1

2.

: , (MR) ,
.
: 87 , 1.5 T , T1
FLASH(Fast low angle shot) .
, ,
(Non- Mass- Like enhancement) , ,
(Time- Signal Intensity curve) ,
ACR BIRADS- MRI lexicon(American College of Radiology Breast Imaging Reporting
and Data Systems - Magnetic Resonance Image) .
, ,
, , p53,
c- erbB- 2, EGFR, Ki- 67 , .
: MR , ,
. ,
,
,
. Ki- 67 .
: , ,
.

MR ,
(1- 4). TNM

,
(5, 6), , (8- 14).
, , MR
(MR technique), (interpretation
(5, 6). criteria) .
. MR (spatial resolution)
(MR) , (temporal resolution)
, , (staging), (7). American College of
(7). Radiology (ACR) 2003 MR
ACR BI- RADS (Breast Imaging and
Reporting and Data System)- MRI (lexicon)
1 , (15).

2 MR

2005 1 11 2005 4 7 .

:

, MR ACR BI- RADS - MRI
.
(invasive ductal carcinoma NOS)
MR ACR BI- RADS - MRI MR
.

2004 3 2004 6 MR
(invasive ductal carcinoma NOS)
122 . MR
25 (2),
5 , MR 5 87
. 29-
69 , 47 . 87
55 32
. (modified radical
mastectomy) 37 , (simple mastectomy) 1
, (quadrantectomy) 47 , (wide
excision) 1 , (lumpectomy) 1 .
MR 1.5 T Sonata (Siemens, Erlangen,
Germany) . T2
TSE (T2- weighted turbo spin echo) (sagittal
image) .
, T1 3D FLASH
(T1 weighted three dimensional fast low angle shot)
(TR 4.9 ms, TE 1.8 ms, flip angle 12°, field of view
100 mm, matrix (224× 448), (acquisition time)
84 , 1 mm) , 0.1 mmol/Kg
Gadolinium- DTPA (Magnevist, Schering, Berlin, Germany)
4
. (manual injection) ,
15 .
T1 SE (T1 weighted spin echo)
, (axial image) . (post-
processing) (standard subtraction,
-) , (reverse
subtraction, -
) , MIP (maximum- intensity- projection)
.
MR 3
, ACR BI- RADS - MRI lexicon
.
(mass enhancement) (shape) (round),
(oval), (lobular), (irregular) ,
(margin) (smooth), , (spiculated) ,
(internal enhancement characteri- stics)
(homogeneous), (heterogeneous),

(rim enhancement) ,
(Non- Mass- Like enhancement) (distri- bution),
.
(Time-
Signal Intensity curve) ROI
. (partial volume
averaging) ROI
.
60% (slow) ,
60% 80% (medium) , 80%
(rapid) .
(persistent) , (plateau) ,
(wash out) (16, 17).
MR 1
. (histopatho-
logic) ,
, .
modified Black's grading system , Elston-
Ellis method . (immuno-
histochemical) (ER
), (PR), p53, c- erbB-
2, EGFR, Ki- 67 .
MR
. (ordinal) , (ordered
normial) , (non- normal interval)
Spearman .
(dichotomous) Pearson's
, ,
Mann Whitney U
. ,
(logistic regression analysis)
, MR ,
.
(forward: condi- tional) (binary)
.
0.05, 0.1 . SPSS 10.0.7 for window (Statistical
Package for Social Sciences, SPSS, Chicago,)
.

87 77 , 10
. 77 1 , 7
, 28 , 41 , 1 ,
42 , 34 , 1 ,
53 , 23 . 10
(distribution) (segmental) 9 ,

(diffuse) 1 , 5 , . EGFR 86 , 1 . Ki-67 1-50%,
(clumped) 5 . 10.1% , 20% , 20%
1 , 4 , (13), 70 , 17 .
82 , 3 , ,
44 , 40 . , ER, PR, Ki-67 (linear
0.1-5.6 cm, 2.2 , 2 cm 45 association) , ,
, 2 cm 42 . 0-29 , , ER, PR, Ki-67
1.8 49 , 38 . , ,
. 1 3 , 2 39 , 3 45 , , ER, PR, p53, Ki-67
, 1 7 , 2 35 , 3 45 , , Ki-
. 34 , 53 , 67 (Table 1, 2). MR
43 , 44 . p53 13 .
, 1 (1-25%) 47 , 2 (25-50%) 2 , 3 , (,
(50-75%) 7 , 4 (75%) 18 , c- low grade, high grade)
erbB-2 45 , 1 24 , 2 4 , 3 14 ,
, ER, PR ,
. Ki-67 (20%
20%)

Table 1. Statistical Relationship Between MR Findings and Histopathologically defined Prognostic Factors

MR findings	Tumor size	Lymph node status	Nuclear grade	Histologic grade
Type[§]	0.02[‡]	0.49[‡]	0.09[†]	0.09[†]
Shape	0.36*	0.39*	0.40*	0.40*
Margin[¶]	0.19*	0.06*	<0.001*	<0.001*
			(=-0.53)	(=-0.48)
Spiculated margin**	0.18[‡]	0.06[†]	<0.001[†]	<0.001[†]
Rim enhancement**	0.02[‡]	0.01[‡]	<0.001[†]	<0.001[†]
Initial rapid enhancement**	0.77[†]	0.06[†]	0.70[†]	0.70[†]
Delayed wash out**	0.14[‡]	0.03[‡]	0.15[†]	0.06[†]

Note.- Numbers are p value. *: Spearman rank-correlation test,
[†]: Pearson x^2-test, [‡]: Mann-Whitney U test
[§] : mass or non-mass
 : 1=round, 2=oval, 3=lobulated, 4=irregular
[¶] : 1=smooth, 2=irregular, 3=spiculated
** : present or absent

, (,
)
. p53
, c-erbB-2
.
, ER , PR
(Fig. 1), ,
, ER , PR
(Fig. 2). Ki-67
(Fig. 2, 3).
,
(Table 3).
, ,

Table 2. Statistical Relationship between MR Findings and Immunohistochemically defined Prognostic Factors

MR findings	ER	PR	P53	C-erbB2	EGFR	Ki-67
Type[§]	0.46[‡]	0.97[‡]	0.67[‡]	<0.001[‡]	0.72[‡]	0.74[‡]
Shape	0.88*	0.76*	0.92*	0.90*	0.37*	0.16*
Margin[¶]	0.002*	<0.001*	0.10*	0.08*	0.40*	<0.001*
		(=0.35)	(=0.52)			(=-0.40)
Spiculated margin**	0.001[‡]	<0.001[‡]	0.06[‡]	0.06[‡]	0.37[‡]	<0.001[‡]
Rim enhancement**	<0.001[‡]	0.001[‡]	0.002[‡]	0.28[‡]	0.50[‡]	<0.001[‡]
Initial rapid enhancement**	0.37[‡]	0.67[‡]	0.91[‡]	0.84[‡]	0.81[‡]	0.72[‡]
Delayed wash out**	0.30[‡]	0.60[‡]	0.46[‡]	0.36[‡]	0.36[‡]	0.01[‡]

Note.- Numbers are p value. * : Spearman rank-correlation test,[†] : Pearson x^2-test, [‡]: Mann-Whitney U test
[§]: mass or non-mass
 : 1=round, 2=oval, 3=lobulated, 4=irregular
[¶] : 1=smooth, 2=irregular, 3=spiculated
** : present or absent
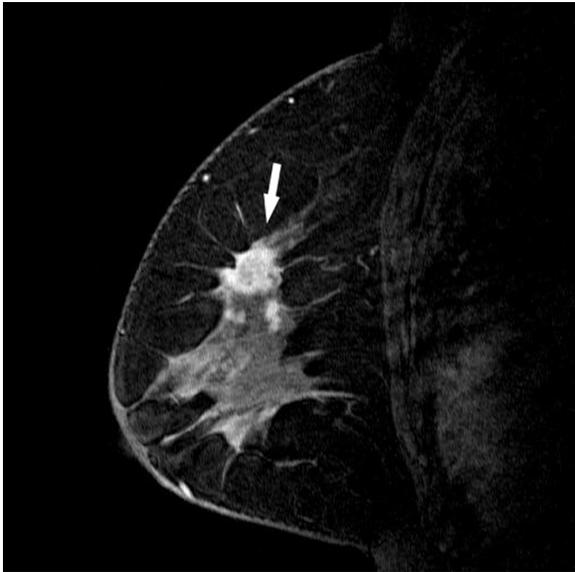
Fig. 1. First contrast-enhanced fat suppressed T1-weighted 3D fast low-angle shot (FLASH) sagittal MR image shows irregular mass with spiculated margin, heterogeneous enhancement (arrow). Pathologic examination reveals histologic grade- , nuclear grade- , ER positive, PR positive

, ER, PR, Ki- 67
Table 4 (Table 4).

MR

(8- 11, 13).
MR ,
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.

, , ,
,
, , ,
.
Ki- 67 .
,
(posterior shadowing) (echogenic
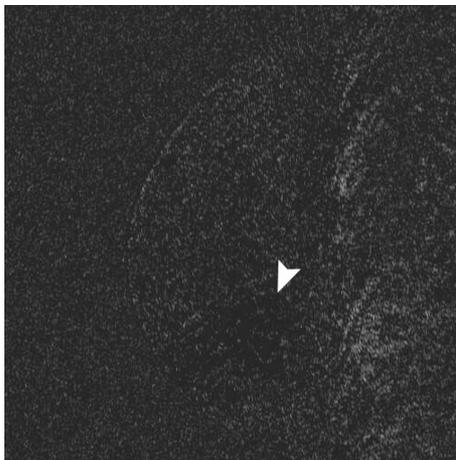
Fig. 2. A Sagittal standard subtracted FLASH MR image shows irregular mass with irregular margin, rim enhancement and central enhancement (arrow). B Sagittal reverse subtracted FLASH MR image shows non-washout kinetics (arrow head). Pathologic examination reveals histologic grade- , nuclear grade- , ER negative, PR negative, low Ki-67 (10%)
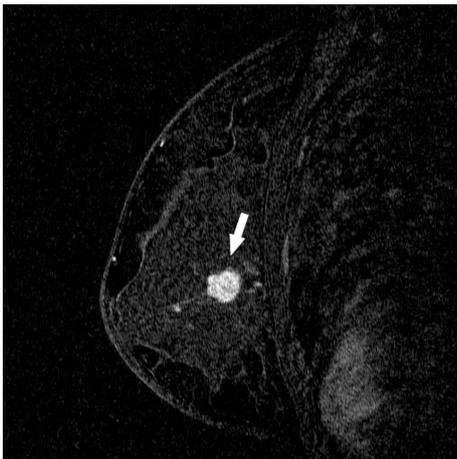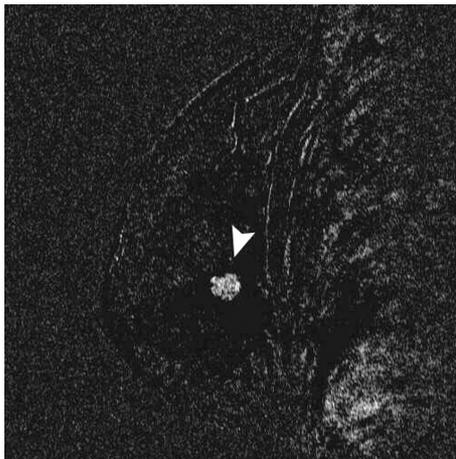
Fig. 3. A Sagittal standard subtracted FLASH MR image shows lobular mass with smooth margin, heterogeneous enhancement (arrow). B Sagittal reverse subtracted FLASH MR image shows washout kinetics (arrow head). Pathologic examination reveals histologic grade- , nuclear grade- , ER negative, PR negative, high Ki-67 (50%)

halo)　　　　　,　　　　　　　　　　(microlobu-

lation)　　　　　　　　(18).　　　　　　　　MR　　　　　　　　　　,

　　　　　　　　　　　　　　　　,

(angiogenesis)　　　　　　　　(19, 20),　　　,　　　　　　(permeability),

Matsubayashi　(21)　　　　　,　　(fibrosis), (perfusion)　　　　　(16, 23, 24).

　　　(inflammatory changes),　　　　　　　　　　　　　60%

　　　　　　　　　　　(slow)　　, 60%　80%

.　　　　　　DNA　S　　　　　(medium)　, 80%　　(rapid)

,　　　　　　　　　　　(16, 17),　(94%)

(22).　　　　　　　　　　　,　. Kuhl　(16)　　　66%

　　ER　, PR　　　　　　　　　　.　40

Table 3. Logistic Regression Analysis * for Nuclear grade, Histologic grade, ER, PR, Ki-67

Independenat variables	(SE)	odds ratio	95% confidence interval	p value
Dependent variable: nuclear grade (+ vs)				
Spiculated margin	- 2.27 (0.58)	0.10	0.03- 0.32	< 0.001
Rim enhancement	1.51 (0.69)	4.52	1.17- 17.41	0.03
Constant	- 1.59 (0.46)	-	-	0.001
Dependent variable: histologic grade (+ vs)				
Spiculated margin	- 1.95 (0.56)	0.14	0.05- 0.43	< 0.001
Rim enhancement	1.54 (0.67)	4.66	1.26- 17.28	0.02
Constant	- 1.43 (0.43)	-	-	0.001
Dependent variable: ER				
Spiculated margin	1.22 (0.59)	3.38	1.06- 10.79	0.04
Rim enhancement	- 1.98 (0.60)	0.14	0.04- 0.45	0.001
Constant	1.89 (0.50)	-	-	< 0.001
Dependent variable: PR				
Spiculated margin	2.02 (0.56)	7.53	2.50- 22.72	< 0.001
Rim enhancement	- 1.31 (0.64)	0.27	0.08-0.94	0.04
Constant	1.56 (0.45)	-	-	< 0.001
Dependent variable: Ki-67				
Wash out	1.43 (0.73)	4.16	1.17- 14.37	0.03
Spiculated margin	- 1.34 (0.71)	0.26	0.07- 1.05	0.06
Constant	- 2.99 (0.73)	-	-	0.004
Competing, non-significant covariate was Rim enhancement				

* :Multivariate analysis was performed by binary logistic regression with forward covariate selection method

Table 4. Breakdown of MR Features as Independent Predictors of Prognostic Factors

Prognostic factors	Spiculated margin		Rim enhancement		Washout	
	Present	Absent	Present	Absent	Present	Absent
Nuclear Gr* (+)	27 (79)	10 (23)	4 (17)	33 (61)	16 (40)	26 (55)
Nuclear Gr* ( )	7 (21)	33 (77)	19 (83)	21 (39)	24 (60)	21 (45)
Histologic Gr* (+)	26 (76)	11 (26)	4 (17)	33 (61)	16 (37)	27 (57)
Histologic Gr* ( )	8 (24)	32 (74)	19 (83)	21 (39)	25 (63)	20 (43)
ER (+)	28 (82)	20 (47)	6 (26)	42 (78)	22 (55)	31 (66)
ER (-)	6 (18)	23 (53)	17 (74)	12 (22)	18 (45)	16 (34)
PR (+)	27 (79)	12 (28)	5 (22)	34 (63)	19 (47)	25 (53)
PR (-)	7 (21)	31 (72)	18 (78)	20 (37)	21 (53)	22 (47)
Ki-67 (< 20%)	31 (72)	29 (67)	15 (65)	45 (35)	27 (66)	43 (91)
Ki-67 (20%)	3 (28)	14 (33)	8 (35)	9 (65)	13 (34)	4 (9)

Note.- Numbers are numbers of lesions. Numbers in parentheses are percentage
* : Grade

80

,

.

(83%) (86%)
(16, 17).
Ki- 67

, .

MR

,

. MR

(8, 11) , Bone
(9) (high contrast enhancement
ratio) ,

,

. Mussurakis (10)
, ,
Szabo (13) , ,
, Ki- 67,
ER .

,

, .

,

, , ACR BI- RADS

- MRI lexicon MR
. , , MR
80 1 mm

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MR

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Breast MR Imaging: Correlation of High Resolution Dynamic MR Findings with Prognostic Factors[1]

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Purpose: We wanted to correlate the kinetic and morphologic MR findings of invasive breast cancer with the classical and molecular prognostic factors.

Materials and Methods: Eighty-seven patients with invasive ductal carcinoma NOS underwent dynamic MR imaging at 1.5 T, and with using the T1-weighted 3D FLASH technique. The morphologic findings (shape, margin, internal enhancement of the mass or the enhancement distribution and the internal enhancement of any non-mass lesion) and the kinetic findings (the initial phase and the delayed phase of the time-signal Intensity curve) were interpreted using a ACR BI-RADS -MRI lexicon. We correlate MR findings with histopathologic prognostic factors (tumor size, lymph node status and tumor grade) and the immunohisto-chemically detected biomarkers (ER, PR, p53, c-erbB-2, EGFR and Ki-67). Univariate and multivariate statisti-cal analyses were then performed.

Results: Among the MR findings, a spiculated margin, rim enhancement and washout were significantly cor-related with the prognostic factors. A spiculated margin was independently associated with the established predictors of a good prognosis (a lower histologic and nuclear grade, positive ER and PR) and rim enhance-ment was associated with a poor prognosis (a higher histologic and nuclear grade, negative ER and PR). Wash out was a independent predictor of Ki-67 activity.

Conclusion: Some of the findings of high resolution dynamic MR imaging were associated with the prognostic factors, and these findings may predict the prognosis of breast cancer.

Index words : Breast neoplasms
Breast, MR
Prognostic factors

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