Efficacy of MRI morphology and kinetic parameters in distinguishing benign and malignant breast lesion

T. Du[1], B. Ding[1], C. Sang[1], and C. zhang[1]

[1]Department of Radiology, Fuxing Hospital Affiliated to Capital University of Medicine Sciences, Beijing, China, People's Republic of

Introduction:

Dynamic contrast-enhanced (DCE) MRI has been reported high sensitivity (up to 100%) in detecting benign and malignant breast lesions, however, with variable specificity ranging from 30% to 85% [1]. To classify breast lesions more accurately, some investigators [2][3] created a scoring system implementing morphologic and dynamic enhancement features. According to morphologic manifestation of breast lesion, if there was spreading signs along duct and vascularity or not, we introduced a scoring method by optimizing some imaging index combined in part with previous criteria [4] to differentiate benign and malignant lesions using a single breast MRI scanning. The reliability of the scoring method was tested by the pathology.

Methods:

The MRI studies of 33 patients with breast lesions, mean age 52.5 yrs (age ranged 27-78 yrs), were performed on a 1.5T system. 17 benign lesions and 16 malignant tumors were proved by histopathology. The benign lesions include 8 cyclomastopathys, 4 of them associated with fibroadenoma structure formation, 4 plasma cell mastitis, 2 fibroadenomas, 2 duct papillomas and 1 epidermoid cyst associated with heavy chronic inflammation. The malignant tumors include 11 infitrating ductal carcinomas, 2 intraductal papilloma associated with atypical hvperplasia, a infiltrating lobular carcinoma, a mucinous carcinoma, and a Paget's disease. Patients were imaged in the prone position in a dedicated bilateral breast coil. Imaging sequences included an axial fat-suppressed T2WI, an axial T1WI, and an axial three-dimensional LAVA was performed after a rapid intravenous bolus injection (0.1mmol/kg and 3ml/sec) gadolinium-contrast medium (Magnevist and Omniscan). The dynamic acquisition had 9 phases, 35s/phase (4mm/-2mm, matrix 256x256). Statistical methods: patient age and size of breast lesion in benign and malignant groups was analyzed using T test. Lesion margin ,shape, spreading signs, time-signal intensity curve, and signal enhancement rate (measured by a GE AW workstation with 4.2 edition software.) were compared by chi-squared test. Lesion morphology and dynamic data of benign and malignant groups on CE-MRI were scored using the criteria in table 1.

Results:

Means ages of benign and malignant patients were 47.4 yrs and 57.6 yrs respectively (p<0.05). There was not statistic difference in the size of breast lesions of the two groups (P=0.097). The morphological features and CE-MRI data was in table 2[See picture 1a.b.c.]. Scoring of breast lesion in the two groups was in table 3. Sensitivity, specificity and accuracy of the scoring method for prediction of breast malignant tumor were 93.8% (15/16), 88.2% (15/17), 90..9% (30/33), respectively.

Table 1: Scoring for Evaluating Breast Lesions on Contrast-Enhanced MRI

Criteria	Classifying	score
margins	well-defined	0
	Ill- defined	1
shape	Round, oval	0
	lobular	1
	Irregular, speculate	2
Spreading signs	no	0
	hook sign, nipple line, carination ecphyma	1
Time-signal intensity curve	Continuous Ⅰ	0
	Plateau Ⅱ	1
	Washout Ⅲ	2
Signal enhan-cement rate	<50%	0
	50-100%	1
	>100%	2

Table 2 MRI morphology and dynamic features of breast lesion

criteria	Classifying	benign	malignance	test
Margin	well- defined	12	3	X^2=8.93
	ill-defined	5	13	P=0.003
shape	Round, oval	10	2	X^2=10.76
	lobular	5	4	P=0.005
	Irregular, dendritic speculate	2	10	
duct spreading signs	hook sign	1*	3	X^2=9.17
	nipple line	1#	4	P=0.002
	carination ecphyma		3	
Signal intensity curve	Ⅰ	9	1	X^2=12.28
	Ⅱ	5	3	P = 0.002
	Ⅲ	3	12	
Signal enhanced extent	<50%	6	0	X^2=10.03
	50-100%	8	6	P = 0.007
	>100%	3	10	

*a plasma cell mastitis , # a duct papillomas.

Table 3: Scoring of benign and malignant lesion

Category /score	0	1	3	4	5	6	7	8	total	(%) n
Benign (n)	5	2	2	3	3	2#	0	0	17	≤5 score , 15 (88.2)
Malignance (n)	0	0	0	1*	0	4	6	5	16	≥6 score , 15 (93.8)

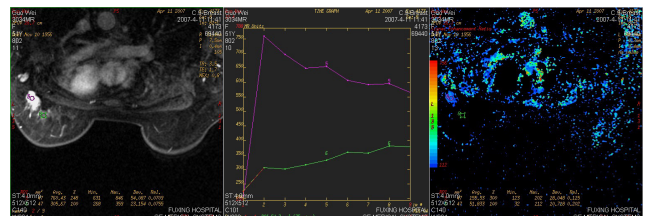# a plasma cell mastitis and a fibroadenomas, * a Paget's disease.

Figure1a.b.c: Infitrating ductal carcinomas of left breast lateral upper quadrant (8 score) showed margin with irregular, speculate(a), Ⅲ curve (b) , and >100% signal enhancement rate(c) on CE-MRI.

Discuss andConclusion:

In this study, we evaluated some criteria of morphologic manifestations, including shape , margin and spreading signs, and dynamic enhancement feature of breast, including signal intensity curve and signal enhancement rate. These criteria were well correlated with invasion and vascularity or blood supply quantity of breast malignant tumor. Scoring of malignant group was almost ≥6 except 1 case with Paget's disease, who got 4 score. On the other hand, scoring of benign group was almost≤5 score except a plasma cell mastitis and a fibroadenomas, who got all 6 score.   There were high specificity, sensitivity and accuracy for distinguishing malignant tumor from benign lesion of breast on CE-MRI using above simple scoring method. However, we need a study of large sample to evaluate further the reliability and practicability of the scoring method.

*Reference:*1 Wang Y. et al. *ISMRM* 2007 Body MR ：Chest，Breast & Genituornaty .   2 Fischer U. et al *Radiology* 1999；231：881-888
3 Sardanelli F. et al. *AJR* 2004; 183:1149-1157.   4 Malich A. et al. *AJR* 2005; 185:964-970