



CT 1

: (Radiofrequency Thermal Ablation) CT
 (Hyperemia)
 : 28 45
 (34 ; 11) 3
 CT 1) , 2) (, THAD[Transient Hepatic Attenuation Difference] ,) , 3) (3 CT , ,)
 CT
 : CT 71%(32/45) ,
 28%(9/32) 8%(1/13)
 ($p > 0.05$). 69%(22/32), THAD
 25%(8/32), 6%(2/32) , 23%(5/22), THAD 38%(3/8),
 50%(1/2) , 가
 66%(21/32), 가 28%(9/32), 가 6%(2/32) ,
 10%(2/21), 67%(6/9),
 100%(2/2)
 ($p=0.001$).
 : CT

가 가 (1).

(1-3),

CT

(circumferential)

(wedge)

1

(

3, 6

CT)

(1, 4, 6).

가

(7, 8),

(Transient Hyperemia)

CT

CT
, 60 , 220
CT
24 CT
1999 5 2000 5
CT
. CT
28 3
(; 22 , ; 6) 45 (; 34
, ; 11)
21 , 7 , 29-71 54 ,
1 cm-5 cm 2.4 cm ,
가 1 가 16 , 2 가 8 , 3 CT CT 가
가 3 , 4 가 1 .
5 cm 가 4 , 가
가 , 가 , 가 ,
(: >80,000; Prothrombin time:
>60%)가
3 , 3 2
, 3 1 가 .
가
1) (Circumferential type), 2)
THAD (Transient
Hepatic Attenuation Difference type), 3)
(Noular
type) (Fig. 1).
3 CT
. 3
CT 가 3 CT
(acute transient pattern) ,
3 (persistent pattern)
(delayed-onset pattern)
가 CT 가
24 3 CT
6 , 6 Fisher's exact test
35 , 9 4 , 12 6 , 0.05
7.1
CT Somatom Plus 4(Simens, Erlangen,
Germany) , 120 mL
(Ultravist 370, Shering AG, Germany) 45 32 (71%)
3 mL , 30

, 13 (29%)
 56%(18/32), 3%(1/32)가
 32 / /
 가 가 22 3
 가 , 가 9
 71%(24/34)
 73%(8/11)
 (p=0.137) (Table 1).
 45 10 (22%)
 , 3 3 , 7 6
 7 , 3 ,
 , 3 3 4 6
 34 24 6
 69%(22/32), THAD
 25%(8/32), 6%(2/32)
 가 66%(21/32) (Fig. 2), 가 28%(9/32) (Fig. 3), 가 6%(2/32) (Fig. 4)
 66%(21/32) 3 ,
 34%(11/32) 6
 23%(5/22), THAD 38%(3/8), 50%(1/2)

(Table 2).
 10%(2/21),
 67%(6/9), 100%(2/2)
 (p=0.001) (Table 3).
 28%(9/32) 8%(1/13)
 (p=1.000) (Table 1).

Table 1. Peritumoral Hyperemia vs. Tissue Histology and Marginal Recurrence

Hyperemia	Presence	Absence	P-value
Tissue Histology			
HCC	24	10	0.137
Metastasis	8	3	
Marginal recurrence			
Yes	9	1	1.000
No	23	12	

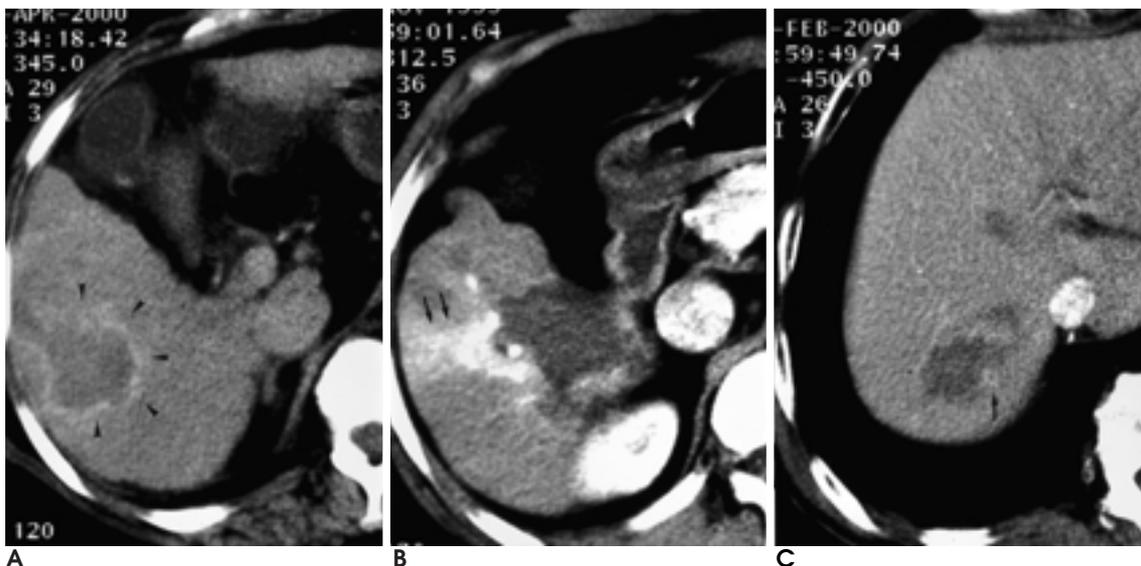


Fig. 1. Morphological characteristics of peritumoral hyperemia on immediate follow-up CT.
A. A 57-year-old man with hepatocellular carcinoma in the segment VI of the liver. One-day follow-up CT scan shows a peritumoral hyperemia of circumferential pattern (arrows).
B. A 51-year-old man with hepatocellular carcinoma. One-day follow-up CT scan shows a peritumoral hyperemia of THAD pattern (arrows).
C. A 65-year-old man with hepatocellular carcinoma. One-day follow-up CT scan shows a peritumoral hyperemia of nodular pattern (arrow).

CT
 (heat . CT
 sink effect)
 Seki (13)
 (microwave)
 가 , 2 가
 , Rossi (7)
 CT . CT
 가 ,

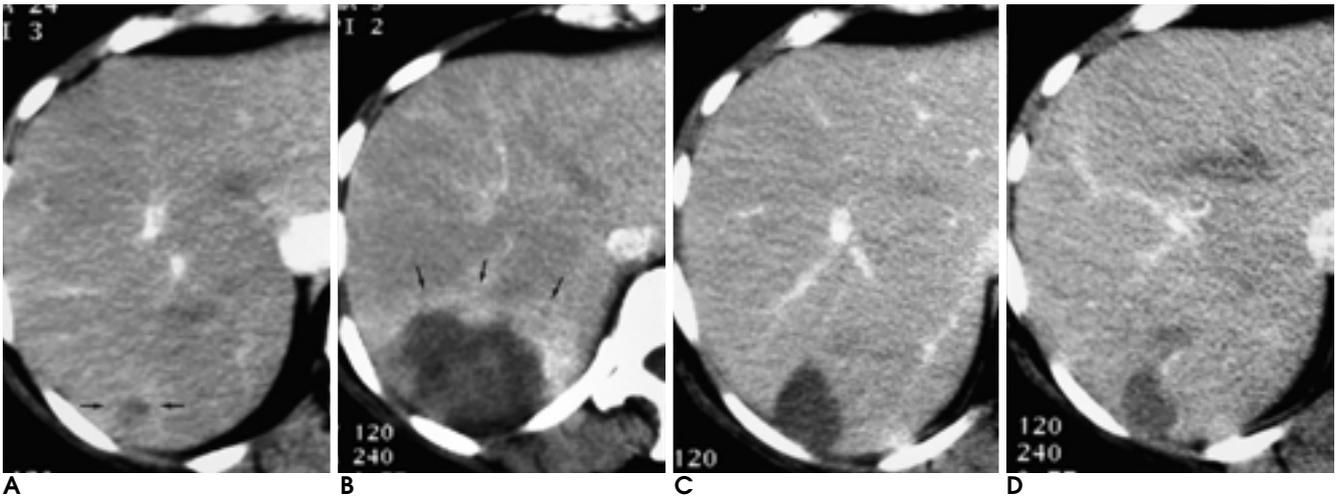


Fig. 2. A 64-year-old man with acute transient hyperemia.
A. Pretreatment CT scan depicts a 1.5-cm-diameter metastatic mass (arrows) from breast cancer.
B. One-day follow-up CT scan depicts a circumferential rim enhancement around coagulation area (arrows).
C. Three-month follow-up CT scan depicts a no peritumoral hyperemia.
D. Six-month follow-up CT scan shows more contraction of previous RF-ablated site without hyperemia.

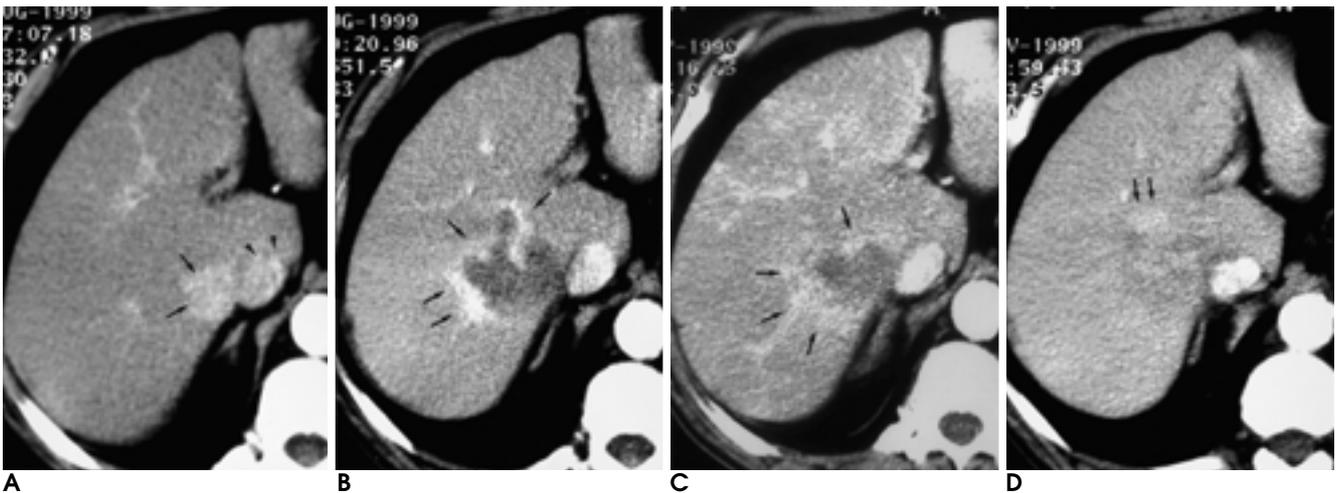


Fig. 3. A 64-year-old man with persistent hyperemia.
A. Pretreatment CT scan depicts a 3.8-cm-diameter hepatocellular carcinoma (arrows) located in segment VII adjacent to IVC (arrowheads).
B. One-day follow-up CT scan depicts a circumferential enhancement (arrows) around coagulation area.
C. Three-month follow-up CT scan depicts no interval change of the peritumoral hyperemia of circumferential pattern (arrows).
D. Six-month follow-up CT scan shows a minimal peritumoral enhancement but anterior aspect of tumor is a marginal tumor regrowth (arrows).

가 (8, 10 - . 1980 . 1980 . 가 (14, 15). Mitsuzaki 54%, 45% (8) (16, 17),

Table 2. Marginal Recurrence according to Morphological Characteristics of Peritumoral Hyperemia on Post-1-Day Follow-up CT

Morphological Characteristics	No. of Tumor	With Marginal Recurrence (%)	Without Marginal recurrence (%)	Total
Circumferential		5(23)	17(77)	22
THAD		3(38)	5(62)	8
Nodular		1(50)	1(50)	2
Total		9(28)	23(72)	32

Table 3. Correlation between the Temporal Course of Peritumoral Hyperemia and the Marginal Recurrence around the Ablated Lesion

Temporal Course	No. of Tumor	With Marginal Recurrence (%)	Without Marginal recurrence (%)	Total
Acute Transient		2(10)	19(90)	21
Persistent		6(67)*	3(33)	9
Delayed-Onset		2(100)*	0(0)	2
Total		10(31)	22(69)	32

* $p < .05$ for prevalence of marginal recurrence in tumors with persistent or delayed onset pattern of peritumoral hyperemia versus that in tumors with acute transient pattern of peritumoral hyperemia.

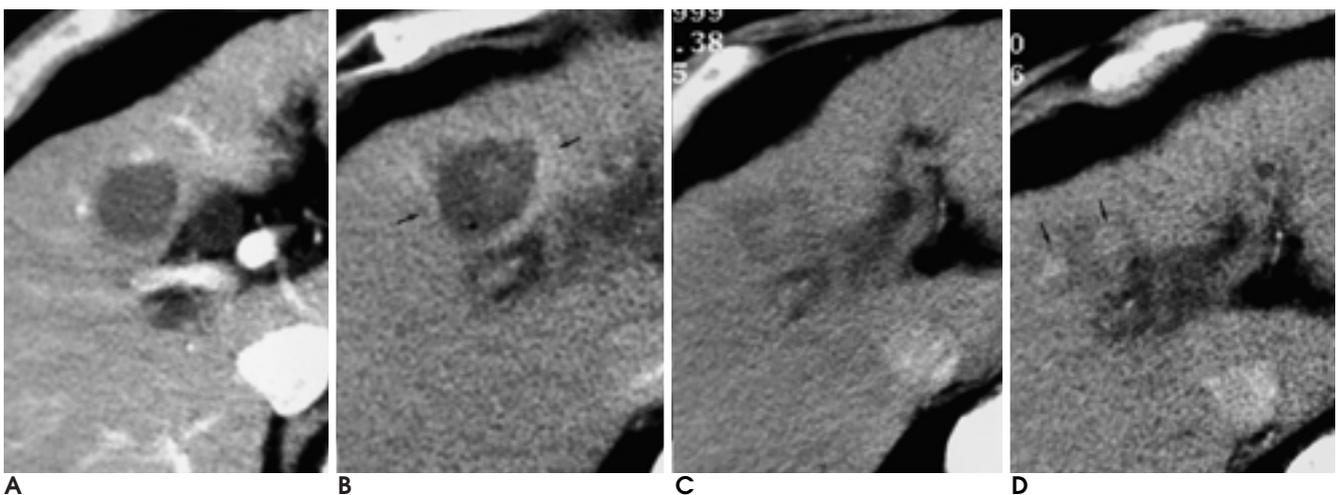


Fig. 4. A 54-year-old man with delayed onset hyperemia.

A. Portal phase CT scan obtained before RF ablation depicts a 4.0-cm-diameter hepatocellular carcinoma in the segment IV.

B. One-day follow-up CT scan depicts a peritumoral hyperemia of circumferential pattern (arrows).

C. Three-month follow-up CT scan shows no peritumoral hyperemia.

D. Six-month follow-up CT scan shows a peritumoral hyperemia of nodular pattern representing marginal tumor recurrence (arrows).

, Ito

(17)

3-11 (, 7)

(7, 8, 10, 11).

가

1

6

(7, 10, 11).

THAD

THAD

(14, 17, 18).

가

, 가

6

(19),

(organized thrombus)

가 THAD

가

가

(20).

Raman (21)

12-48 CT

가

3

CT

가

. CT

가

, CT

가

가

가

가

가

(resolution time)

가

가

24

3

가

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가

1

CT

CT

6

. Rossi

CT

가

가

3-4

(7).

Mitsuzaki (8)

3

1. : 1999;5:4-11

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66%(21/32) 3

34%(11/32) 6

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CT Spectrum of Transient Peritumoral Hyperemia after Radiofrequency Thermal Ablation of Hepatic Tumors¹

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Purpose: To determine the incidence and pattern of peritumoral hyperemia at CT after radiofrequency thermal ablation of hepatic tumors, as well as its correlation with local marginal recurrence.

Materials and Methods: Forty-five tumor nodules in 28 patients with hepatocellular carcinoma ($n=34$) or metastasis ($n=11$) were treated by RF thermal ablation. Serial follow-up contrast-enhanced CT scans were reviewed by three radiologists for 1) the presence, 2) the morphological characteristics [circumferential, THAD (transient hepatic attenuation difference), nodular form], and 3) the temporal course (acute, persistent, delayed onset pattern) of peritumoral hyperemia after RF thermal ablation. These findings were correlated with the frequency of recurrence at the margin of the treated tumors.

Results: The frequency of acute hyperemia observed on immediate follow-up CT scans after RF ablation was 71% (32/45). There was the local recurrence in nine of 32 tumors (28%) with hyperemia and in one of 13 (8%) without hyperemia ($p>0.05$). Among 32 tumors, the circumferential form was observed in 22 (69%); the THAD form in eight (25%); and the nodular form in two (6%). Marginal recurrence was noted in five of 22 tumors circumferential tumors (23%), in three of eight (38%) with the THAD form, and in one of two (50%) which were nodular. Among 32 nodules, an acute transient pattern was noted in 21 (66%), a persistent pattern in nine (28%), and a nodular pattern in two (6%). There was marginal recurrence in two (10%) of 21 tumors with acute transient hyperemia, in six (67%) of nine with persistent hyperemia, and in both tumors with delayed-onset hyperemia. There was significant correlation between the pattern of persistent/delayed-onset hyperemia and marginal tumor recurrence of ($p=0.001$).

Conclusion: Although peritumoral hyperemia after RF thermal ablation therapy is a frequent transient finding at follow-up imaging studies, its temporal pattern may help detect early marginal tumor recurrence.

Index words : Radiofrequency (RF) ablation

Liver neoplasms

Liver neoplasms, therapy

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