1

1,2.   .

:   -
.

:   54   THRIVE (T1 High Resolution Isotropic
Volume Examination)   -   .
,   ,   ,
,   ,
.

.   (
,   ,   , Ki-67, p53, c-erb B2)
.

:   (1   2, 3   ),
Ki-67   (p=0.045, p=0.009), Ki-67
(p=0.009,
p=0.045).

:   -
,
.

.
,   ,
,   ,
,
(1-   2005   1   2006   7
7).   ,   ,   ,   49   54
.
27-73 ,   47   . 23   , 26
(8-12).   ,   .
(13, 14).
-
,   1.5T (Avanto, Siemens, Erlangen,
Germany)
.   T2-   (axial
T2-Weighted turbo spin echo,   T2-weighted TSE)
(TR/TE=4000/104,   =3 mm,   (FOV)=320
mm   512× 512),   - T2-

(sagittal fat suppressed T2-weighted TSE)

(TR/TE= 7110/106,　　　= 3 mm,　　　(FOV)= 320 mm　384× 269)　　　　　　- T1-　(TR/TE= 4.42/1.52,　　　= 1.5 mm,　(FOV)= 280 mm　512× 338)　　　　0.2 mmol/kg　Gd- DTPA (Magnevist; Schering Berlin, Germany)　2 cc/sec

.　　　54　.
(subtraction image)　,　　　(maximal intensity projection, MIP)　　　.

THRIVE (T1 High Resolution Isotrpic Volume Examination)

-　　(time- signal intensity curve)　　.

(peak signal intensity),　　(maximum signal intensity)

(Dpeak, Dmax),　　　　(Epeak, Emax)　(Speak, Smax)　　.　,
(Wpeak, Wmax)　(Fig. 1).

Dpeak= SIpeak- SIinitial
Dmax= SImax- SIinitial
Speak= Dpeak/Tpeak
Smax= Dmax/Tmax
Epeak(%)= Dpeak/SIinitial× 100
Emax(%)= Dmax/SIinitial× 100
Wpeak(%)= (SIpeak- SIlast)/SIpeak× 100
Wmax(%)= (SImax- SIlast)/SImax× 100

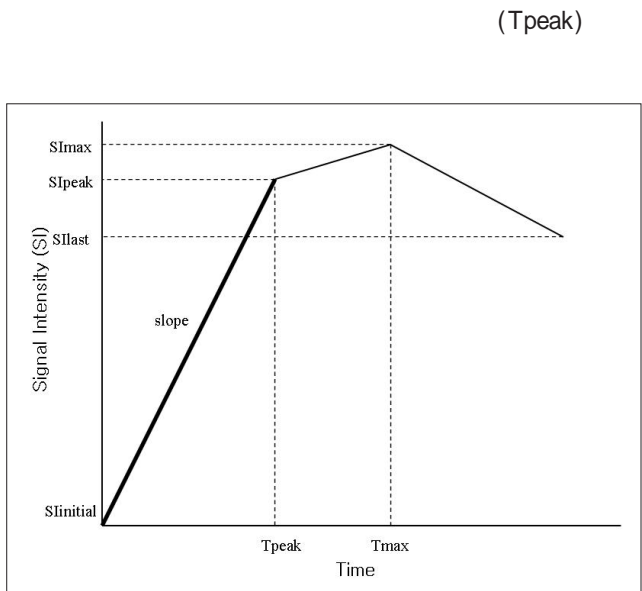(Tpeak)

Fig. 1. Time and Signal Intensity Parameters.

(Tmax)

.

(peak signal intensity)　　　1
, 2　, 2　　　　　　　,
1 ,
2 ,　　　　　　　　　3
.
(Wmax)　- 5%　5%　　　2 , 5%
3 , - 5%　　　1　　.

54
1　　　　　　　.
(Elston- Ellis method)　　(Modified Black's nuclear grade)　1, 2, 3　　　,　　　,
, Ki- 67, p53, c- erb B2
.

Table 1. Comparison of Histologic Grade, Nuclear Grade, Estrogen Receptor, Progesteron Receptor, Ki-67, p53 and c-erb B2 with Time of Early Maximum Enhancement (Tpeak) on Dynamic MR

	Time of early maximal enhancement (Tpeak)		
	< 1 minute (n= 20)	1- 2 minutes (n= 3)	2 minutes (n= 31)
Histologic grade			
I	6	1	11
II	6	2	15
III	8	0	5
Nuclear grade			
I	1	1	6
II	13	1	20
III	6	1	5
Estrogen receptor			
Negative	5	0	7
Positive	15	3	24
Progesterone receptor			
Negative	11	0	9
Poaitive	9	3	22
Ki-67			
Negative	5	0	0
Positive	15	3	31
p53			
Negative	8	2	11
+ 1	4	1	6
+ 2	1	0	4
+ 3	7	0	10
c-erb B2			
Negative	4	1	7
+ 1	6	1	10
+ 2	9	1	9
+ 3	1	0	5

Mann- Whitney U test, Pearson ²- tests, Spearman rank- correlation test   -   .

1   18 , 2   23 , 3   13   ,
1   8 , 2   34 , 3   12   .
42 ,   12 ,
34 ,   20   . Ki- 67   49 ,
5   . p53   21 , 1   11 , 2   5 , 3
17   , c- erb B2   12 , 1   17 , 2   19 ,
3   6   .

54   51 ,   1 ,
(   ) 1 ,   1   1   20 , 1- 2   3 , 2   31
. 27   , 27   (Table 1).
.   0.6- 6 cm,   2.4 cm   .

(peak signal intensity)
(Tpeak)
Ki- 67

Table 2. Statistical Relationship Between Parameter of Signal-Intensity Curve and Prognostic Factors

	Histologic Grade	Nuclear Grade	Estrogen Receptor	Progeseteron Receptor	Ki-67	p53	c-erb B2
Dpeak	0.375 [a]	0.468 [a]	0.110 [a]	0.426 [a]	0.669 [a]	0.965 [a]	0.313 [a]
Tpeak	0.072 [a]	0.091 [a]	0.837 [a]	0.342 [a]	0.009 [a] rho = 0.353	0.436 [a]	0.938 [a]
Epeak	0.790 [a]	0.913 [a]	0.984 [a]	0.830 [a]	0.965 [a]	0.888 [a]	0.521 [a]
Speak	0.045 [b†]	0.107 [a]	0.536 [a]	0.305 [a]	0.009 [a] rho = - 0.354	0.668 [a]	0.594 [a]
Wpeak	0.919 [a]	0.538 [a]	0.396 [a]	0.663 [a]	0.197 [a]	0.470 [a]	0.185 [a]
Dmax	0.536	0.346 [a]	0.231 [a]	0.565 [a]	0.713 [a]	0.582 [a]	0.447 [a]
Tmax	0.183 [a]	0.070 [a]	0.694 [a]	0.977 [a]	0.045 [a] rho = 0.277	0.374 [a]	0.309 [a]
Emax	0.922 [a]	0.892 [a]	0.703 [a]	0.721 [a]	0.825 [a]	0.820 [a]	0.165 [a]
Smax	0.464 [a]	0.250 [a]	0.955 [a]	0.861 [a]	0.081 [a]	0.511 [a]	0.320 [a]
Wmax	0.821 [a]	0.485 [a]	0.743 [a]	0.887 [a]	0.399 [a]	0.846 [a]	0.093 [a]
Early Enhancement	0.272 [c]	0.393 [c]	0.591 [c]	0.356 [c]	0.378 [c]	0.796 [c]	0.830 [c]
Delayed Enhancement	0.425 [c]	0.250 [c]	0.956 [c]	0.932 [c]	0.075 [c]	0.233 [c]	0.164 [c]

Note. Numbers are *p* value. [a] : Spearman rank-correlation test, [b] : Mann-Whitney U test, [c] : Pearson ²-tests
[†]: Histologic grade I versus II, III
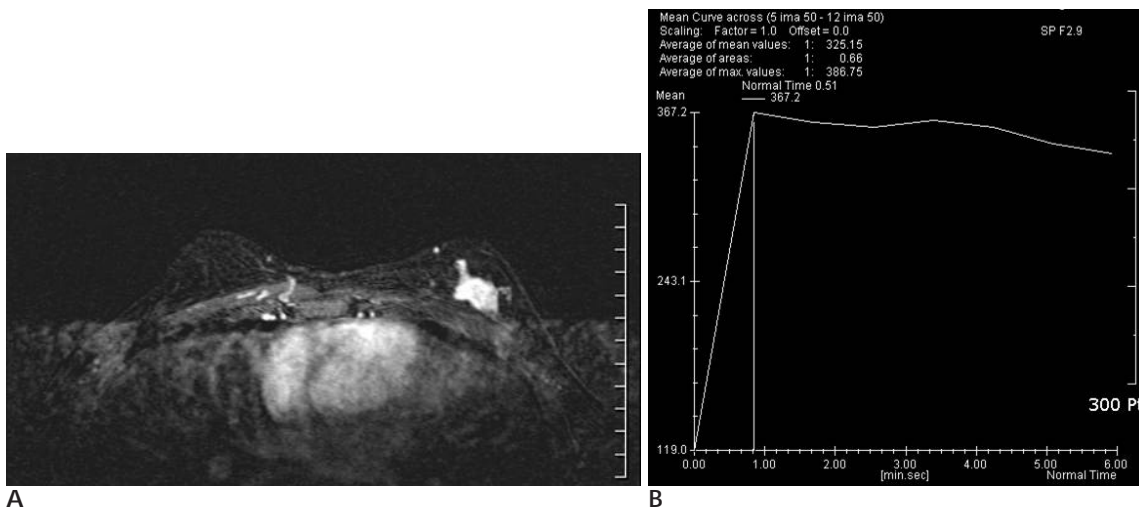
Fig. 2. A 38-year-old woman with invasive ductal carcinoima, which was histologic grade III, nuclear grade III, estrogen receptor negative, progesterone receptor negative, Ki-67 positive, p53 negative and c-erb B2 positive.
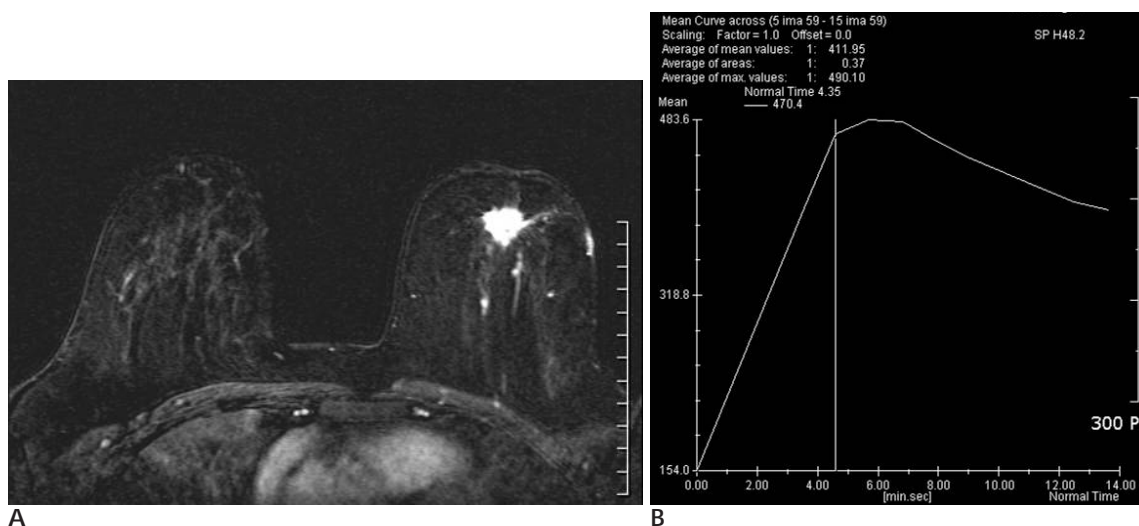**A**. Early subtractiom imge shows lobulated well circumscribed and heterogeneous enhanced mass.
B. Time-signal intensity curve of the lesion was early peak signal intensity and washout.

(Spearsman's test, r= 0.353, p= 0.009) (Table 2).   , Ki- 67
(Tmax)   (r= 0.277, p= 0.045).
                                        (Speak)
                    (r= - 0.354, p= 0.009)
(Fig. 2, 3).   -
                              (Speak)
      1   2, 3
                (Mann- Whitney U test, p= 0.045) (Fig. 2, 3).   -
                                    (Table 2).
                    1   0 ,   2   33 ,
  3   21   ,   ,   ,
        ,   , p53, c- erb B2, Ki- 67
                    (Table 3).

                        .   ,

                                    .

                    ,   ,

                    .

    ,   ,   ,

      ,

        (1- 8).

        Ki- 67   (proliferation)
        (2, 5). c- erb B2   (herceptin)

Table 3. Comparison of Histologic Grade, Nuclear Grade, Estrogen Receptor, Progesteron Receptor, Ki-67, p53 and c-erb B2 with Kinetic Curve Pattern on Dynamic MR

	MR Kinetic curve pattern		
	Type I ($n=0$)	Type II ($n=33$)	Type III ($n=21$)
Histologic grade			
I	0	13	5
II	0	12	11
III	0	8	5
Nuclear grade			
I	0	7	1
II	0	19	15
III	0	7	5
Estrogen receptor			
Negative	0	8	4
Positive	0	25	17
Progesterone receptor			
Negative	0	12	8
Positive	0	21	13
Ki-67			
Negative	0	5	0
Positive	0	28	21
p53			
Negative	0	13	8
+1	0	8	3
+2	0	1	4
+3	0	11	6
c-erb B2			
Negative	0	10	2
+1	0	11	6
+2	0	10	9
+3	0	2	4

Fig. 3. A 49-year-old woman with invasive ductal carcinoima, which was histologic grade I, nuclear grade I, estrogen receptor positive, progesterone receptor negative, Ki-67 negative, p53 negative and c-erb B2 positive.
A. Early subtractiom imge shows irregular, speculated and heterogeneous enhanced mass.
B. Time-signal intensity curve of the lesion was relative slow peak signal intensity and washout.

p53 .

(tumor suppressor gene)   G1   S

(chemotherapy)   ,   ,

(4).   ,   ,   ,   ,   , p- 53

,

(1- 12).

Ki- 67   .

(Speak)   ,   Ki- 67   -

(Tmax)

(Tpeak)   1.5 mm,   54

.   .

,   -

(permeability)   (perfusion)   ,

(15- 17).

Stomper   54

(11)   Fischer   (12)   ,   .

Mussurakis   (8)   -

,

Tuncbilek   (9)   1   ,

,   -

,   ,   -

. Bone   (10)

,   .

, Szabo   (14)

(short peak time)   , c- erb B2   ,

61   48 (78%)

, Ki- 67

.

Ki- 67

,

.   (13)

60%

, 60%   80%   ,

80%   87   82

(94%)

.

2   54   23 (43%)

Ki- 67

.

87   40 (46%)

Ki- 67   .

54   21 (39%)

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13.　　　　,　　　　,　　　　,　　　　,　　　　,　　　　.
　　　　　2005;52:355-361

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Dynamic MRI for Breast Cancer: Correlation with the Prognostic factors and the Time-Signal Intensity Curve[1]

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Purpose: We wanted to evaluate the relation of the kinetic MRI features of dynamic contrast-enhanced MRI with the histopathological prognostic factors of breast cancer.

Materials and Methods: Fifty-four lesions of breast cancer patients were evaluated with using a 1.5 T MR scanner. The dynamic studies were performed in the axial plane with using T1 High Resolution Isotropic Volume Examination (THRIVE) so we obtained the time signal intensity curves. By considering the early peak signal intensity, the maximal signal intensity, the pre-enhanced signal intensity and the last signal intensity, we calculated the absolute value, percentage, slope of enhancement and the washout. The time of the early peak signal intensity and the time of the maximal signal intensity were obtained. We classified the early and delayed enhancement patterns. The kinetic MR features were correlated with the histopathological findings (the histologic and nuclear grades, estrogen receptor, progesteron receptor, Ki-67, p53 and c-erb B2).

Results: The early peak signal intensity slope was significantly correlated with the histologic grade (I versus II, III), and the Ki-67 ($p = 0.045$, $p = 0.009$). Ki-67 was also significantly correlated with the time of the peak signal intensity and the time of the maximal signal intensity ($p = 0.009$, $p = 0.045$).

Conclusion: Some of the parameters of the time-signal intensity curve of dynamic MRI were associated with the prognostic factors, so these MRI signs may be useful to noninvasively identify prognostic factors in the future.

Index words : Breast
Breast neoplasms
Magnetic resonace imaging (MRI)
Prognosis

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