

1

• • • • •

:

:

3

6

2

60

3 ,

3

3

6

9

5

: 6

T2

가

가

5

,

,

,

. 2

1

. T1

가

가 4

, 1

3

가

(n=5)

(n=1).

가

가

:

가가

(status epilepticus)
(generalized tonic clonic seizure)

가

(1, 2-4).

가

가

(DWI; diffusion-weighted imaging)

1998 2

1999 8

가

(5, 6).

3

32

(metabolic disease)

19

60 (19), 3 , 3 . 2 T2 , 1 FLAIR
, 4 (pulse sequence)
(1) T1 (TR/TE/NEX 400/9~10/1)
(axial image) , 256 ×
192matrix, 7mm, (FOV) 16 × 16cm
(2) (Fast spin echo) T2 (TR/TE/
NEX 4000/102/1) , 256 × 256matrix, 5 mm ,
2mm, 16 × 16cm
(3) (Fast spin echo) T2 (TR/TE/
NEX 4000/102/4) , 512 × 256matrix,
5mm, 16 × 16cm
(4) Fast FLAIR (TR/TE/TI/NEX 11000/127 ~ 140/
2200 ~ 2600/2) , 256 × 192matrix, 5 mm
, 16 × 16cm
(5) (TR/TE/NEX 5000/100/1, B factor 1000)
, 128 × 128matrix, 5mm,
24 × 24cm
T1 T2
, 6
, 4
, 5
, 1 ()
9 5 1 (1)
9 30 2
(Table 1). 6
T1 , 4

Table 1. Patients 'Profile

Patient			Seizure Type	Timing of MRI	
No	Age (yr)	Sex		Initial	Follow-Up
1	3	M	CPS	< 48hr	9d, 30d
2	12	M	GTC	< 48hr	14d
3	25	M	CPS	< 72hr	5mo
4	12	F	GTC	< 72hr	43d
5	60	F	CPS	< 24hr	8d
6	2	F	CPS	< 48hr	3mo

CPS: complex partial seizure with secondary generalization

GTC: generalized tonic clonic seizure

Timing of MRI: time lapse after seizure onset

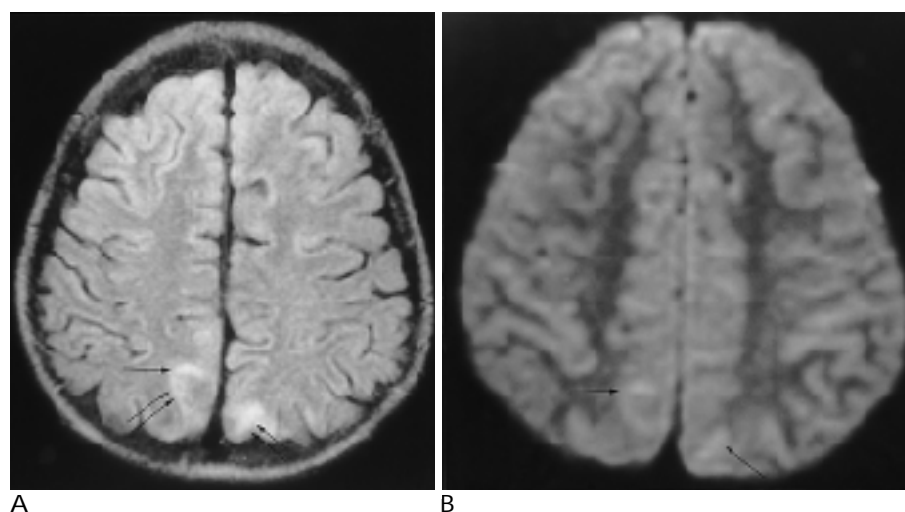


Fig. 1. A 12-year-old boy (patient 2) with generalized tonic clonic seizure with slightly increased signal intensity in both parietooccipital lobes on diffusion weighted image.

A. Initial FLAIR image shows increased signal intensity in the cortical and subcortical white matter in cuneus and precuneus bilaterally (arrows).

B. Initial diffusion-weighted image shows the slightly increased signal intensity in the corresponding area (arrows).

1 (4) . T1 4 (Fig. 3). 5 8 , 가
 2 . T1 가 가
 6 1 (4) . 4 (2, 3, 4, 6)
 3 (2, 5, 6)
 가 2 4 43
 가 FLAIR
 (Fig. 1), 5 가
 6 가
 (Fig. 2). FLAIR 3 T2
 가 T2
 (Table 2). 가
 가 , 가
 가 (vasogenic edema) (2). Horowitz
 (3) (mesial
 cortex)
 가 가 , 가
 가 , 가
 가 (autoregulation) 가
 가 30 가

Table 2. MRI Signal Changes and Pulse Sequences

Patient No	Initial MRI					Location of MRI Signal Change	Follow-Up MRI
	T2	T1	CE	DWI	FLAIR		
1	+	-	-			Bilateral cingulate gyri	Resolved
2	+	-	-		+	Bilateral cuneus, precuneus	Resolved
3	+	+	-			Lt. parietal	Resolved
4	+	+				Lt. fronto-parietal	Resolved
5	+	+	-		+	Lt. temporal, Lt. hippocampus	Decreased
6	+	+	-		+	Rt. hippocampus	Resolved

CE: contrast enhancement

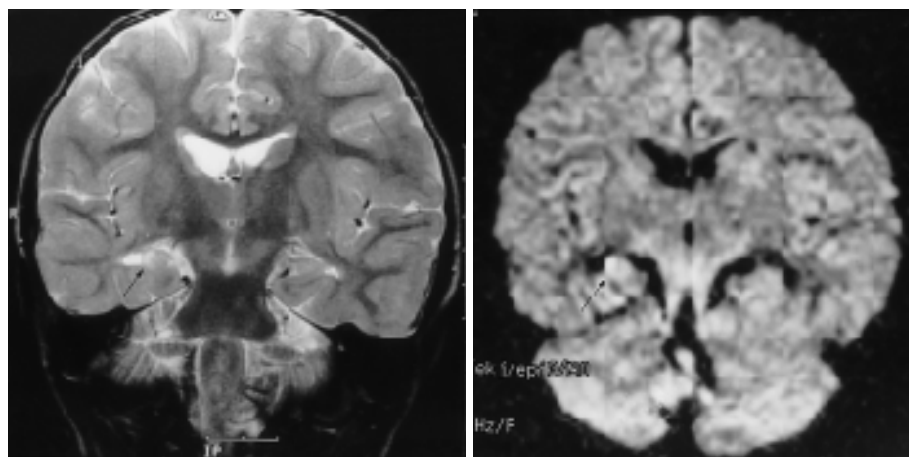
DWI: diffusion-weighted image, Decreased: decreased signal change

FLAIR: fluid attenuated inversion recovery

T1: T1- weighted image, T2: T2- weighted image

+ : visible signal change, - : no visible signal change

: mild degree of increased signal intensity, : high degree of increased signal intensity



A

B

Fig. 2. A 2-year-old girl (patient 6) with generalized status epilepticus with increased signal intensity in right hippocampus on diffusion weighted image.

A. Initial T2-weighted image obtained within 48 hours after seizure onset shows high signal intensity in the right hippocampus (arrow).

B. Initial diffusion-weighted image also shows increased signal intensity in the right hippocampus (arrow).

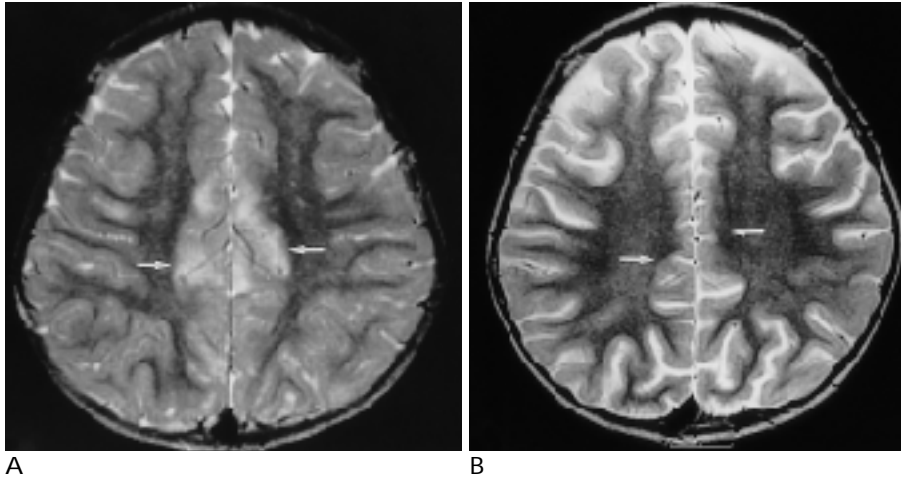


Fig. 3. A 3-year-old boy (patient 1) with generalized status epilepticus, showing the resolution process of the signal change.

A. Initial T2-weighted image shows increased signal intensity in the cortical and subcortical white matter of both cingulate gyri (arrows). Follow-up T2-weighted image obtained 9 days after seizure onset showed partial resolution of the increased signal intensity (not shown).

B. Follow-up T2-weighted image obtained 30 days after seizure onset shows complete resolution of the increased signal intensity and mild atrophic change (arrows).

Henry (4)

T2 가 가 가

가 (cytotoxic edema)

Cox (1) 가 T2

가 (mass effect)

FLAIR (inversion time) (nulling)

(standard double-echo) 가 (7, 8).

Wiesmann (9) 128 fast (neocortical) (conspicuity)

FLAIR

3 (1, 5, 6) 3

FLAIR T2

가

3

24 72

가

(n=6) FLAIR (n=3)

7 8 2 (1, 5)

가 1 30

가 4

가 2

1

Righini (10) kainic acid (complex partial status epilepticus)

kainic acid

3 9-20% apparent diffusion coefficient (ADC)가

24 36-49%가

Nakasu (6) kainic acid 1

T2

가 (amygdala) (pyriform cortex) 가

가

가 가 (anaerobic metabolism)가 가

(lactic acid) 가
가
(extracellular space)
가
(5).
3 가 가
5 6 30
48 가 2 1
48 가
48 가 2
48 가 1
가
가
ADC(apparent diffusion coefficient)
5 6 T2
가
4 43
FLAIR
6 , 3
가
가 T2
(3)
가

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MR Imaging Findings of Generalized Tonic Clonic Seizure Induced Brain Changes¹

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Purpose : To evaluate MRI signal changes in the brain induced by generalized tonic clonic seizure.

Materials and Methods : Six patients who underwent MRI within three days of generalized tonic clonic seizure were retrospectively reviewed. Diffusion-weighted images were added in three patients during initial examination, and in six, the follow-up MRI was performed nine days to five months after the onset of seizure. We evaluated the patterns of signal change, location of the lesion and degree of contrast enhancement, and the signal change seen on diffusion weighted images. We also compared the signal changes seen on initial and follow-up MRI.

Results : In all six patients, MR images showed focally increased T2 signal intensity, and swelling and increased volume of the involved cortical gyrus. In five, the lesion was mainly located in the cortical gray matter and subcortical white matter; namely, in the bilateral cingulate gyri, and the bilateral parieto-occipital, left parietal, left frontoparietal, and left temporal lobe. In the remaining patient, the lesion was located in the right hippocampus. Two patients showed bilateral lesions and one showed multiple lesions. In four patients, T1-weighted images revealed decreased signal intensity of the same location, and in one, gyral contrast enhancement was noted. On diffusion-weighted images, three patients showed increased signal intensity. Follow-up MRI demonstrated complete resolution of the abnormal signal change (n= 5), or a decrease(n= 1).

Conclusion: A transient increase in MR signal intensity with increased volume was noted in cortical and subcortical white matter after generalized tonic clonic seizure. This finding reflects the vasogenic and cytotoxic edema induced by seizure and can help exclude etiologic lesions such as tumors, inflammation and demyelinating disease that induce epilepsy.

Index words : Brain, edema

Brain, MR

Magnetic resonance (MR), diffusion

Epilepsy

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