wall of breast ducts and surrounding stroma [13]. In this study, through univariate analysis, there were significant differences in segmental distribution and cluster ring enhancement between benign and malignant groups of NMLE lesions (P values were 0.002 and 0.014, respectively), consistent with literature reports.

TIC curve has a very important value in the diagnosis of mass type breast cancer. It can provide the blood supply characteristics of breast lesions. However, the study shows that TIC type is of little significance in the differential diagnosis of benign and malignant lesions of NMLE [14], there is no statistically significant difference between benign and malignant NMLE lesions ($P>0.05$), which is consistent with the literature. $(1.39\pm0.26)\times 10^{-3}$ $mm^2/s$, the mean ADC value of malignant lesion group was $(1.07 \pm 0.22) \times 10^{-3}$ $mm^2/s$, the difference between the two is statistically significant ($P < 0.05$), which is consistent with the report of Cheng l et al. [15]. However, DWI, as a functional imaging, can not be used as an independent imaging diagnosis at present. For NMLE lesions, the diagnostic efficiency of simply using ADC value to identify the nature of lesions is low, which needs to be combined with dynamic enhanced MRI.

### *4.3. Diagnostic Value of DCE-MRI Combined with Mammography*

Due to the influence of dense glands and other factors, the detection rate of malignant lesions in NMLE by breast molybdenum target X-ray is low. In this study, 26 of the 59 cases diagnosed as benign lesions by breast molybdenum target X-ray are malignant, and the misdiagnosis rate is high. However, compared with DCE-MRI, breast molybdenum target X-ray has higher specificity for the detection of malignant lesions, which is mainly detected according to the malignant calcification inside the lesions Among the 6 lesions underestimated by MRI, 5 cases were ductal carcinoma in situ and 1 case was invasive ductal carcinoma, which was missed due to the lack of typical malignant signs. Among the 8 lesions overestimated by MRI, 5 cases were mastitis, 3 cases were intraductal papilloma and 1 case was adenopathy. Among them, 5 cases of mastitis showed segmental distribution or cluster ring enhancement, which was difficult to distinguish from malignant lesions. 3 cases were ductal inflammatory lesions In this study, the benign and malignant lesions of NMLE were comprehensively analyzed by the combined application of DCE-MRI and breast molybdenum target X-ray. On the basis of 41 cases correctly diagnosed by MRI, 3 cases of malignant lesions were detected. These three cases were detected according to the malignant calcification of breast molybdenum target X-ray The sensitivity, positive predictive value and negative predictive value of NMLE malignant lesions were improved.

## 5. Conclusion

Malignant signs of NMLE lesions: 1. Breast molybdenum target X-ray shows malignant calcification or focal gland structure distortion. 2. DCE-MRI mostly shows segmental distribution and cluster ring enhancement. The combined application of DCE-MRI and breast molybdenum target X-ray can improve the sensitivity, positive predictive value and negative predictive value of NMLE malignant lesions.

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