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3

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: 15

2-10

(15-20cc)

echo planar imaging

4

4

3

1

가

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67%(10/15)가

가 80%(12/15)가

가

(6/7),

가

가 가

(7/7)

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가

가

(4-6).

PET

SPECT

가

(1-3).

가

가

positron emission tomography(PET) scan

1998 2

1998 11

(2). Xenon enhanced computed tomography

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15

(3).

6

84

( 49 )

가 6

가 9

15

PET scan 201 Thallium single photon emission computed tomography (201 TI SPECT)

(glioblastoma multiforme) 4

(meningioma) 4

(metastatic brain tumor)

3

(anaplastic astrocytoma) 1

(anaplastic ependymoma) 1

(heman-

gioblastoma) 1

(pilocytic astro-

cytoma) 1

3

( 1 , 1 ,

1999 3 15

1999 9 3

1 )

(dexamethasone) 10-20mg/day 4

2-10

MR 1.5T (Signa, GE Medical System, Milwaukee, Wisconsin, U.S.A.) , single shot gradient echo EPI 가

5 Gd-DTPA(Magnevist) 15-20cc(0.2mmol/kg ) 가

TR = 1500ms, TE = 80ms, matrix size = 128 x 128, FOV = 24 x 24, slice thickness = 5mm, flip angle = 90.

3

100-150 300-450 (raw image data ) GE workstation 가

(regional cerebral blood volume map; rCBV) (raw image data ) (ethernet ) IDL 5.0(Interactive Data Language, Research system Inc., CO, U.S.A.) Unix system 가 (Fig. 1)

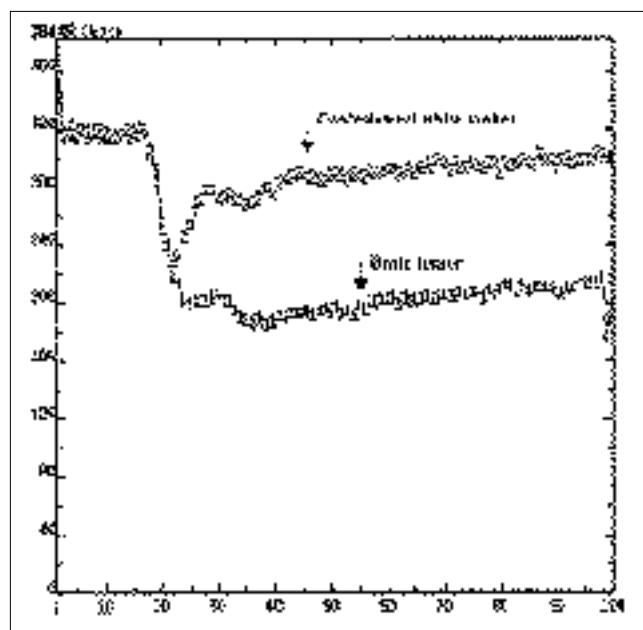


Fig. 1. Time-signal intensity curves after intravenous injection of Gd-DTPA. In brain tumor, signal decrease is more marked than that of normal contralateral white matter.

가

가 가 가

t T2\*

( 1 )

( 2 )

$S_i = S_0 e^{-TE/T2^*_i}$  ( 1 )

$S_i$  : i

$S_0$  : 0 1 ( )

TE : echo time

$R2^*_i = 1/T2^*_i = -\ln(S_i/S_0)$  ( 2 )

$R2^*_i$  : i

가

가

가 (high perfusion) , (intermediate perfusion) ; 가 (low perfusion) 가 가 가 가 가 가 가

가

paired sample t-test

SPSS for Windows

15 7

가

가(Table 1)

가 67%

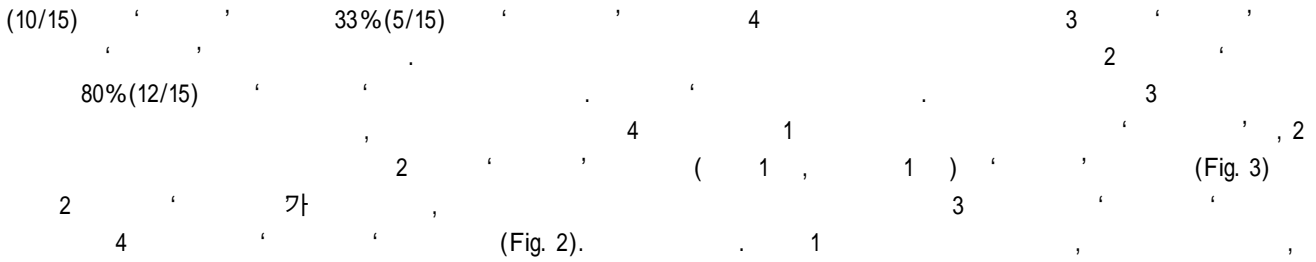


Table 1. Visual Evaluations of rCBV Maps Before and After Steroid Treatment in Brain Tumors

Patients number	Sex/Age	Diagnosis	Before	After
1	F/34	Meningioma	High	
2	F/84	Meningioma	High	
3	F/64	Meningioma	Intermediate	-
4	M/31	Meningioma	High	-
5	F/65	GM*	High	
6	F/65	GM	Intermediate	
7	M/49	GM	High	
8	F/56	GM	Intermediate	
9	M/41	Met <sup>†</sup>	High	
10	F/58	Met <sup>‡</sup>	High	
11	M/68	Met <sup>§</sup>	Intermediate	
12	F/6	Pilocytic astrocytoma	Intermediate	-
13	F/41	Anaplastic astrocytoma	High	
14	M/38	Hemangioblastoma	High	
15	M/38	Anaplastic ependymoma	High	

GM\*: Glioblastoma multiforme, Met<sup>†</sup>: Lung cancer metastasis, Met<sup>‡</sup>: unknown origin, Met<sup>§</sup>: Esophageal cancer metastasis.  
 : Decreased perfusion, -: No changes of perfusion.  
 High: High perfusion, Intermediate: Intermediated perfusion.

Table 2. Objective Evaluations by Relative Perfusion Ratio Before and After Steroid Treatment in Brain Tumors

Patients Number	Before			After		
	Tumor	Contralateral WM	T/C*	Tumor	Contralateral WM	T/C*
1	13.90	4.64	3.21	8.63	4.46	1.93
2	23.29	14.85	1.57	15.28	18.36	1.20
3	28.27	4.13	6.83	33.63	9.12	3.69
4	28.30	5.37	5.27	43.60	4.12	3.34
5	43.36	11.20	3.87	9.70	3.47	2.79
6	9.87	2.98	3.31	21.09	6.80	3.10
7	24.56	2.20	5.90	60.99	8.39	7.27
8	32.24	8.28	3.98	27.06	9.77	2.77
9	15.40	6.62	2.32	13.03	7.05	1.85
10	28.66	6.58	4.37	14.60	4.58	3.19
11	27.86	11.91	2.34	33.96	18.62	1.82
12	6.12	3.44	1.78	5.28	4.29	1.23
13	38.45	7.03	5.47	18.40	6.97	2.64
14	73.94	8.23	8.98	28.10	3.52	7.97
15	28.01	8.60	3.25	22.90	9.68	2.36
Mean	23.40	7.07	4.16	23.75	7.95	3.14

\*T/C: Tumor/Contralateral white matter.  
 Mean T/C ratio difference between before and after steroid treatment: p< 0.005

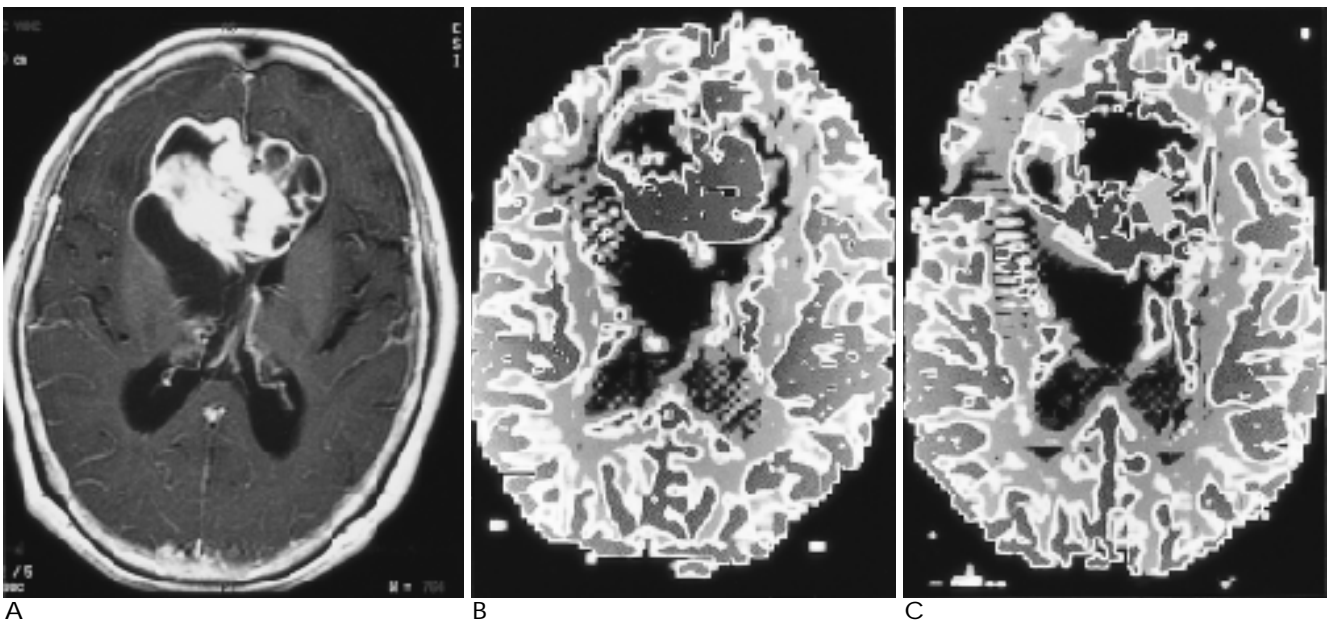


Fig. 2. Glioblastoma multiforme in the midline frontal area in a 56-year-old woman. Axial Gd-enhanced T1 weighted image (A) show lobulated, partly cystic mass with well enhanced solid portions. Regional cerebral blood volume maps (rCBV map) before (B) and after (C) steroid treatment demonstrate decreased perfusion in the tumor (arrows, C) after steroid treatment.

: 가 (8-12).

가(Table 2) (2, 7, 13) .

가 가 2 가 .  
 (6.83 R 3.69, 5.27 R3.34) 1 (4.16 R 0.1mmol/kg Gd-DTPA  
 3.14)  
 (p<0.005).

가(Table 3) 가 .  
 가 가  
 (Fig. 3) 6 가가 (14-16).

(first-pass technique)  
 Gadolinium-DTPA bolus 가  
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 (susceptibility gradient-magnetic field  
 distortion) extravascular spin  
 intravoxel dephasing T2\*  
 가

가(Table 4) 가 ,  
 가 1 , 7  
 가 ( 0.73 R 0.89)  
 (p<0.05).

(prosta- glandin) (rCBF) (rCBV)  
 (17). (18,19).  
 EPI EPI  
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Table 3. Visual Evaluations of rCBV Maps Before and After Steroid Treatment in Peritumoral Edemas

Patients Number	Sex/Age	Diagnosis	Before	After
1	F/34	Meningioma	Low	-
3	F/64	Meningioma	Low	-
6	F/65	GM	Low	-
8	F/56	GM	Low	-
9	M/41	Met <sup>+</sup>	Low	-
11	M/68	Met <sup>+</sup>	Low	-
15	M/38	Anaplastic ependymoma	Low	-

GM\*: Glioblastoma multiforme, Met<sup>+</sup>: Lung cancer metastasis,  
 Met<sup>+</sup>: Esophageal cancer metastasis. Low: Low perfusion,  
 - : No change in perfusion, : Increased perfusion.

Table 4. Objective Evaluations by Relative Perfusion Ratio Before and After Steroid Treatment in Peritumoral Edemas

Patients Number	Before			After		
	Edema	Contralateral WM	E/C*	Edema	Contralateral WM	E/C*
1	4.29	4.64	0.92	4.41	4.46	0.99
3	2.76	4.13	0.67	9.11	9.12	0.99
6	1.86	2.98	0.62	6.32	6.80	0.93
8	2.09	8.28	0.25	4.28	9.77	0.44
9	5.79	6.62	0.88	7.03	7.05	0.99
11	11.88	11.91	0.99	19.39	18.60	1.04
15	6.68	8.60	0.78	8.26	9.68	0.86
Mean	5.05	6.74	0.73	8.4	9.35	0.89

\*E/C: Edema/Contralateral white matter ratio  
 Mean E/C ratio difference between before and after steroid treatment: P< 0.05

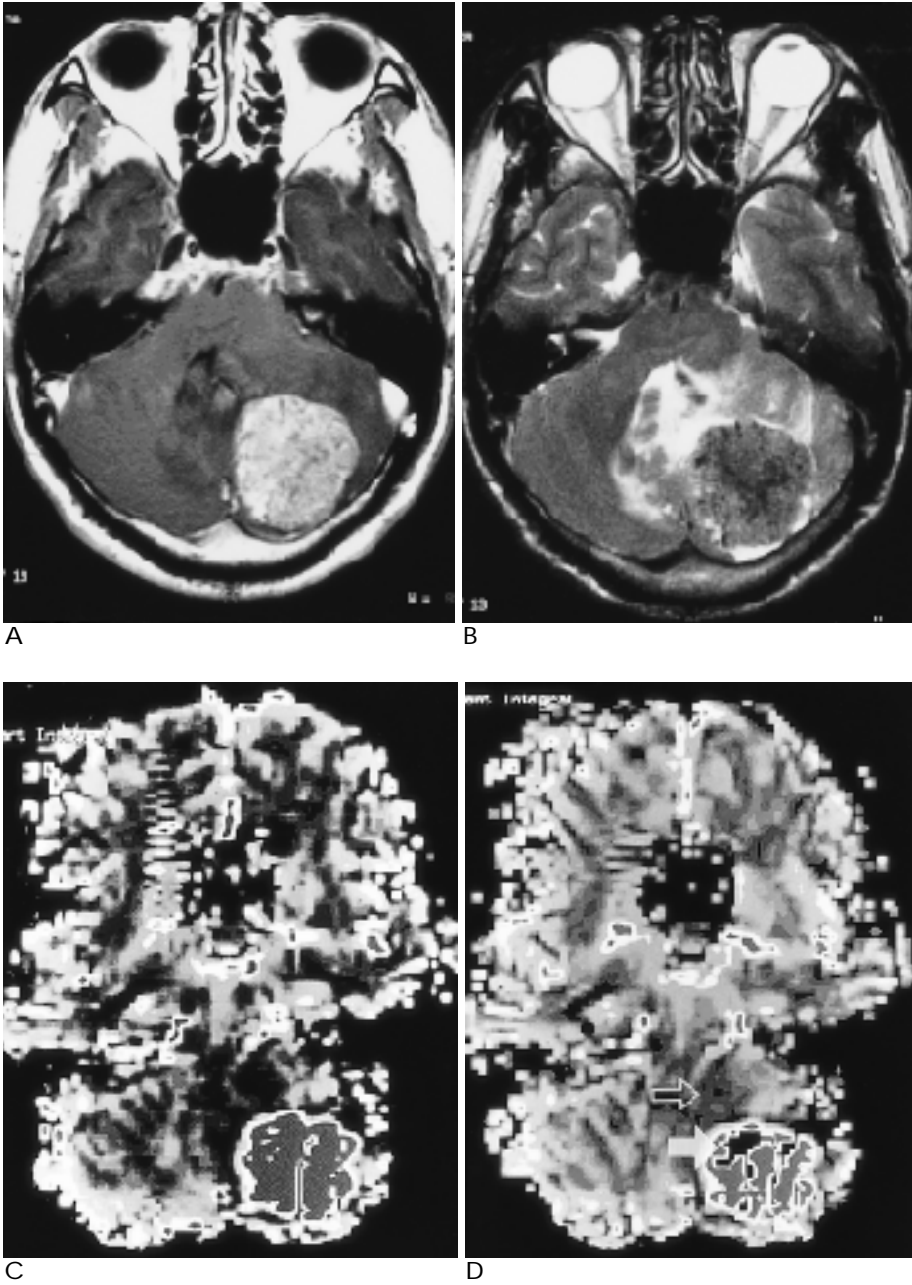


Fig. 3. Metastatic brain tumor (primary lung cancer) in left cerebellar hemisphere. Gd-enhanced T1-weighted (A) and T2-weighted (B) images show moderately enhanced mass with moderate peritumoral edema. rCBV maps before (C) and after (D) steroid treatment. RCBVmaps (coronal images) demonstrate decreased perfusion within the tumor (arrow, D) but slightly increased perfusion of the edema (open arrow, D) after steroid treatment.

(20) 가

(18).

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(2,10). 7 가

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가 (10-12)

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## **Effect of Steroid on Brain Tumors and Surround Edemas : Observation with Regional Cerebral Blood Volume (rCBV) Maps of Perfusion MRI<sup>1</sup>**

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<sup>2</sup>*Department of Neurosurgery, Ajou University, School of Medicine*

<sup>3</sup>*Department of Neurology, Ajou University, School of Medicine*

**Purpose :** To observe the hemodynamic change in brain tumors and peritumoral edemas after steroid treatment, and then investigate the clinical usefulness of perfusion MRI.

**Materials and Methods :** We acquired conventional and perfusion MR images in 15 patients with various intracranial tumors (4 glioblastoma multiformes, 4 meningiomas, 3 metastatic tumors, 1 anaplastic ependymoma, 1 anaplastic astrocytoma, 1 hemangioblastoma, and 1 pilocytic astrocytoma). For perfusion MR imaging, a 1.5T unit employing the gradient-echo EPI technique was used, and further perfusion MR images were obtained 2-10 days after intravenous steroid therapy. After processing of the raw data, regional cerebral blood volume (rCBV) maps were reconstructed. The maps were visually evaluated by comparing relative perfusion in brain tumors and peritumoral edemas with that in contralateral white matter. Objective evaluations were performed by comparing the perfusion ratios of brain tumors and peritumoral edemas.

**Results :** Visual evaluations of rCBV maps, showed that in most brain tumors (67%, 10/15), perfusion was high before steroid treatment and showed in (80%, 12/15) decreased afterwards. Objective evaluation, showed that in all brain tumors, perfusion decreased. Visual evaluation of perfusion change in peritumoral edemas revealed change in only one case, but objective evaluation indicated that perfusion decreased significantly in all seven cases.

**Conclusions :** rCBV maps acquired by perfusion MR imaging can provide hemodynamic information about brain tumors and peritumoral edemas. Such maps could prove helpful in the preoperative planning of brain tumor surgery and the monitoring of steroid effects during conservative treatment.

**Index words :** Magnetic resonance (MR), image processing  
Brain neoplasms, MR  
Steroids

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