



: CT, ,  
 T2 FLAIR MR 1  
 . . . . . 2  
 : CT , T2 ,  
 FLAIR MR  
 가 : (Dog: 12-20Kg) 5  
 (polyvinyl-alcohol, 300-600  $\mu$ )  
 1 1 5  
 CT , T2 , FLAIR MR .  
 2 가 ,  
 CT MR  
 (contrast-to-noise ratio)  
 : CT 1-3 가 . MR  
 1 가 가 ,  
 T2 3 5 , FLAIR 2 5  
 CT CNR  
 가 , 가 CT T2 FLAIR  
 : 가 가  
 , CT FLAIR , T2 MR  
 가 가 , 가  
 가 CT 가  
 가 (1-5). CT  
 (4, 5).  
 (Computed Tomography, CT) (Magnetic  
 Resonance, MR) CT MR (6).  
 가 CT T2 MR  
 (7),  
 CT  
 가 (8,9).

<sup>1</sup>  
<sup>2</sup>  
 1998  
 1999 3 30 1999 5 17

가 5 가 10cc

가 12-20Kg 15.6Kg 2 1

12

Ketamine 20mg/Kg 10 Xylozine 2mg/Kg Atropine 0.05mg/Kg 1liter Hartman 0.1% Pentobarbital sodium 1g 8-10 mg/Kg/hr

(micropuncture needle) 4Fr

Seeker -14 wire(Target Therapeutics, CA, U.S.A.) (tracker 18, Target Therapeutics, CA, U.S.A.) Advantx LCN(GE Medical System, Milwaukee, WI, U.S.A.)

(Fig. 1). 가 300-600  $\mu$  polyvinyl-alcohol(Ivalon, Ingenor, Paris, France) particles 1:1 1cc

CT MR Highspeed advantage(GE Medical System, Milwaukee, Wisconsin, U.S.A.) 1 5 CT 120KV, 200mA, FOV 16cm, matrix 512  $\times$  512, 3mm (coronal)

48cm 16slice MRI Signal 1.5 T System(GE Medical System, Milwaukee, Wisconsin, U.S.A.) coil head coil CT MR CT CT

3mm FLAIR (TR 10000msec, effective TE 123, TI 2200msec), T2 (fast-spin echo, TR 3666msec, effective TE 104msec) EPI T2 (TR 6500msec, TE 98.9msec) b-value 900 3 (isotropic) CT MR 10

2 가 CT FLAIR, T2 가

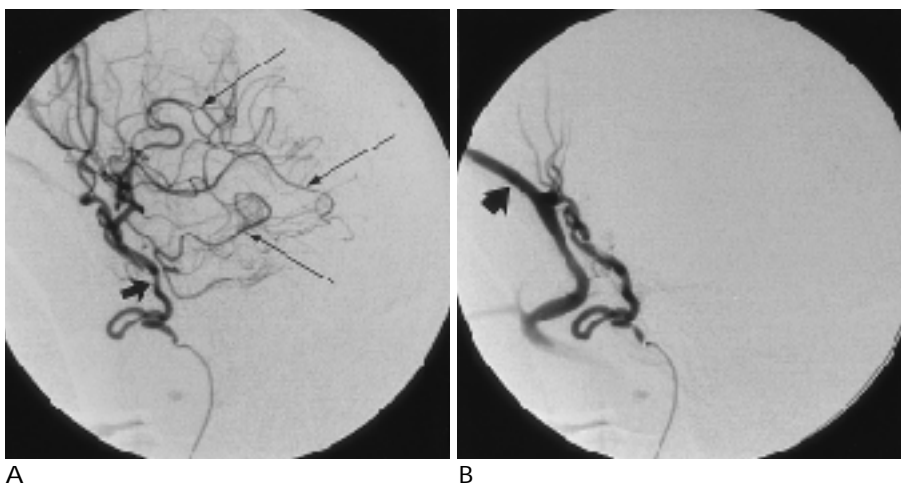


Fig. 1. A. Pre-embolization arteriography of right internal carotid artery (short arrow) shows anterior and middle cerebral arteries (long arrows). B. Post-embolization angiogram shows complete occlusion of right distal internal carotid artery and intracranial arteries. Right external carotid artery (arrow) is opacified by the collateral flow from proximal right internal carotid artery.

CT  
, MR  
가  
가  
CT  
CT  
MR  
(Hounsfield Units, HU)  
CT  
MR  
HU  
ROI  
CT  
MR  
(73.4mm<sup>2</sup>)  
HU  
HU  
CNR  
× (HU) /  
HU - HU.  
% CNR = 100  
CT  
5  
가  
1  
2  
가  
(Fig. 2).  
1  
MR  
FLAIR  
2, 2  
3  
T2  
1  
3, 2  
4, 2  
가  
(Fig. 2).  
가  
CT  
1  
FLAIR  
가  
FLAIR  
3  
CT  
HU  
HU  
34  
1

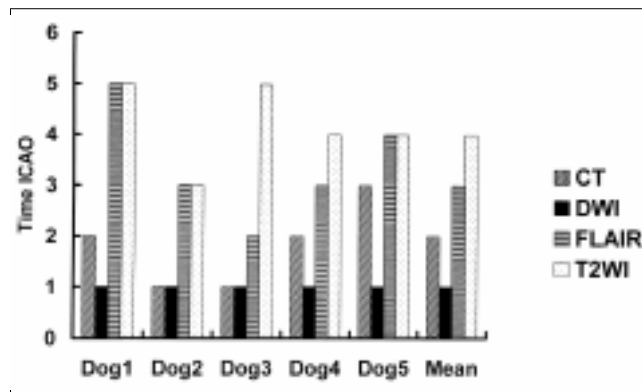


Fig. 2. Detection time of the ischemic lesions on unenhanced CT, diffusion-weighted, T2-weighted, and fast FLAIR MR images after occlusion of intracranial arteries in five dogs. Time ICAO = Time after occlusion of internal carotid artery

2.7 HU  
가  
HU  
4.1 HU  
HU  
1  
2.7 5 6.7 가 (Fig. 4).  
MR  
1 74.5  
가 가 5  
169.4 FLAIR  
가  
가 36.2, 1  
19.5 가 5 58.7 가  
T2  
가 4 75.9 가 가 5  
78.4 가 (Fig. 5). CNR  
가  
CT T2 FLAIR  
(Table 1, Fig. 6).

(18),  
 가  
 (19), coil  
 , head  
 가 가  
 가 ,

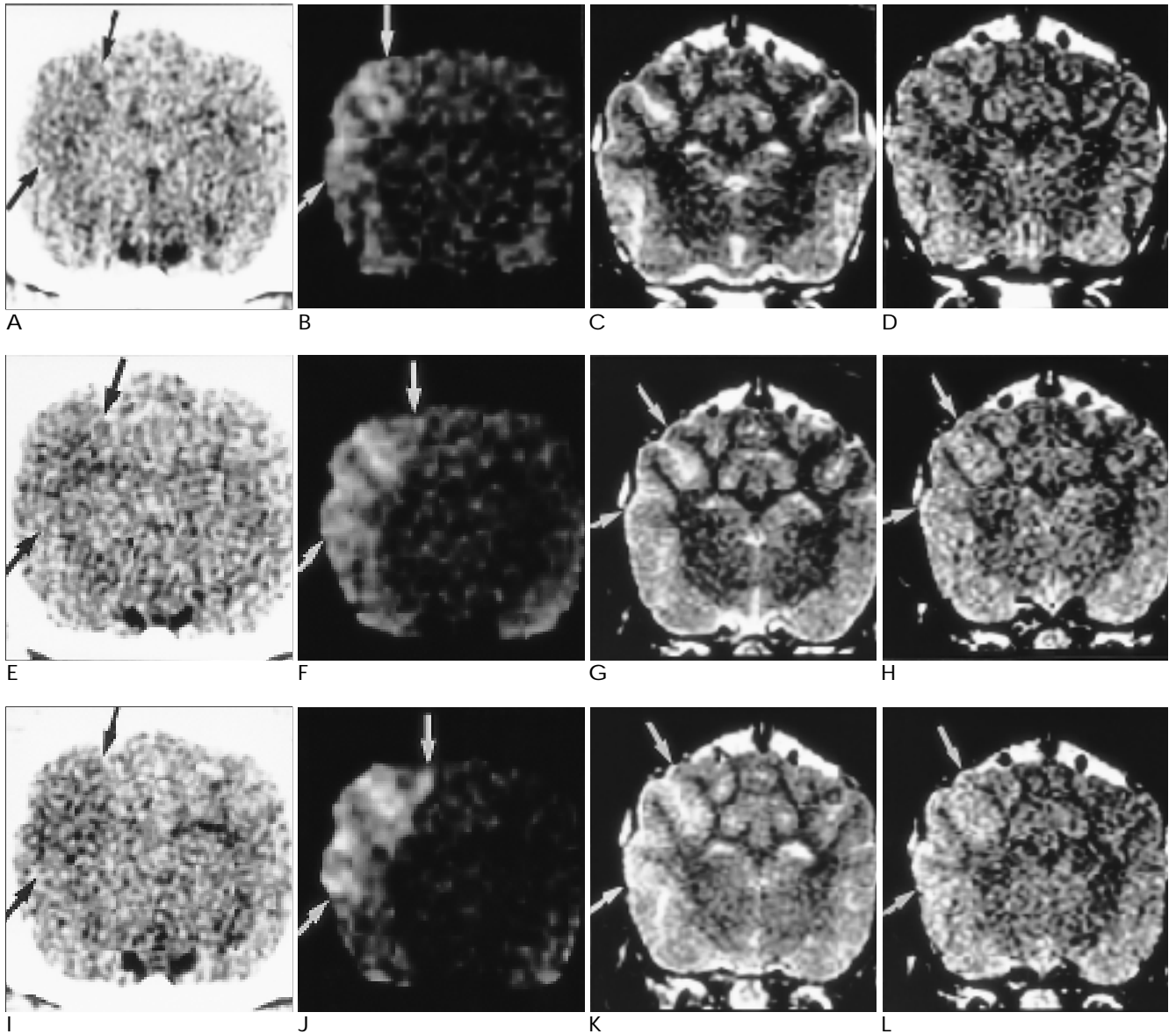


Fig. 3. CT and MR Images obtained 1 hour (A-D), 3 hours (E-H), and 5 hours (I-L) after occlusion of the right ICA and intracranial arteries in a dog 2.  
 Coronal unenhanced CT (A) shows a focal low attenuation area (arrows) in the right hemisphere. Coronal diffusion-weighted image (B) also shows abnormal high signal intensity (arrows) in the right hemisphere corresponding to the low density area on unenhanced CT. Coronal T2-weighted (C) and fast FLAIR image (D) shows no definite abnormal signal intensity in the brain. Unenhanced CT (E) obtained 3 hours after occlusion of intracranial arteries shows a similar low attenuationa lesion(arrows) in the right hemisphere. The lesion has become brighter on diffusion-weighted image(arrows) (F). T2-weighted (G) and fast FLAIR images (H) show slightly high signal intensity of the cortex in the right hemisphere(arrows). The ischemic lesion is more evidently demonstrated on CT and MR images (arrows) (I-L) obtained 5 hours after occlusion of intracranial arteries.

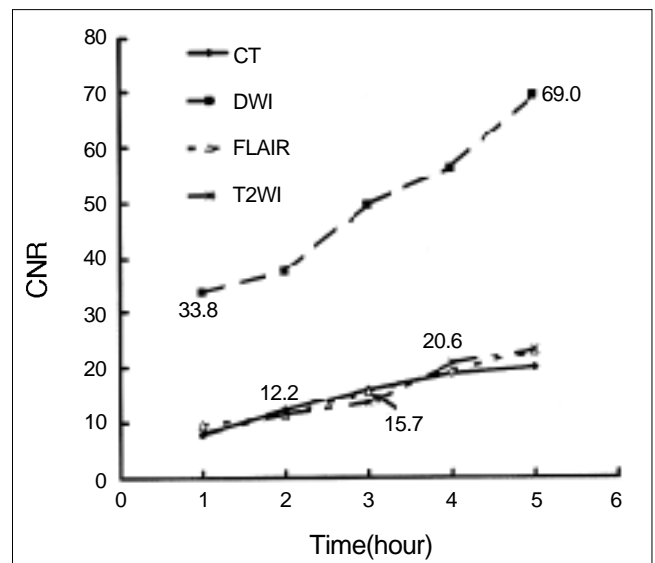
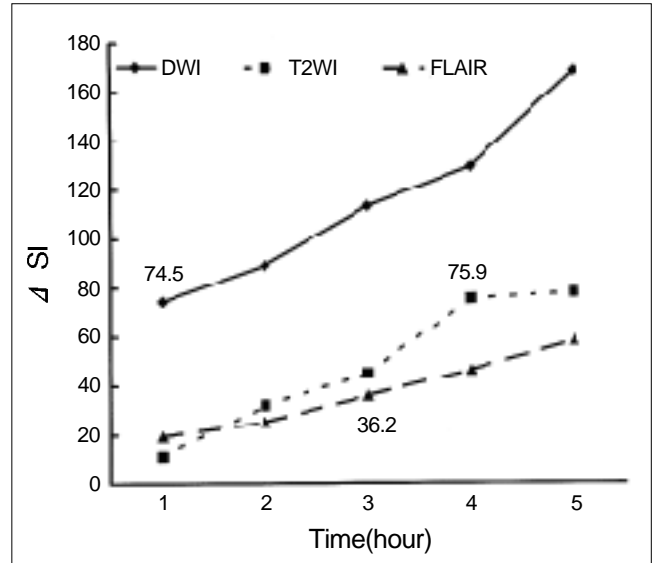
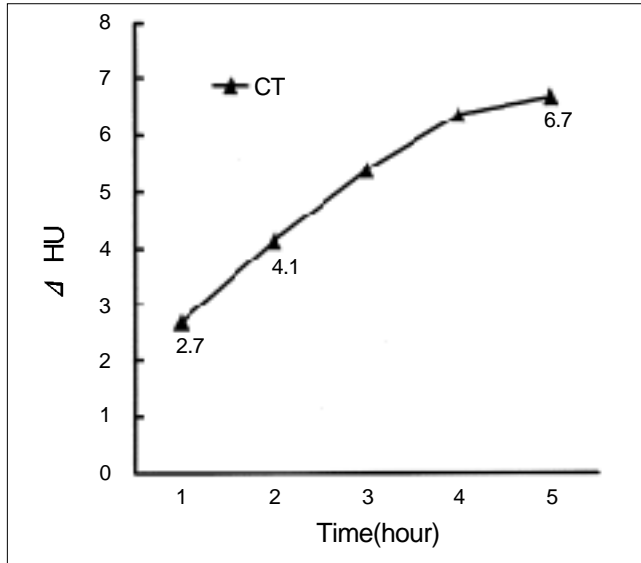


Table 1. Comparison of CNR on Unenhanced CT, Diffuison-weighted, T2-weighted, Fast FLAIR MR Images (n= 5)

| Time<br>(hour) | CT   |     | Diffusion-weighted |      | FLAIR |      | T2-weighted |      |
|----------------|------|-----|--------------------|------|-------|------|-------------|------|
|                | Mean | SE  | Mean               | SE   | Mean  | SE   | Mean        | SE   |
| 1              | 7.9  | 4.8 | 33.8               | 13.4 | 9.6   | 7.5  | 8.2         | 4.3  |
| 2              | 12.2 | 4.7 | 37.4               | 17.9 | 11.2  | 9.8  | 11.5        | 8.2  |
| 3              | 16.0 | 5.5 | 49.6               | 35.6 | 15.7  | 14.1 | 13.5        | 10.8 |
| 4              | 18.8 | 3.2 | 56.2               | 31.4 | 19.2  | 10.6 | 20.6        | 17.5 |
| 5              | 19.8 | 3.1 | 69.0               | 31.4 | 23.0  | 15.7 | 23.3        | 24.9 |

CNR= Contrast-to-Noise Ratio, SE = Standard Error

Drayer (20) 160 × 160 matrix

(8,21-23)

CT 1

HU 4.2

4

4

(25,26)

가 10-15 ml/100g/min

가 , 4

3% 가

CT 2.5 HU가

4 HU

2% 가

CT

가

MR

30 45 , T2

(10,11,13-15).

1

3

5

T2

가 ,

CT

가

가

가

(Fig. 6, Table 1).

가

5

HU가

가

HU

CT

가

Kummer (24)

(apparent diffusion coefficient)가

가

가

ATP가

osmolarity 가 acidosis

osmotic gradient가

가

T2

(27),

(24).

MR

T2

(12,19)

, T2

4

4

T2

가가 (19). T2 T2 가가 T2 가 T2 (13, 14), T2 1 가 (26) T2 (27). T2 FLAIR CT CNR CT T2 , FLAIR CT T2 CT MR 가 CNR (window with) (9, 32). CNR CT T2 , CT 80 HU 700-800 T2 가 CT MR (9). CT T2 FLAIR 가 CNR CT T2 FLAIR 가 CT T2 CNR T2 가 FLAIR T2 가 T2 가 (33). 가 CT가 T2 FLAIR

MR 가 CT 가 가 CT T2 FLAIR 가 (14), 가 (34,35), 가 CT, FLAIR T2 CT가 T2 FLAIR CT

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## **Early Detection of Hyperacute Cerebral Infarction in Dogs: Comparison of Unenhanced CT, Diffusion-weighted, Spin-echo T2-weighted, and Fast FLAIR MR Imaging<sup>1</sup>**

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**Purpose :** This study was performed in order to compare unenhanced CT with diffusion-weighted, T2-weighted, and fast FLAIR MR imaging in the detection of hyperacute cerebral ischemia induced in a dog and to determine which modality first detected cerebral ischemia.

**Materials and Methods :** Experimental cerebral infarction was induced by the occlusion of intracerebral arteries using embolic materials (polyvinyl-alcohol, 300-600  $\mu$ ) introduced through a microcatheter into the internal carotid artery of five dogs weighing 12-20 kg. Serial CT and MR images were obtained at one hour intervals from one to five hours after occlusion, and were analyzed independently by two radiologists. We assessed changes in attenuation, as seen on unenhanced CT and the signal intensity of the lesion on each MR image, and measured the contrast-to-noise ratio (CNR) of the lesions.

**Results :** Ischemic lesions were detected on unenhanced CT 1-3 hours after occlusion of cerebral arteries. In all dogs, the lesions were detected earliest on diffusion-weighted images obtained at 1 hour. They were detected on T2-weighted images at 3-5 hours and on fast FLAIR images of 2-5 hours. The CNR of ischemic lesions increased gradually during the 5-hour period. It was highest on diffusion-weighted images, while on unenhanced CT, T2-weighted, and fast FLAIR images it was similar.

**Conclusion :** Hyperacute ischemic lesions were detected earliest on diffusion-weighted images, and earlier on unenhanced CT than on fast FLAIR or T2-weighted MR image.

**Index words :** Brain, infarction

Brain, CT

Brain, MR

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