

1

: (MR)

: MR 32 ( 8 , 24 )  
 MR ( , SIC),  
 ( , ) (Time -  
 Signal Intensity curves)

: 2 cm 11 ( 9 , 2 ) 8 가  
 ( 20), 2 cm 21 ( 15 , 6 ) 2 5  
 가 100% SIC 11 , 2 8  
 (< 20) 2  
 ( 3 min) 18 ( 17 , 1 ) ,  
 17 11  
 18 ( 17 , 1 )  
 17 12

: 가  
 , 가

가 가  
 (8 - 10).

(1 - 4). MR

(Maximum - 가  
 Microvessel Density) 가  
 (5, 6).

가

가 (7),  
 ( MR )

MR 32 8 ( 3 , 3 , 1 , 1 ),  
 24 ( 13 , 5 , 2  
 1 )

MR 1.5 T (Signa Advantage, General  
 Electric Medical System, Milwaukee, Wisconsin)

T1, T2  
(post - contrast fast multi - planar spoiled  
grass (FMPSPGR) fat suppression techniques/ FOV: 26 cm,  
3 mm thickness, 256×192 matrix, flip angle: 30°, axial or  
sagittal scan) Gadolinium - DTPA (0.1  
mmol/Kg)

1 30, 3, 5, 10  
MR  
(Maximum enhancement amount),  
(Time to peak),  
(Time - Signal Intensity curves)

2 cm  
% (% signal intensity change) 50%  
, 50 - 100%, 100%  
3  
3  
(wash - out) 1, 1  
(plateau) 2, 3  
(persistent) 3, 20%  
(no enhancement) 4

Factor VIII  
가  
density area) 200  
가  
(Fig. 1).  
, factor VIII

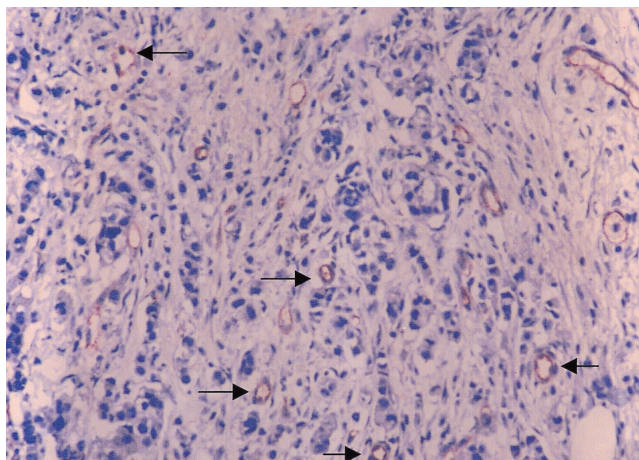


Fig. 1. Photomicrograph shows multiple microvessels (arrows), which are immunostained for factor VIII-related antigen (×200).

가 8  
가  
가 20  
MR  
가  
Fischer's exact test P value가 0.05

32 20 가 3  
(38%), 14 (58%), 20 가 5  
(62%), 10 (42%),  
(Table 1) (Fig. 2, 3).

2 cm  
2 20 9 8  
20  
가  
2 cm  
6 5, 15  
2 가 20

(Table 2).  
MR  
, 8 5 (62.5%)가 50%  
24 20 (83.3%)가 50%  
50% 가 5, 4  
3 4 ( 2, 1, 1  
) 가 20  
100%  
11, 2 11 8

Table 1. Comparison with MVD\* and Pathology of Breast Tumors

MVD	Benign (n=8)	Malignant (n=24)
<20	3	14
20	5	10

\* MVD: Maximum Microvessel Density

Table 2. Relationship of MVD<sup>†</sup> and Size of Breast Tumors

Size / MVD <sup>†</sup>	Benign (n=8)	Malignant (n=24)	Total (n=32)
<2 cm			
<20	2	1	3
20		8*	8
2 cm			
<20	1	13	14
20	5**	2	7

\* p<0.05 \*\* p=0.0055, <sup>†</sup>MVD: Maximum Microvessel Density

가 20 , 2 20  
(Table 3).  
가 .  
3 가  
24 17 (70%), 8 1 (13%, )  
, 17 11 (65%) 가가 20  
. 3 8  
7 (87%), 24 7 (30%) , 가  
7 4 (57%), 7 4 (57%,  
2 , 1 , 1 ) 가 20

Table 3. Comparison with MVD\* and % Signal Intensity Change\*\* (SIC) of Breast Tumors on Contrast Enhanced Dynamic MR

% SIC**/MVD* Benign (n=8)	Malignant (n=24)	Total (n=32)
< 50%		
< 20	2	2
20	3	7
< 100%		
< 20	1	7
20	3	3
100%		
< 20	8	8
20	3	5

\*MVD: Maximum Microvessel Density

\*\*%SIC: Signal Intensity Change =  

$$\frac{(\text{Postcontrast SI} - \text{Precontrast SI}) \times 100}{\text{Postcontrast SI}} (\%)$$

(Table 4),  
가 .  
( )  
가  
4가 가  
(wash -  
out, I ) (plateau, II )  
17 , 1 12 20  
(persistent, III ) 10 20%  
(no enhancement, IV ) ,  
7 4 , 7 5 20 가  
가 (Table 5).

Table 4. Comparison with MVD\* and Time to Peak of Breast Tumors on Contrast Enhanced Dynamic MR

Pathology Time/MVD*	Benign (n=8)	Malignant (n=24)	Total (n=32)
Early Peak ( 3 min)			
< 20		11	11
20	1	6	7
Delayed Peak (3 min < )			
< 20	3	3	6
20	4	4	8

\* MVD: Maximum Microvessel Density

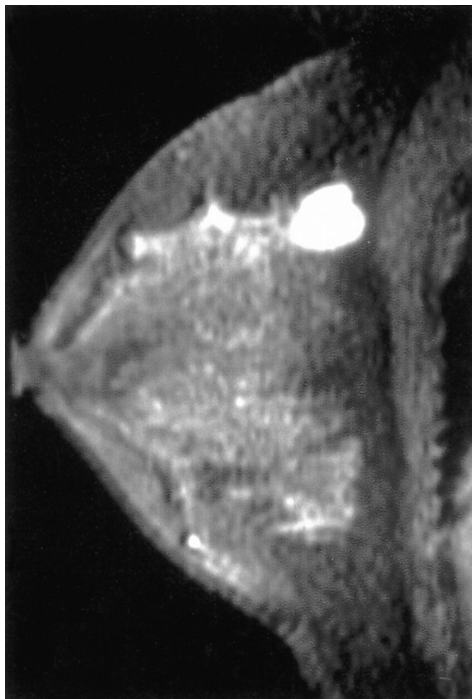


Fig. 2. Fibroadenoma in 42-year-old woman. MR post-contrast 3 min. sagittal image shows 2.1 cm sized well-defined homogeneous enhancing mass. The Max-MVD of the lesion was 28.

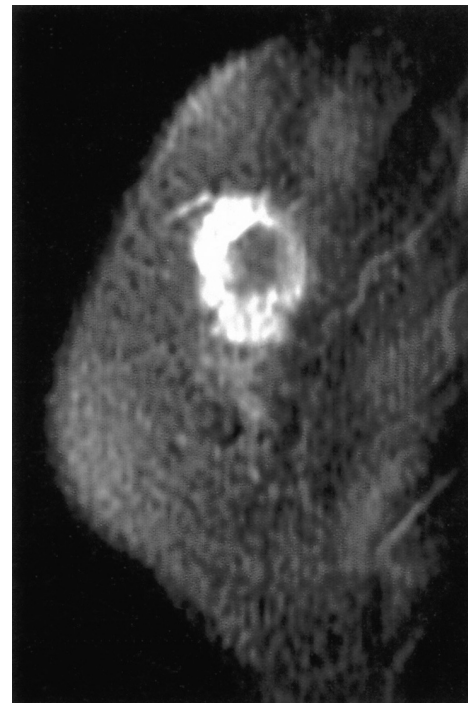


Fig. 3. Invasive ductal carcinoma in 54-year-old woman. MR post-contrast 3 min. sagittal image shows 2.7 cm sized well-defined irregular lobulated rim enhancing mass. The Max-MVD of the lesion was 22.

Table 5. Comparison with MVD\* and Types of TSIC\*\* of Breast Tumors on Contrast Enhanced Dynamic MR

Types of TSIC**/MVD*	Benign (n=8)	Malignant (n=24)	Total (n=32)
Early peak & wash-out (I)			
<20		8	8
20		2	2
Early peak & plateau (II)			
<20		4	4
20	1	3	4
Delayed (persistent) peak(III)			
<20	1	1	2
20	2	2	4
No change(IV)			
<20	2	1	3
20	2	3	5

\* MVD: Maximum Micorovessel Density

\*\* TSIC: Time-Signal Intensity Curve

가 (perfusion) (18)

MR

가

(19),

가 가

(

)

(19 - 22). Yasumura (9)

가

,

,

(23).

MR

,

가

(8,

24 - 26).

가

가

MR

2 mm

가

(26).

가

가

(areas of highest vas -

cularity or "hot spots ")

가

가

가 가

가

(6, 11).

,

,

(chaotic fashion) ,

Buadu

(25)

가

(fragility)

가,

가

(leaking)

(12, 13).

Mussurakis

(28)

MR

가

(7, 14,

MR

가

15), Lee (16)

가

(disorderly vessels and

, Fisher

(20)

MR

가

chaotic flow)

가

가

2 cm

가

가

, MR

가

(2 cm )

(9 8 )

가

가

가

가

.

,

,

,

가

.

Gd - DTPA

가

(heterogeneous angiogenic activ -

(17).

ity)

, , MR

(BIRAD - category 4, 5)

MR

가

MR

1:1

가

MR

가

(macromolecular)

가

가

MR

가

가

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## Correlation of Contrast-Enhanced MR Findings and Tumor Microvessel Density of Breast Masses<sup>1</sup>

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**Purpose:** To compare the contrast-enhanced dynamic MR findings of solid breast masses with their histopathologic tumor angiogenesis.

**Materials and Methods:** Thirty-two cases of pathologically proved breast lesions (8 benign and 24 malignant lesions) examined with contrast-enhanced MRI were retrospectively reviewed, focusing on the tumor size, the maximum amount of contrast enhancement (% Signal Intensity Change, SIC), the time to peak (early or late peak) and the type of time-signal intensity curve (TSC). We compared the characteristic MR findings of breast cancer with the microscopic maximum microvessel density (MVD).

**Results:** Among the total of 11 small lesions ( $\leq 2$  cm, 9 malignant and 2 benign), 8 cases of malignant lesions showed high MVD ( $\geq 20$ ). On the other hand, among the 21 large lesions ( $> 2$  cm, 15 malignant and 6 benign), only two cases of malignant and five cases of benign lesions showed high MVD. More than 100% SIC was observed in a total of 11 malignant and two benign lesions, but 8 of these 11 malignant lesions showed low MVD ( $< 20$ ), whereas the two benign lesions showed high MVD. Early time to peak ( $\leq 3$  min) was observed in 18 (17 malignant and 1 benign) lesions, and 11 of these 17 malignant lesions showed low MVD. An early high peak and early or slow wash-out pattern, which is typical of the malignant type, was seen in 18 (17 malignant and 1 benign) lesions, but 12 of these 17 malignant lesions showed low MVD. There is no statistically significant correlation between the characteristic MR findings of breast cancer and the MVD.

**Conclusion:** Although high MVD indicated malignancy in the case of the small lesions, the histopathologic MVD was not significantly correlated with either the increased amount of enhancement, early time-to peak or the malignant pattern of the TSC.

**Index words :** Breast neoplasms  
Breast, MR

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