

# CT 1

1,2 1,3

CT  
(hemodynamics)  
CT  
3 30  
가 II ) 5 cm (n = 16, III )  
2 cm (n = 6, I ), 2 - 5 cm (n = 18,  
(plateau)  
(nodule in nodule)  
3 18.8  
( 6.8 )  
I 16.5 294.1 HU, II  
18.5 324.1 HU, III 20.1 114.0 HU (I )  
( $p < 0.05$ ), 가 (III ) 가  
( $p < 0.05$ ). 가 I  
(83%) , II (72%), III (69%)  
CT

가 가  
(1), 2 CT  
cm 가 , CT, MRI, CT CT  
CT  
CT (CT during hepatic arteriography, CTHA) . CT  
CT (CT during arterial portography, CTAP)가 , , , ,  
(2 - 8). (single - level dynam -  
ic) CT CT  
(9).

CT

1  
2  
3

1998

가 가

2000 9 26

2000 11 6

1997 3 1998 5

CT 40 43 80

32:8 57.3

(femoral artery) 5

mm , 2 4F Yashiro (digital subtraction angiography)

(proper hepatic artery) (common hepatic artery)

CT CT (10, 11).

CT

(Ultravist, Schering, Germany)

1.2 ml/sec 24 ml 3 10 , 45 60

CT (Siemens Somatom Plus S, Erlangen, Germany) CT 5mm (collimation)

5cm

2 cm 3

(2 cm : I , 2-5 cm : II , 5 cm : III ).

40 I ( : 1.6 cm)

6 , II ( : 3.4 cm) 18 , III ( : 9.3 cm)

16 가

(absorption attenuation number; Houns - field Unit; HU), (plateau)

가 ROI(region of interest)

**Table 1.** Summary of Contrast Enhancement Time and Density according to the Size of HCC.

Group	Mean peak CE time (sec)	Mean peak CE HU
I (n=6)	16.50 ± 1.64	294.17 ± 94.01
II (n=18)	18.50 ± 1.85	324.11 ± 176.76
III (n=16)	20.06 ± 2.83	114.06 ± 63.07
Total	18.83 ± 2.54	235.60 ± 162.74

가

CT

5%

가

1.5cm ROI

(nodule in nodule or mosaic pattern),

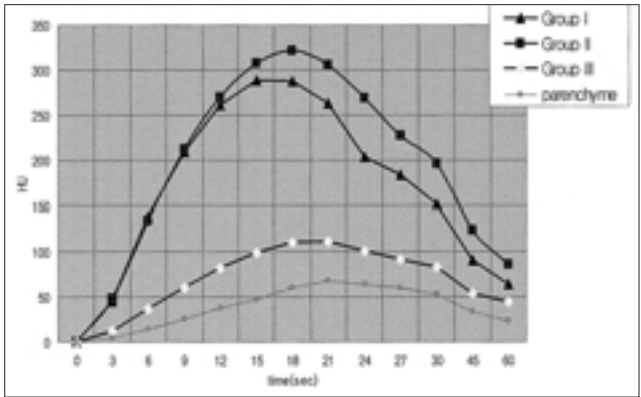
Kruskal - wallis (p < 0.05), Duncan

Anova with multiple com - (p < 0.05), Duncan

I 16.5 , 294.1

II 18.5 , 324.1

III



**Fig. 1.** A diagram shows the relationship between time and Hounsfield unit in ROI according to the size of HCC. Three groups show similar enhancement pattern{early contrast enhancement, plateau (including peak contrast enhancement), and delayed washout of contrast material}. The group I shows fast peak contrast enhancement time and the group III shows the lowest contrast enhancement. ( Group I: less than 2 cm, Group II: 2- 5 cm, Group III: more than 5cm in HCC size)

20.0 , 114.0 .  
I, II, III 18.8 (Table 1).  
20  
I III  
가 ( $p < 0.05$ ), I II  
( $p > 0.05$ ).  
II III ( $p < 0.05$ ), I  
II ( $p > 0.05$ ).  
3  
( 16.8 )  
( 6.83 )  
(Table 2).  
I 5 (83%) (Fig.  
2), 1 (17%)  
II 13 (72%) (Fig. 3), 1 (6%)

, 2 (11%) , 2 (11%)  
III 11 (69%)  
(Fig. 4), 4 (25%) , 1 (6%)  
(Table 3).

CT

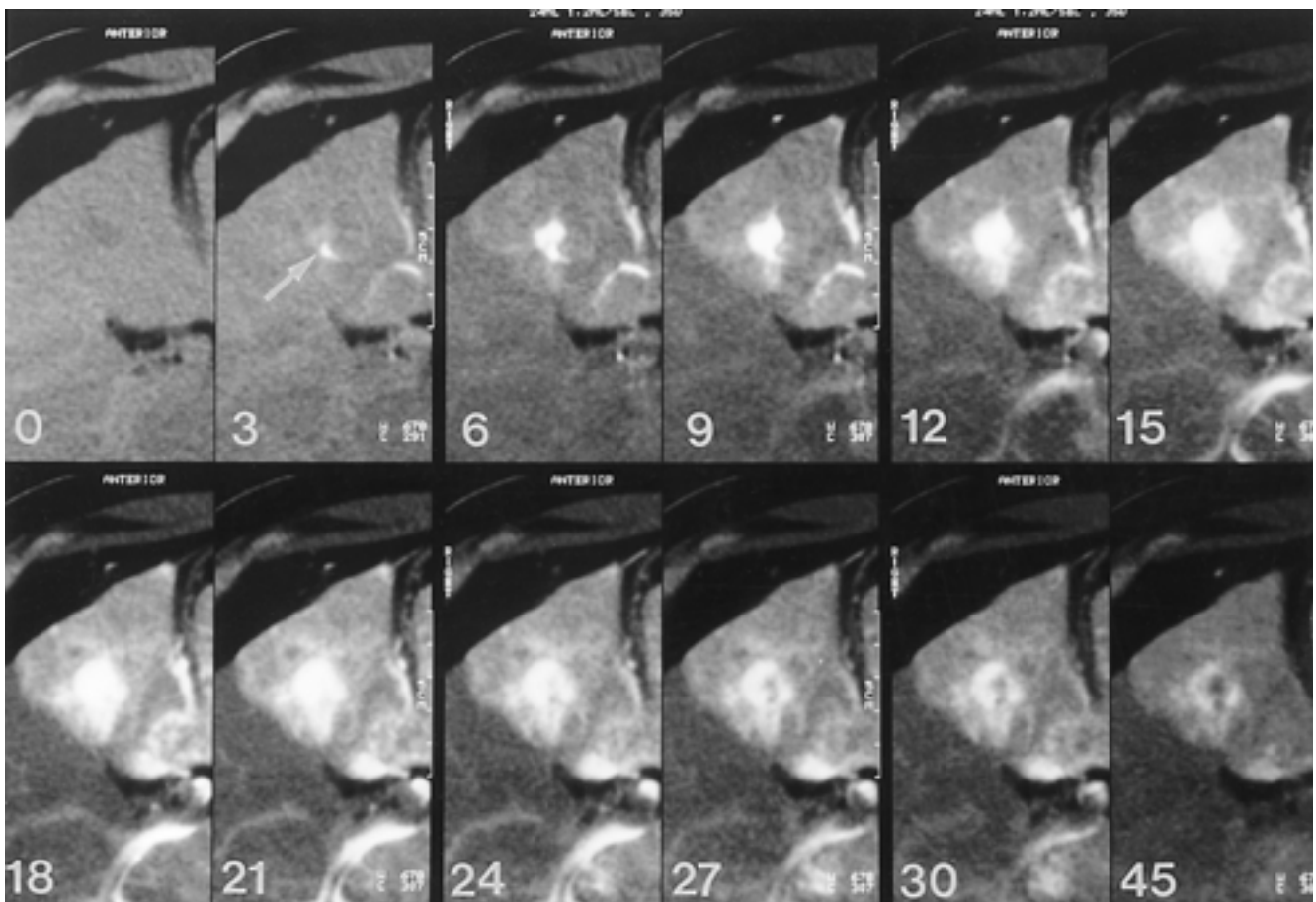
(mul-

tiphasic) CT,

CT,

**Table 2.** Summary of Onset Time and Duration of Plateau according to the Size of HCC.

Group	Mean onset time of plateau (sec)	Duration time of plateau (sec)
I (n=6)	14.50 $\pm$ 2.25	7.00 $\pm$ 2.45
II (n=18)	15.83 $\pm$ 2.00	7.16 $\pm$ 1.50
III (n=16)	18.75 $\pm$ 2.04	6.37 $\pm$ 2.87
Total	16.80 $\pm$ 2.61	6.83 $\pm$ 2.25



**Fig. 2.** Single-level dynamic CTHA images in a 57-year-old man with HCC in segment IV. The lesion is 1.2 x 1.1 cm in size. Images were obtained before intraarterial injection of contrast material and thereafter at three second intervals upto 30 seconds and the final image at 45 sec after the start of injection. At three seconds, tumor enhancement is already visible (arrow). The maximal enhancement is seen in 15 second-delayed image. The tumor enhancement shows homogeneous pattern.

CT, CT Lipiodol CT

CT

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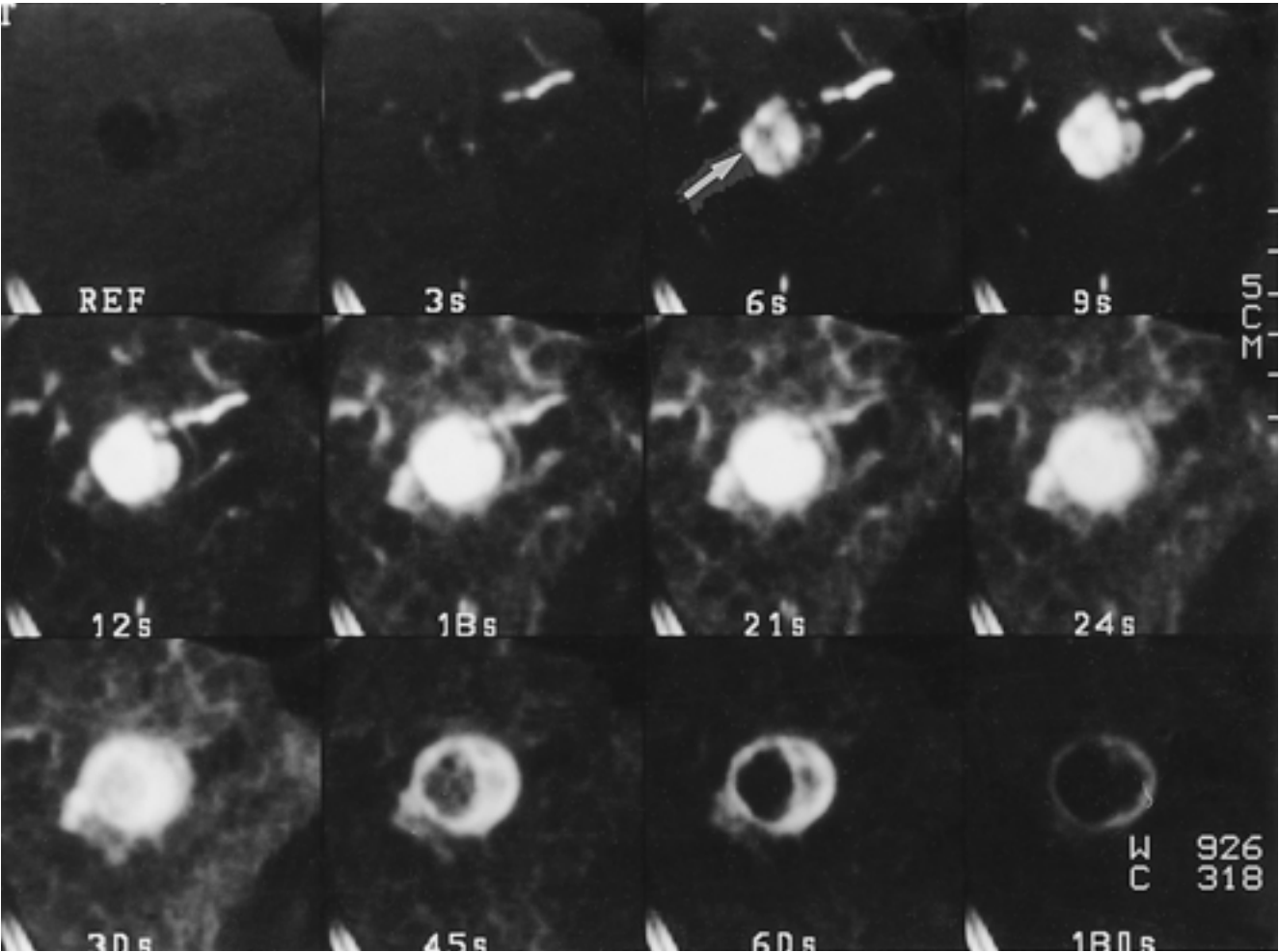
CT

(12).

**Table 3.** Summary of Pattern of Contrast Enhancement according to the Size of HCC.

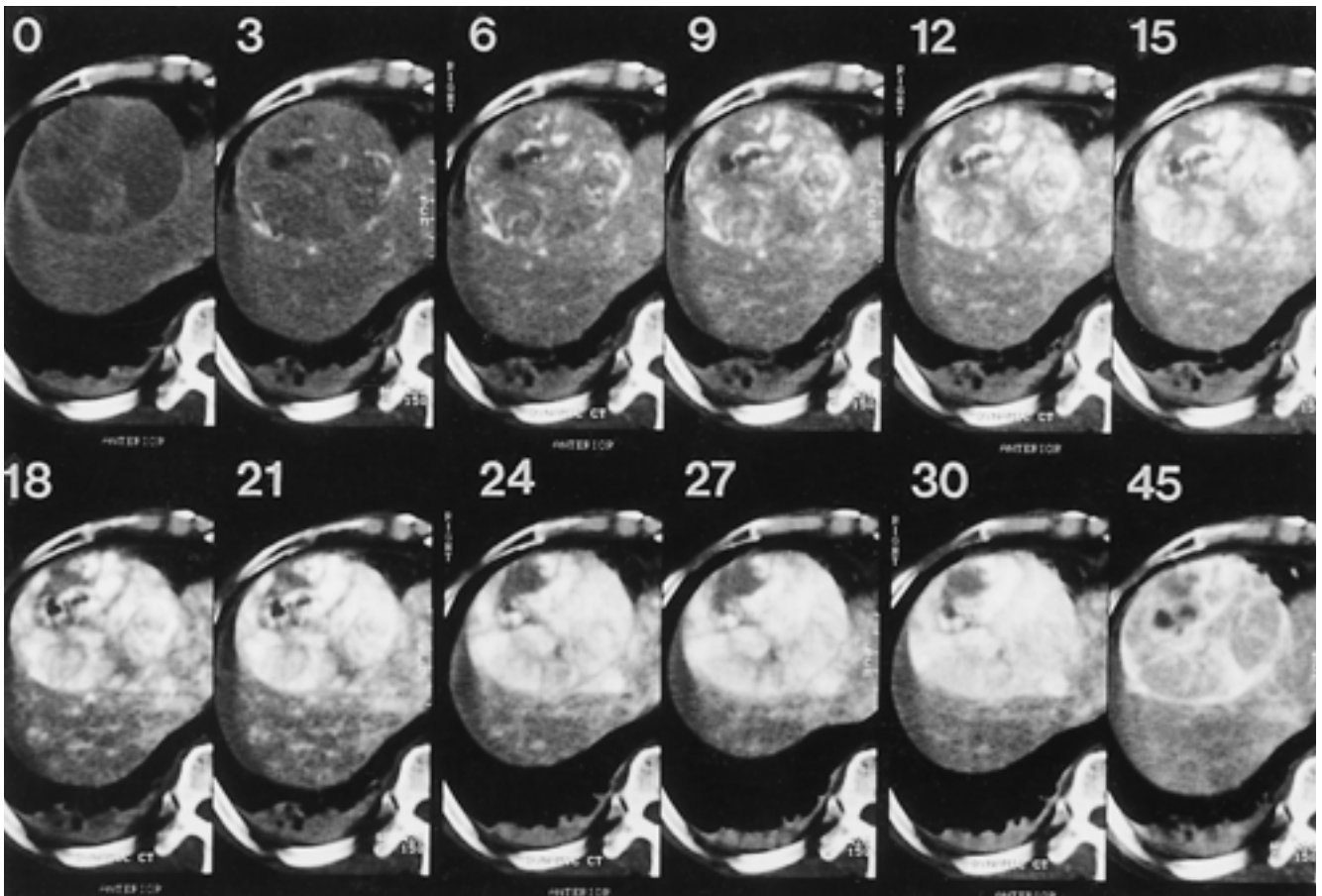
Group	CE pattern	Number	Percentage (%)
I (n = 6)	homogeneous	5	83
	peripheral	1	17
II (n = 18)	nodule in nodule	13	72
	heterogeneous	2	11
	peripheral	2	11
	homogeneous	1	6
III (n = 16)	heterogeneous	11	69
	peripheral	4	25
	nodule in nodule	1	6

(13).  
Ueda Matsui (9)  
CT CT  
1 mm 1  
가 가  
가  
CT  
가 가



**Fig. 3.** Single-level dynamic CTHA images in a 45-year-old man with HCC in segment VI. The lesion is about 2.2 x 2.0 cm in diameter. Images were obtained before and after three second for 30 seconds after intraarterial injection of contrast material. A 4 leaf-clover-like enhancement (arrow) in the larger nodule is well seen on initial 3, 6, 9 second CT images, suggestive of "nodule in nodule" pattern. And rapid washout of contrast material is seen on 24 sec & 30 sec images.

CT 20 가 12 , 20  
 21  
 Takashima (14) 24  
 (10 ) (infusion) 가 가  
 (well differentiated HCC) 가 가 (wash - out)  
 CT 24 , 30 , 45 , 21  
 1 - 1.5 ml 15 - 가 45  
 20 (hepatic dome) . 60 , 180 “ ” 가  
 20 가 16.8 (Fig. 3).  
 CT Fig. 2 6.8  
 1.2 ml/sec 20 24 ml 가  
 CT 가  
 3 가 (Table 2, Fig. 1).  
 가 4 (background)  
 6, 9 ( “ ” (contamination)  
 (tumor stain) CT



**Fig. 4.** Single-level dynamic CTHA images in a 65-year-old man with HCC. The lesion is 10 x 9.7 cm in size. Images were obtained before intraarterial injection of contrast material and thereafter at three second intervals upto 30 seconds and the final image at 45 sec after the start of injection. At three seconds, tumor enhancement is already visible. The maximal enhancement is seen in 18 second-delayed image. The tumor enhancement shows heterogeneous pattern.



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## Nodular Hepatocellular Carcinoma: Findings of Single-Level Dynamic CT During Hepatic Arteriography<sup>1</sup>

Hong Weon Kim, M.D., Yun Hwan Kim, M.D., Hwan Hoon Chung, M.D.,  
Sung Bum Cho, M.D.<sup>1,2</sup>, Bo Kyoung Seo, M.D.<sup>1,3</sup>, Hyoung Rae Kim, M.D.,  
Chang Ho Kang, M.D., Kyoo Byung Chung, M.D., Won Hyuck Suh, M.D.

<sup>1</sup>Department of Diagnostic Radiology, Korea University College of Medicine

<sup>2</sup>Department of Radiology, Eulji College of Medicine, Eulji Hospital

<sup>3</sup>Department of Radiology, Kangnam Miz Medi Hospital

**Purpose:** To evaluate the hemodynamics of nodular hepatocellular carcinoma (HCC) using single-level dynamic CT during hepatic arteriography (CTHA) according to the size of the nodule.

**Materials and Methods:** Forty 40 patients with nodular HCC confirmed histologically or radiologically underwent single-level dynamic CTHA. Contrast media was injected via the hepatic artery for 20 seconds at a rate of 1.2 ml/sec. Images were obtained prior to this and thereafter at 3-second intervals until 30 seconds after the start of injection, and additional images at 45 and 60 seconds. The CTHA findings were retrospectively reviewed, and cases were assigned to one of three groups, according to the size of the tumor [ $< 2$  cm (group I,  $n = 6$ ); 2 - 5 cm (group II,  $n = 18$ ); and  $> 5$  cm (group III,  $n = 16$ )]. We focused on onset time of contrast enhancement (CE), peak CE time and density, and duration of plateau. The patterns of CE were classified as homogeneous, heterogeneous, peripheral, or "nodule in nodule".

**Results:** The onset time of CE was 3 seconds and mean peak CE time was 18.8 seconds. A plateau was noted in all groups (mean duration, 6.8 seconds). Mean peak CE time and density were 16.5 seconds and 294.1 HU in group I, 18.5 seconds and 324.1 HU in group II, and 20.1 seconds and 114.0 HU in group III. The most frequent pattern of CE (83%) was homogeneous, and this was found in group I. The small HCC group (group I) showed a faster mean peak CE time than the large group (group III) ( $p < 0.05$ ), and this latter showed a lower peak CE density than the other groups ( $p < 0.05$ ). In groups II and III, "nodule in nodule" (72%) and heterogeneous patterns (69%) were, respectively, the most frequent findings.

**Conclusion:** Single-level dynamic CTHA is useful in evaluating the hemodynamics of HCC.

**Index words :** Liver, CT  
Liver, angiography  
Liver neoplasms, CT

Address reprint requests to : Yun Hwan Kim, M. D., Department of Diagnostic Radiology, Korea University Anam Hospital,  
Korea University College of Medicine, 126-1, 5-ka, Anam-dong, Sungbuk-ku, Seoul 136-705, Korea.  
Tel. 82-2-920-5573 Fax. 82-2-929-3796 E-mail: yhkku@ns.kumc.or.kr