

T1 MR
: Child-Pugh

1

2

: T1 MR 가
가
: CT 25
20 1.5T MR T1 MR ,
(CNR1), (CNR2)
(Contrast to Noise ratio: CNR) . 25 Child-Pugh
A, B, C A B 8 , C 9 .
Child B 3 C 4 .
CNR
: CNRs(CNR1, CNR2) 3.2±5.9, 8.4±8.0
10.6±9.0, 9.8±6.4 CNR1 (p < 0.05).
CNRs(CNR1, CNR2) Child A 8.5±11.5, 11.7±8.7, B
10.4±5.1, 9.3±3.2, Child C 12.8±9.7, 8.7±6.5 CNR1
가 CNRs
9.4±6.0, 8.2±3.7, 11.1±10.0, 10.4±7.0

: T1 MR

CT
20

25

T1 MR
가

가 가

가

CT

(1, 2).

25

20

T1 MR

49 ,

20 : 5

40 ,

13 : 7

(3, 4)

가

가

Child-Pugh

A, B, C

A

B

8 ,

C

9

가

¹
²

25 7 8.0 10.6 ± 9.0, 9.8 ± 6.4 CNR1
 B 3 C 4 . 48 1.5T p value 0.05 (Table 1).
 (Signa, GE Medical System, Milwaukee,
 Wis-consin, U.S.A.) 45
 T1 (TR/TE = 433 ms/16 ms) T1 MR CNR1
 7mm, (Fig. 3)
 19cm, 256 × 192 1 가 Child-Pugh A 8.5 ± 11.5, B 10.4 ±
 5.1, C 12.8 ± 9.7 가
 T1 MR CNR2 가 (Table 2).

(con-
 trast to noise ratio: CNR)
 CNR1,
 CNR2 (Fig. 1).
 CNRs(CNR1, CNR2) T1 MR
 Child-Pugh
 ANOVA test Student-t test
 (p value < 0.05).

Table 1. Comparison of Contrast to Noise Ratio(CNR) between Control and Cirrhotic Groups

| | Control(n= 20) | Cirrhosis(n= 25) | p value |
|--------------------|----------------|------------------|---------|
| CNR 1 [†] | 3.2 ± 5.9 | 10.6 ± 9.0 | p< 0.05 |
| CNR 2 [‡] | 8.4 ± 8.0 | 9.8 ± 6.4 | NS* |

CNR 1[†]: contrast to noise ratio 1
 CNR 2[‡]: contrast to noise ratio 2
 NS*: not significant

Table 2. Comparison of Contrast to Noise Ratio among Child-Pugh Groups

| | Child A(n= 8) | Child B(n= 8) | Child C(n= 9) | p value |
|--------------------|---------------|---------------|---------------|---------|
| CNR 1 [†] | 8.5 ± 11.5 | 10.4 ± 5.1 | 12.8 ± 9.7 | NS* |
| CNR 2 [‡] | 11.7 ± 8.7 | 9.3 ± 3.2 | 8.7 ± 6.5 | NS* |

CNR 1[†]: contrast to noise ratio 1
 CNR 2[‡]: contrast to noise ratio 2
 NS*: not significant

T1 MR (Fig. 2),
 CNR CNR1 3.2 ± 5.9, CNR2가 8.4 ±

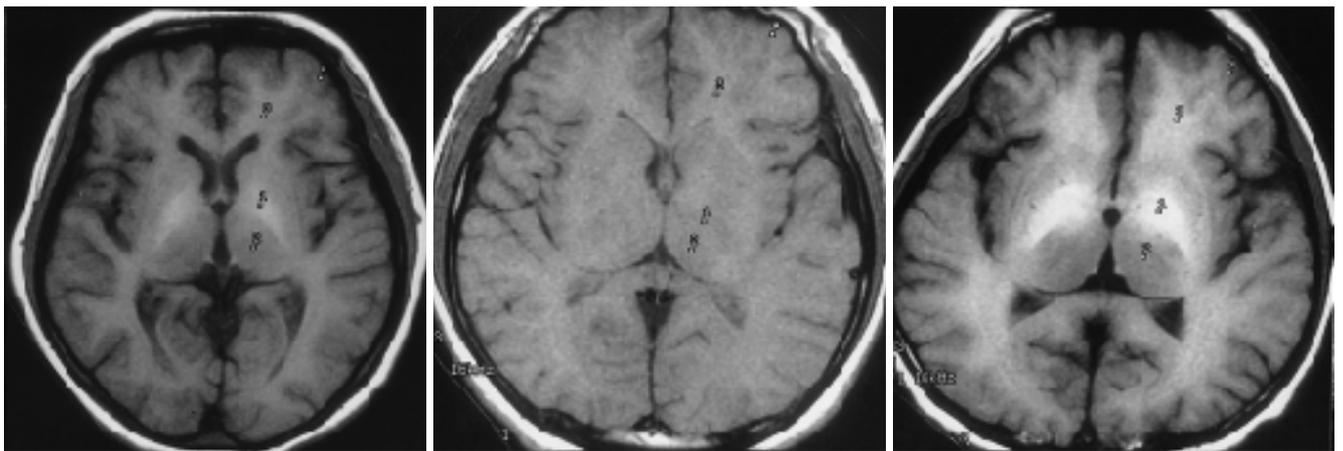


Fig. 1. Measurements of contrast to noise ratio(CNR) on T1-weighted MR image
 CNR1= (Globus pallidus SI(1) - Thalamus SI(2))/ Background SI(5)
 CNR2= (White matter SI(3) - Cortex SI(4))/ Background SI(5)
 SI: signal intensity

Fig. 2. T1-weighted spin-echo images of the brain in normal control(a) and cirrhotic group(b)
 A. Normal brain shows no abnormal signal intensity in the globus pallidus(1) and white matter(3) on T1-weighted MR image.
 B. Liver cirrhosis group shows high signal intensity in the globus pallidus(1) and white matter(3).

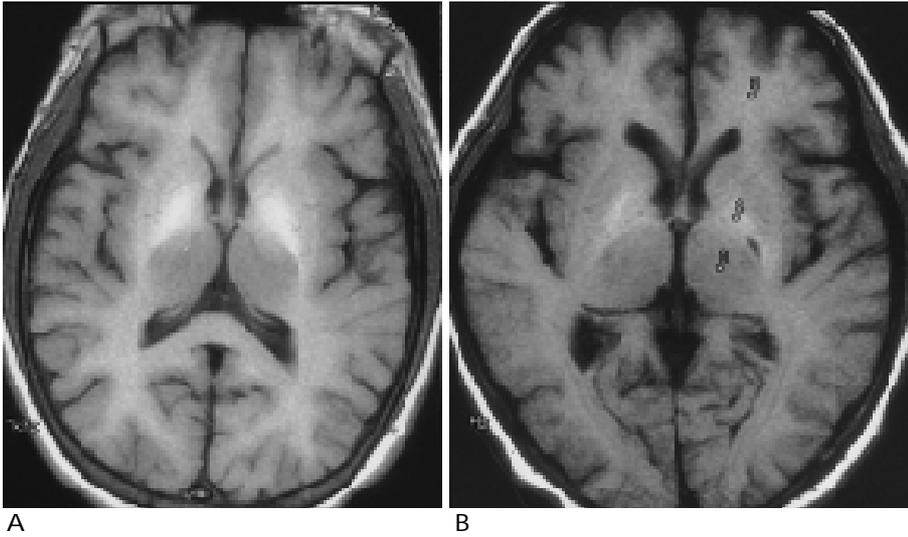


Fig. 3. Comparison of CNRs between Child-Pugh B and Child-Pugh C of liver cirrhosis
T1-weighted MR images of liver cirrhosis patients show high signal intensity in the globus pallidus(CNR1) and white matter(CNR2), which were all measured 15 and 8 in Child group B(A) and 3.8 and 4.2 in Child group C(B), respectively.

Table 3. Comparison of Contrast to Noise Ratio in Liver Cirrhosis with or without Hepatic Encephalopathy

| | Liver Cirrhosis | | p value |
|--------------------|-----------------------------|---------------------------------|---------|
| | with HE ^a (n= 7) | without HE ^a (n= 18) | |
| CNR 1 [†] | 9.4 ± 6.0 | 11.1 ± 10.0 | NS* |
| CNR 2 [‡] | 8.2 ± 3.7 | 10.4 ± 7.0 | NS* |

HE^a: hepatic encephalopathy
CNR 1[†]: contrast to noise ratio 1
CNR 2[‡]: contrast to noise ratio 2
NS*: not significant

CNRs
CNR2가 8.2 ± 3.7, 7.1
가 (Table 3),
CNR1 9.4 ± 6.0, 11.1 ± 10.0, 10.4 ±

T1 MR (3, 4). Norton (8)

가
T1 MR Gleissler (9)

가

pallidal index(PI =) (10).

(Contrast

to Noise ratio: CNR)

T1 MR

T1 MR ferritin T2 (11).

T1 MR

가 가 가

가 Schwann

가

(12-16). T1 90-95%가

(5, 6)

(7).

T1 MR

가

가

가 striatal output (17)

30-40% T1 MR (18)

, T2

T1 MR

Schwann T2

가

70-80%가 T1 MR

Weissenborn (21) 92% T1

MR

Pujol (19)

Child-Pugh MR

가 T1 MR

Kulisevsky (22) 가

가 2

T1 MR

Gleissler (9)

가 glutamine/gluta-

mate 가

가

가

T1 MR

Child-Pugh

가

T1 MR

: T1 MR

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Quantitative Evaluation of Hyperintensity on T1-weighted MRI in Liver Cirrhosis : Correlation with Child-Pugh Classification and Hepatic Encephalopathy¹

Hyo Won Eun, M.D., Hye Young Choi, M.D., Sun Wha Lee, M.D., Sun Young Yi, M.D.²

¹Department of Radiology, College of Medicine, Ewha Womans University

²Department of Internal Medicine College of Medicine, Ewha Womans University

Purpose : To investigate the differences in signal changes in the globus pallidus and white matter, as seen on T1-weighted MR brain images, and to determine whether these differences can be used as an indicator of sub-clinical hepatic encephalopathy.

Materials and Methods : A total of 25 cases of liver cirrhosis were evaluated and as a control group, 20 subjects were also studied. Using a 1.5T MRI scanner, brain MR images were obtained, and the differences in signal intensity in both the globus pallidus and thalamus and in both white and gray matter were then quantified using the contrast to noise ratio(CNR). On the basis of the Child-Pugh classification, 25 patients with liver cirrhosis were divided into three groups, with eight in group A, eight in B, and nine in C. Using clinical criteria, hepatic encephalopathy was diagnosed in seven of the 25 patients. Thereafter, CNRs(CNR1 and CNR2) were compared between the control and cirrhotic groups and between cirrhotic groups with or without hepatic encephalopathy.

Results : In the control group, mean values were 3.2 ± 5.9 for CNR1 and 8.4 ± 8.0 for CNR2. In the cirrhotic group, these values were 10.6 ± 9.0 for CNR1 and 9.8 ± 6.4 for CNR2. A statistically significant difference was noted between normal and cirrhotic groups only for CNR1 ($p < 0.05$). CNR values in patients with liver cirrhosis were 8.5 ± 11.5 for CNR1 and 11.7 ± 8.7 for CNR2 in the Child A group, 10.4 ± 5.1 for CNR1 and 9.3 ± 3.2 for CNR2 in the B group, and 12.8 ± 9.7 for CNR1 and 8.7 ± 6.5 for CNR2 in the C group. There was no significant difference in mean CNR1 values between patients with or without hepatic encephalopathy.

Conclusion : Differences in signal intensities in the globus pallidus and white matter, as seen on T1-weighted MR brain images, cannot be used as an indicator of hepatic encephalopathy in patients with liver cirrhosis.

Index words : Liver, cirrhosis
Brain, diseases
Brain, MR

Address reprint requests to : Hye Young Choi, M.D., Department of Radiology, Ewha Womans University Mokdong Hospital
#911-1 Mok-Dong, Yancheoun-Ku, Seoul, 158-056, Korea.
Tel. 82-2-650-5174 Fax. 82-2-644-3362