

# The comparison between young and old patients and the prognostic roles of magnetic resonance imaging-related parameter characteristics in young patients—a retrospective cohort study

# Lijuan Hu<sup>1#</sup>, Jimei Jiang<sup>2#</sup>, Xiaoyan Wang<sup>3</sup>

<sup>1</sup>Department of Radiology, Hubei Provincial Hospital of Integrated Chinese and Western Medicine, Wuhan, China; <sup>2</sup>Department of Radiology, Shanghai Fourth People's Hospital, School of Medicine, Tongji University, Shanghai, China; <sup>3</sup>Department of Radiology, The People's Hospital of Zhaoyuan City, Yantai, China

*Contributions:* (I) Conception and design: L Hu, J Jiang; (II) Administrative support: X Wang; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data: All authors; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

<sup>#</sup>These authors contributed equally to this work.

*Correspondence to:* Xiaoyan Wang, Bachelor. Department of Radiology, The People's Hospital of Zhaoyuan City, 168 Yingbin Road, Zhaoyuan, Yantai 265400, China. Email: wxy13954550906@163.com.

**Background:** Breast dynamic enhanced magnetic resonance imaging (MRI) is an important in the diagnosis and treatment of breast cancer. However, it is unclear whether the characteristics of breast dynamic enhancement MRI-related parameters in young breast cancer patients are specific. The present study was to study the dynamic enhancement of MRI-related parameter characteristics and its correlation with clinical features in young breast cancer patients.

**Methods:** A total of 196 breast cancer patients admitted to the People's Hospital of Zhaoyuan City from January 2017 to December 2017 were retrospectively collected, and the patients were divided into a young breast cancer group (n=56) and a control group (n=140) according to whether the patient age limit of <40 years old. All patients underwent breast dynamic enhanced MRI and were followed up for 5 years to observe whether there was recurrence or metastasis. We compared the differences of breast dynamic enhanced MRI-related parameters between the 2 groups, and then analyzed the correlation between breast dynamic enhancement MRI-related parameters and clinical features in young breast cancer patients.

**Results:** Compared with the control group, the apparent diffusion coefficient (ADC) of the young breast cancer group was significantly reduced ( $0.84\pm0.13 vs. 0.93\pm0.14\times10^{-3} mm^2/s$ , P<0.001); the proportion of patients with non-mass enhancement was significantly increased in the young breast cancer group (25.00% vs. 8.57%, P=0.002). The ADC was significantly positively correlated with age (r=0.226, P=0.001) and negatively correlated with the maximum diameter of the tumor (r=-0.199, P=0.005). The ADC was shown to be valuable in predicting the absence of lymph node metastasis in the young breast cancer patients, and the area under the curve (AUC) was 0.817 [95% confidence interval (CI): 0.702–0.932, P<0.001]. The ADC was shown to be valuable in predicting the absence of recurrence or metastasis in the young breast cancer patients, and the AUC was 0.784 (95% CI: 0.630–0.937, P=0.007). The rates of lymph node metastasis and recurrence at 5 years were significantly increased in young breast cancer patients with non-mass enhancement (P<0.05).

**Conclusions:** The present study provides a reference for further evaluation of the characteristics of young breast cancer patients.

Keywords: Young; breast cancer; magnetic resonance imaging (MRI); prognosis

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# Introduction

The incidence of breast cancer is increasing year by year, with an incidence rate which currently ranks first among malignant tumors (1). In recent years, studies have found that the age-related incidence of breast cancer is tending to be younger (2,3). Young breast cancer patients refer to breast cancer patients under the age of 40, and the current studies have found that young breast cancer patients have different clinical features, manifested by a higher positive rate of human epidermal growth factor receptor 2 (HER-2), a lower positive rate of estrogen receptor (ER), and a worse prognosis (4-6). Magnetic resonance imaging (MRI) is currently mainly used for staging assessment and preoperative evaluation in breast cancer, which has great advantages in finding small lesions, evaluating the extent of lesions, predicting the efficacy of neoadjuvant chemotherapy and evaluating prognosis (7,8). Due to the specific clinical features of young breast cancer patients, we speculated that parameters related to breast dynamic enhancement MRI may also be specific. However, there is a lack of relevant studies, so we designed this study to investigate the characteristics of dynamic enhancement MRI parameters in young breast cancer patients and their correlation with clinical features. We present the following article in accordance with the STARD

#### Highlight box

#### Key findings

 Parameters related to breast dynamic enhancement MRI in young breast cancer patients are specific.

#### What is known and what is new?

- Breast dynamic enhanced MRI is an important examination in the diagnosis and treatment of breast cancer, and it is of great clinical significance for clinicians to evaluate surgical plans;
- An increased proportion of young breast cancer patients presented with non-mass enhancement and a decreased apparent diffusion coefficient, which is associated with clinical features and prognosis.

#### What is the implication, and what should change now?

• The parameters related to breast dynamic enhancement MRI in young breast cancer patients are specific, which provides a reference for further evaluation of the characteristics of young breast cancer patients.

reporting checklist (available at https://gs.amegroups.com/ article/view/10.21037/gs-23-84/rc).

#### Methods

#### General information

The present study was a retrospective cohort study. A total of 196 breast cancer patients admitted to the People's Hospital of Zhaoyuan City from January 2017 to December 2017 were retrospectively collected, and the patients were divided into a young breast cancer group (n=56) and a control group (n=140) according to whether the patient's age was <40 years old. The clinical and pathological features of the 2 groups were compared. The inclusion criteria were as follows: (I) female patients with invasive breast cancer; (II) newly diagnosed patients who did not receive special treatments such as neoadjuvant therapy before surgery; (III) age  $\geq 18$  years; (IV) breast dynamic enhancement MRI examination in our hospital, with complete information. The exclusion criteria were as follows: (I) carcinoma in situ or benign mass; (II) inflammatory breast cancer; (III) special types of breast cancer such as metaplastic carcinoma; (IV) combined with other malignant tumors; (V) recurrent breast cancer; (VI) distant metastases. This study was in accordance with the Declaration of Helsinki (revised in 2013), and this retrospective clinical study was approved by The Ethics Committee of People's Hospital of Zhaoyuan City (No. 202200842). The informed consent requirement was waived for this retrospective study. A flowchart of patient inclusion is shown in Figure 1.

#### Examination method of breast dynamic enhancement MRI

Examination instrument: Siemens 3.0T MRI (Siemens, Erlangen, Germany); contrast agent: gadolinium acid glucosamine, dose 0.2 mmol/kg (intravenous injection, flow rate: 2.5 mL/s). A total of 6 consecutive acquisitions were performed before and after enhancement.

#### Data collection

(I) General information: age, site of onset, smoking



Figure 1 The flowchart of breast cancer patients' inclusion.

history, alcohol history, body mass index (BMI), family history, comorbidities;

- (II) MRI characteristics: mass enhancement features (non-mass enhancement or mass enhancement), early enhancement rate, enhancement platform, apparent diffusion coefficient (ADC);
- (III) Pathological features: lesion size, ER, progesterone receptor (PR), Ki-67 (%), and HER-2 positive rate, lymph node metastasis rate and skin or chest wall invasion rate. We confirmed the presence of lymph node metastasis and skin or chest wall invasion based on the pathology;
- (IV) Prognostic factor: rate of recurrence or metastasis at 5 years postoperatively. After the surgery, all patients were followed up by clinical visits at least once a year. The patients received breast ultrasound, chest computed tomography examination, head computed tomography examination, breast MRI and other examinations to observe the rate of recurrence or metastasis at 5 years postoperatively.

#### Treatment method

After admission, all patients completed relevant examinations, underwent radical mastectomy, and were provided symptomatic supportive treatment such as early functional exercise, prevention of infection, and maintenance of water-electrolyte balance after surgery. Within 1 month after surgery, the patients received chemotherapy, radiotherapy, targeted drug therapy, or endocrine therapy according to the postoperative pathological results.

#### Statistical analysis

The software SPSS 26.0 (IBM Corp., Armonk, NY, USA) was used to complete the data analysis, and the difference was considered statistically significant when P<0.05 (two-tailed). The BMI and other measurement data of the 2 groups were expressed by mean  $\pm$  standard deviation, and the independent sample *t*-test was used to analyze the differences of the measurement data between the 2 groups. The counting data of the 2 groups were expressed by n (%), and the chi-square test was used to analyze the difference of the counting data between the 2 groups. The receiver operating characteristic (ROC) curve was used to analyze the predictive value of ADC on recurrence or metastasis in breast cancer patients at 5 years after surgery.

#### Results

# Comparison of clinical features and parameters related to breast dynamic enhancement MRI in the 2 groups

Compared with the control group, the ADC of the young breast cancer group was significantly reduced ( $0.84\pm0.13 vs.$   $0.93\pm0.14\times10^{-3}$  mm<sup>2</sup>/s, P<0.001); the proportion of patients with non-mass enhancement was significantly increased in the young breast cancer group (25.00% vs. 8.57%, P=0.002); the maximum tumor diameter was increased in

Table 1 Comparison of clinical features and parameters related to breast dynamic enhancement MRI between the two groups

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Group	Young breast cancer group (n=56)	Control group (n=140)	$t/\chi^2$ value	P value
Age (years)	31.48±5.31	60.19±11.85	17.429	<0.001
Site of onset			0.207	0.649
Left	30 (53.57)	80 (57.14)		
Right	26 (46.43)	60 (42.86)		
History of smoking	6 (10.71)	14 (10.00)	0.022	0.881
History of alcoholism	4 (7.14)	9 (6.43)	0.033	0.856
Body mass index (kg/m²)	24.04±2.37	24.14±2.31	0.253	0.800
Family history	3 (5.36)	6 (4.29)	0.105	0.746
Hypertensive disease	4 (7.14)	9 (6.43)	0.033	0.856
Diabetes	3 (5.36)	8 (5.71)	0.010	0.922
Apparent diffusion coefficient (×10 <sup>-3</sup> mm <sup>2</sup> /s)	0.84±0.13	0.93±0.14	4.266	<0.001
Mass enhancement features			9.383	0.002
Non-mass enhancement	14 (25.00)	12 (8.57)		
Mass enhancement	42 (75.00)	128 (91.43)		
Early enhancement rate (%)			0.662	0.416
>120	30 (53.57)	66 (47.14)		
≤120	26 (46.43)	74 (52.86)		
Enhancement platform			0.002	0.964
Outflow type	31 (55.36)	77 (55.00)		
Platform type	25 (44.64)	63 (45.00)		
Inflow type	0 (0.00)	0 (0.00)		
Maximum tumor diameter (cm)	3.14±1.07	2.26±1.07	5.180	<0.001
Positive HER-2 rate	17 (30.36)	27 (19.29)	2.186	0.093
Positive Ki-67 rate	51 (91.07)	125 (89.29)	0.139	0.709
Positive ER rate	48 (85.71)	131 (93.57)	3.117	0.077
Positive PR rate	50 (89.29)	128 (91.43)	0.220	0.639
Lymph node metastases	22 (39.29)	41 (29.29)	1.834	0.176
Invasion of the skin or chest wall	3 (5.36)	7 (5.00)	0.011	0.198
Rate of recurrence or metastasis at 5 years postoperatively	9 (16.07)	7 (5.00)	6.540	0.011

Data are presented as mean ± standard deviation or n (%). MRI, magnetic resonance imaging; HER-2, human epidermal growth factor receptor 2; ER, estrogen receptor; PR, progesterone receptor.

the young breast cancer group  $(3.14\pm1.07 \text{ vs. } 2.26\pm1.07 \text{ cm}, P<0.001)$ ; the rate of recurrence or metastasis was increased at 5 years after surgery in the young breast cancer group (16.07% vs. 5.00%, P=0.011) (*Table 1* and *Figure 2*).

# Correlation analysis between ADC and age, maximum tumor diameter

The ADC was significantly positively correlated with age



Figure 2 Comparison of mass enhancement and non-mass enhancement in breast cancer patients. (A) Non-mass enhancement; (B) mass enhancement.

Table 2 Correlation between ADC and age, maximum tumor diameter

	Age (years)		Apparent diffusion coefficient (×10 <sup>-3</sup> mm <sup>2</sup> /s)		Maximum tumor diameter (cm)	
	r value	P value	r value	P value	r value	P value
Age (years)	-	-	0.226	0.001	-0.312	<0.001
Apparent diffusion coefficient (×10 <sup>-3</sup> mm <sup>2</sup> /s)	0.226	0.001	-	-	-0.199	0.005
Maximum tumor diameter (cm)	-0.312	<0.001	-0.199	0.005	-	-

ADC, apparent diffusion coefficient.



**Figure 3** The value of ADC in predicting the absence of lymph node metastasis in the young breast cancer patients. ADC, apparent diffusion coefficient.

(r=0.226, P=0.001), and negatively correlated with the maximum tumor diameter (r=-0.199, P=0.005) (*Table 2*).

## Predictive value of ADC on the absence of lymph node metastasis in young breast cancer patients

The ADC was found to be valuable in predicting the absence of lymph node metastasis in young breast cancer patients, and the area under the curve (AUC) was 0.817 [95% confidence interval (CI): 0.702–0.932, P<0.001] (*Figure 3*).

# Predictive value of ADC on the absence of recurrence or metastasis in young breast cancer patients

The ADC was shown to be valuable in predicting the absence of recurrence or metastasis at 5 years

postoperatively, and the AUC was 0.784 (95% CI: 0.630–0.937, P=0.007) (*Figure 4*).

## Correlation analysis of mass enhancement characteristics and lymph node metastasis, recurrence or metastasis in young breast cancer patients

Lymph node metastasis and recurrence or metastasis at 5 years postoperatively were significantly increased in the young breast cancer patients with non-mass enhancement (P<0.05) (*Table 3*).

#### Discussion

Since the clinical features of young breast cancer patients are different from those of other patients, we speculated



**Figure 4** Predictive value of ADC on the absence of recurrence or metastasis in young breast cancer patients. ADC, apparent diffusion coefficient.

that parameters related to breast dynamic enhancement MRI may also be specific in young breast cancer patients. To confirm this hypothesis, we designed this study and showed that younger breast cancer patients had a lower ADC and a higher proportion of patients with non-mass enhancement compared to other patients.

ADC is an indicator of water molecule movement in the tissue, which can reflect the density of tumor cell arrangement, cell matrix, and cell membrane integrity. When the tumor cell density is high, the movement of water molecules is restricted, which is manifested by a decrease in the ADC (9,10). The lower the ADC, the higher the tumor cell density in breast cancer patients, and the more likely they are to have lymph node metastasis, postoperative recurrence, or metastasis (11,12). Studies on patients with other malignancies have also confirmed that the ADC were associated with lymph node metastasis (13-15). In the present study, the ADC had a high predictive value for the absence of lymph node metastasis, and the AUC was 0.817 (95% CI: 0.702-0.932, P<0.001). Another study on breast cancer patients also confirmed that a decrease in the ADC was associated with postoperative recurrence or metastasis (16), supporting the present study. This study showed that the ADC was valuable in predicting the absence of recurrence or metastasis in the young breast cancer patients, with an AUC of 0.784 (95% CI: 0.630-0.937, P=0.007). Studies on patients with other malignancies have also shown that the ADC was associated with recurrence or metastasis (17-19). It can be seen from the above that the ADC of young breast cancer patients was reduced, which indicated that the tumor cell density of young breast cancer patients was high, and it was related to the poor prognosis of young breast cancer patients. In addition, this study also showed that the ADC of breast cancer patients was negatively correlated with the maximum

Table 3 Correlation analysis of mass enhancement characteristics and lymph node metastasis, recurrence, or metastasis in young breast cancer patients

Group	Non-mass enhancement (n=14)	Mass enhancement (n=42)	$\chi^2$ value	P value
Lymph node metastases			4.891	0.027
Yes	9 (64.29)	13 (30.95)		
No	5 (35.71)	29 (69.05)		
Recurrence or metastasis at 5 years postoperatively			5.340	0.021
Yes	5 (35.71)	4 (9.52)		
No	9 (64.29)	38 (90.48)		

tumor diameter, which indicated that the lower the ADC, the larger the tumor. This had also been confirmed by a study in patients with renal cancer (20). A previous study also showed that ADC value was valuable in predicting the pathologic complete response in breast cancer receiving the neoadjuvant chemotherapy (21).

According to the morphological characteristics of breast dynamic enhancement MRI enhancement, breast lesions can be divided into punctiform enhancement, mass enhancement, and non-mass enhancement. Punctiform enhancement lesions refer to enhancement lesion less than 5 mm, most of which are benign lesions, so punctiform enhancement is rare in patients with invasive breast cancer. The mass enhancement is a space-occupying lesion, which was most commonly seen in patients with invasive breast cancer. Non-mass enhancement can be benign or malignant. Patients with non-mass enhancement lesions are scattered and more extensive, making them more prone to recurrence and metastasis (22,23). The present study showed that non-mass enhancement was characterized by a significantly increased rate of lymph node metastasis, recurrence, or metastasis at 5 years postoperatively in young breast cancer patients compared with mass enhancement breast cancer (P<0.05).

A study which explored the characteristics of breast dynamic enhanced MRI in young breast cancer patients found that young breast cancer patients have more extensive lesions and are associated with poor prognosis (24). Another study showed that young patients with triple-negative breast cancer had different MRI characteristics compared with other young breast cancer patients (25). This illustrated the unique characteristics of breast dynamic enhancement nuclear magnetic resonance (NMR) characteristics in young breast cancer patients. Studying the dynamic enhancement MRI characteristics of young breast cancer patients is conducive to further revealing the lesion characteristics of young breast cancer patients, which is helpful for fine management of young breast cancer patients. But further studies are still needed to confirm the clinical values.

#### Shortcomings

This was a retrospectively clinical study that included a relative limited number of young breast cancer patients, which was likely to cause some deviations in the results. Therefore, the results needed to be further confirmed by large sample multi-center clinical trials. Moreover, only 16 patients in the present study suffered from postoperative recurrence or metastasis, Therefore, COX regression analysis cannot be carried out.

#### Conclusions

The research on the prognosis and related biological indicators of different diseases is the focus of current research (26-30). The parameters of breast dynamic enhancement MRI in young breast cancer patients are specific, which is manifested by an increased proportion of patients with non-mass enhancement, a decrease in the ADC, and is related to the clinical features and prognosis of patients. This provides a reference for further evaluation of the characteristics of young breast cancer patients.

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#### Footnote

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*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at https://gs.amegroups.com/article/view/10.21037/gs-23-84/coif). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was in accordance with the Declaration of Helsinki (revised in 2013), and this retrospective clinical study was approved by The Ethics Committee of People's Hospital of Zhaoyuan City (No. 202200842). The informed consent requirement was waived for this retrospective study.

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472

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