

가

:

1

2

3

:

: 15

2-10

(15-20cc)

echo planar imaging

4

4

3

1

가

:

가

67%(10/15)가

‘

‘

80%(12/15)가 ‘

‘

가

‘

‘

가

(6/7),

가

가 가

(7/7)

:

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

가

15

(3).

6

84

(49)

가 6

가 9

15

(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

(10/15) ' , 33%(5/15) ' , 4 3 ' ,
 80%(12/15) ' , ' , 2 ' ,
 , 4 1 ' , 3 ' , 2
 2 ' , 가 , (1 , 1) ' , (Fig. 3)
 4 ' , 3 ' ,
 (Fig. 2). 1 ,

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 [†]	High	
10	F/58	Met [†]	High	
11	M/68	Met [§]	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[†]: Lung cancer metastasis,

Met[†]: unknown origin,

Met[§]: 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: $p < 0.005$

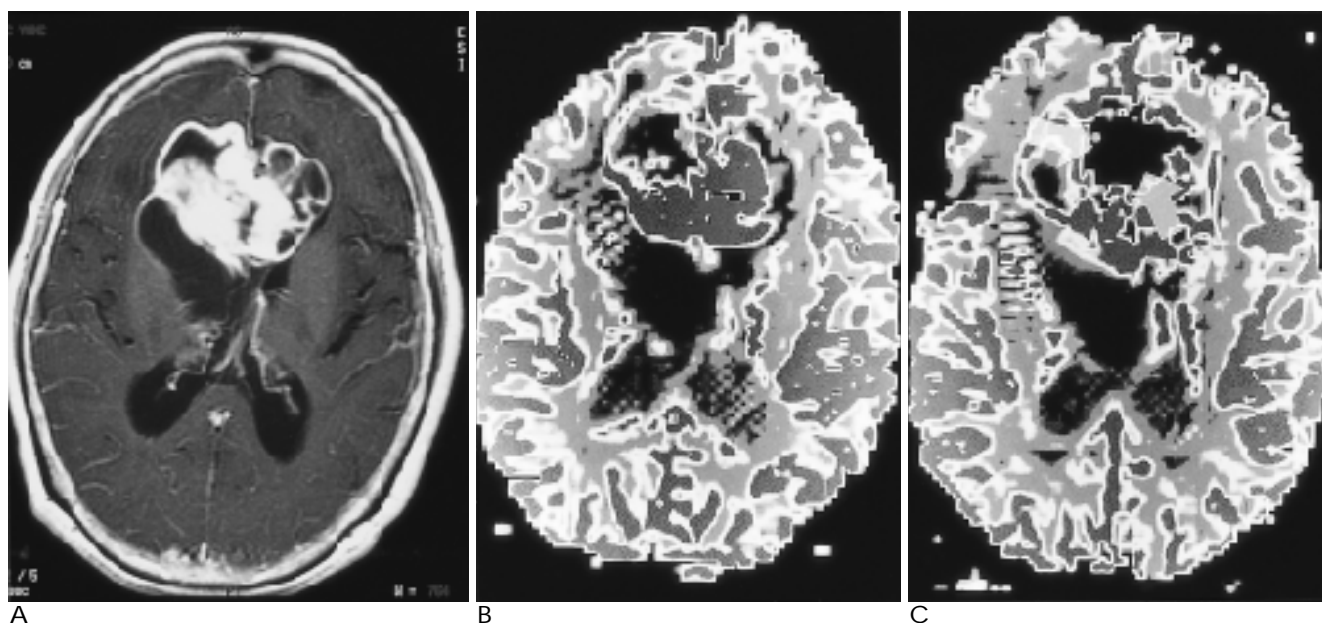


Fig. 2. Glioblastoma multiforme in the midline frontal area in a 56-year-old woman. Axial Gd-enhanced T1 weighted image (A) show lobulated, partly cystic mass with well enhanced solid portions. Regional cerebral blood volume maps (rCBV map) before (B) and after (C) steroid treatment demonstrate decreased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

가 : 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
(Fig. 3) 6 가가 (14-16).
(first-pass technique)
Gadolinium-DTPA bolus 가
1 가
(susceptibility gradient-magnetic field
distortion) extravascular spin
intravoxel dephasing T2*
가
가 (0.73 R 0.89)
(p<0.05).

가 (prosta- glandin) (rCBF) EPI (rCBV) (18,19).
(2,7). 가 EPI

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 ⁺	Low	-
11	M/68	Met ⁺	Low	-
15	M/38	Anaplastic ependymoma	Low	-

GM*: Glioblastoma multiforme, Met⁺: Lung cancer metastasis,
Met⁺: 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

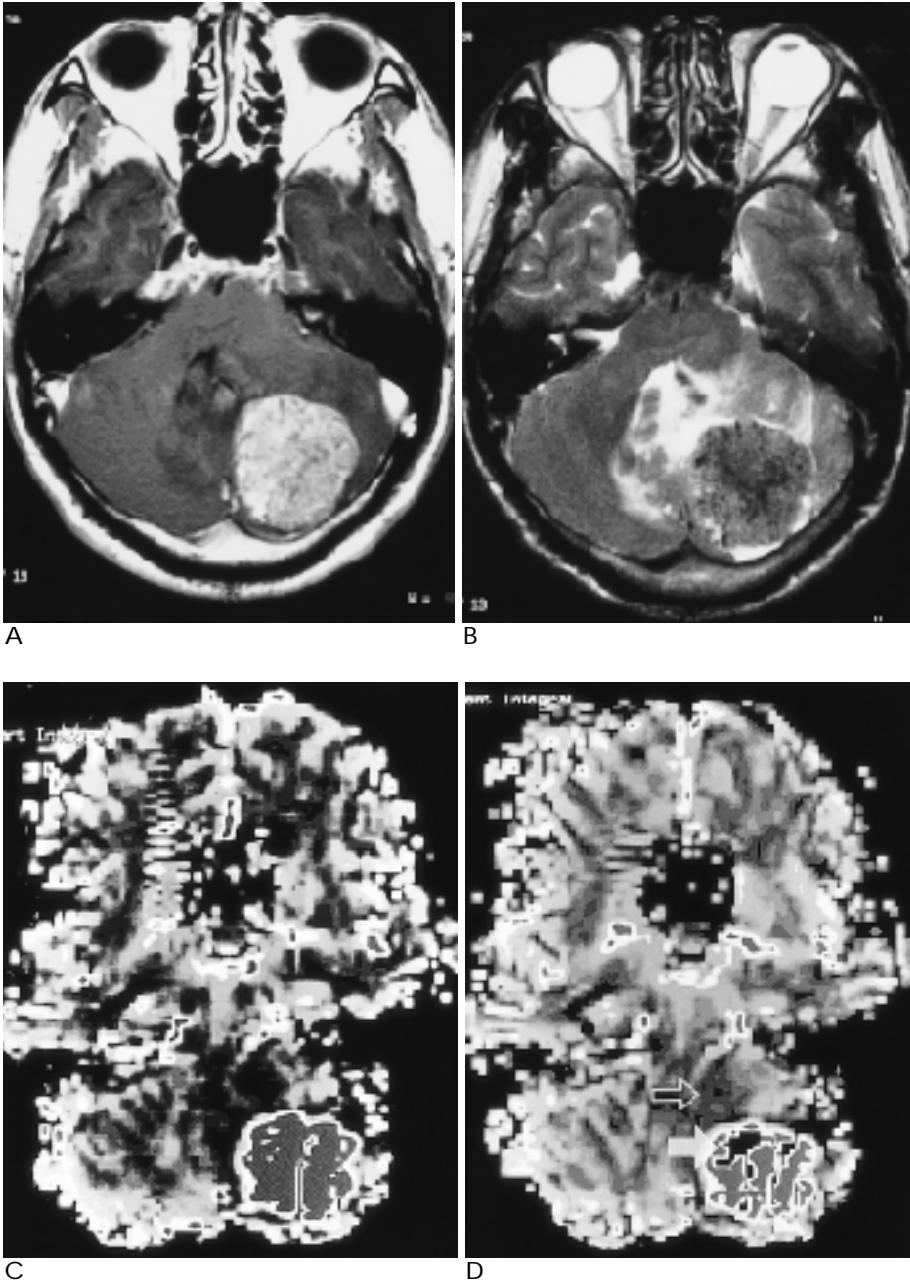


Fig. 3. Metastatic brain tumor (primary lung cancer) in left cerebellar hemisphere. Gd-enhanced T1-weighted (A) and T2-weighted (B) images show moderately enhanced mass with moderate peritumoral edema. rCBV maps before (C) and after (D) steroid treatment. RCBVmaps (coronal images) demonstrate decreased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

(20) 가

(18).

가

가

가

(2,10).

7

가

가

가

가

가

가

(10-12)

가

5. Martin WH, Delbeke D, Patton JA, et al. Detection of malignancies with SPECT versus PET, with 2-[fluorine-18] fluoro-2-deoxy-D-glucose. *Radiology* 1996;198:225-231
6. Kahn D, Follett KA, Bushnell DL, et al. Diagnosis of recurrent brain tumor: value of 201Tl SPECT vs [18F]-fluorodeoxyglucose PET. *AJR Am J Roentgenol* 1994;163:1459-1465
7. Shoshan Y, Siegal T. Control of vasogenic edema in a brain tumor model: Comparison between dexamethasone and superoxide dismutase. *Neurosurgery* 1996;39:1206-1214
8. Stoll M, Hagen T, Bartylla K, Weber M, Jost V, Treib J. Change of cerebral perfusion after osmotherapy in acute cerebral edema assessed with perfusion weighted MRI. *Neuro Res* 1998;20:474-478
9. Ernst TM, Chang L, Witt MD, Aronow HA, Cornford ME, Walot I, Goldberg MA. Cerebral toxoplasmosis and lymphoma in AIDS: perfusion MR imaging experience in 13 patients. *Radiology* 1998;208:663-669
10. Reulen HJ, Graham R, Spatz M, Klatzo I. Role of pressure gradients and bulk flow in dynamics of vasogenic brain edema. *J Neurosurg* 1977;46:24-35
11. Shapiro WR, Posner JB. Corticosteroid hormones. Effects in an experimental brain tumor. *Arch Neurol* 1974;30:217-221
12. Pappius HM, McCann WP. Effects of steroids on cerebral edema in cats. *Arch Neurol* 1969;20:207-216
13. Reid AC, Teasdale GM, McCulloch J. The effects of dexamethasone administration and withdrawal on water permeability across the Blood-Brain Barrier. *Ann Neurol* 1983;13:28-31
14. Aronen HJ, Gazit IE, Louis DN et al. Cerebral blood Volume Maps of Gliomas: Comparison with Tumor Grade and Histologic Findings. *Radiology* 1994;191: 41-51
15. Lev MH, Hochberg F. Perfusion Magnetic resonance imaging to assess brain tumor response to new therapies. *Cancer control: JMCC* 1998;5:115-123
16. Rother J, Guckel F, Neff W, Schwartz A, Hennerici M. Assessment of regional cerebral blood volume in acute human stroke by use of single-slice dynamic susceptibility contrast-enhanced MRI. *Stroke* 1996;27:1088-1093
17. Kim JH, shin T. Temporal pattern of blood volume change in cerebral infarction: evaluation with dynamic contrast-enhanced T2*-weighted MR Imaging. *AJR Am J Roentgenol* 1998;170:765-770
18. ' ' ' ' '
Echo Planar Imaging
MRI 1998;39: 249-255
19. Katrin A. Rempp, Gunnar Brix et al. Quantification of Regional Cerebral Blood Flow and Volume with Dynamic Susceptibility contrast-enhanced MR Imaging. *Radiology* 1994;193:637-641
20. Pronin IN, Holodny AI, Petraikin AV. MRI of high-grade glial tumors: correlation between the degree of contrast enhancement and the volume of surrounding edema. *Neuroradiology* 1997;39:348-350
21. ' ' ' ' '
1998;1:119-124

Effect of Steroid on Brain Tumors and Surround Edemas : Observation with Regional Cerebral Blood Volume (rCBV) Maps of Perfusion MRI¹

Ju Youl Choi, M.D., Joos Sung Sun, M.D., Sun Yong Kim, M.D., Ji Hyung Kim, M.D.,
Jung Ho Suh, M.D., Kyung Gi Cho, M.D.², Jang Sung Kim, M.D.³

¹Department of Diagnostic Radiology, Ajou University, School of Medicine

²Department of Neurosurgery, Ajou University, School of Medicine

³Department 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

Address reprint requests to : Sun Yong Kim, M.D., Department of Diagnostic Radiology, Ajou University, School of Medicine,
#5 San, Wonchon-dong, Paldalgu, Suwon, 442-749, Korea.
Tel. 82-331-219-5854 Fax, 82-331-219-5862

가	2000 가	00. 5. 27() 14:00-	7
		00. 4. 29()	
	11 22	00. 6. 9()-10()	KAL
		00. 3. 31() 00. 4. 29() 00. 4. 29()	
	2001 Scholarship	00. 7. 31()	
	2001 Fellowship	00. 7. 31()	
2001	, 2001	00. 9. 30()	
56	56	00. 10. 26()-10. 28()	
	가	00. 7. 31() 00. 7. 31() 00. 9. 15()	
		00. 11. 4()	
86th RSNA	86th RSNA()	00. 11. 26()-12. 1()	Chicago, USA
Imaging Conference		00. 1. 19() 18:00-	()
		00. 2. 16() "	"
		00. 3. 15() "	"
		00. 4. 19() "	"
		00. 5. 17() "	"
		00. 6. 21() "	"
		00. 7. 19() "	"
		00. 8. 16() "	"
		00. 9. 20() "	"
		00. 10. 18() "	"
		00. 11. 15() "	"
		00. 12. 20() "	"