

$^{99m}\text{Tc}$ -DTPA

:

가<sup>1</sup>

2 . . . 3 . 4 . 5 . 5

:  $^{99m}\text{Tc}$ -DTPA

: 20

 $^{99m}\text{Tc}$ -DTPA

(200 mg/ml, 300 mg/ml, 400 mg/ml)

( ) , 6가

,  $^{99m}\text{Tc}$ -DTPA 가 (time peak,  $T_{\text{peak}}$ ):  $^{99m}\text{Tc}$ -DTPA $T_{\text{peak}}$   $6.3 \pm 0.9$  sec .

$T_{\text{peak}}$   $13.8 \pm 1.6$  sec( 1),  $6.5 \pm 1.1$  sec( 2),  $14.8 \pm 1.7$  sec( 3),  
 $6.6 \pm 1.0$  sec( 4),  $15.2 \pm 2.0$  sec( 5),  $6.4 \pm 0.7$  sec( 6) .  $T_{\text{peak}}$   
 6 가 .

:  $^{99m}\text{Tc}$ -DTPA가  $^{99m}\text{Tc}$ -DTPA $^{99m}\text{Tc}$ -DTPA가.  $^{99m}\text{Tc}$ -DTPA

가

(1-3).

가

가

,

6).

(4-

(harmonic image)  
ear signal)(nonlin-  
ear signal)

(7, 8).

가

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가

가

(coded harmonic angio ultrasound (CHA US))

가

(9).

 $^{99m}\text{Tc}$ -DTPA

CHA US

1  
2  
3  
4  
5

2002 7 31

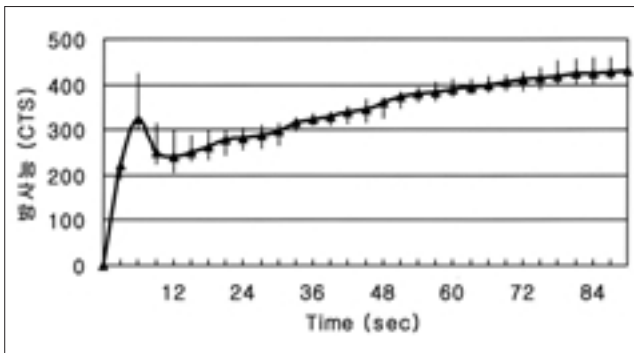
2002 10 9

20 (New Zealand white rabbit)  
3.5 Kg 3.2 - 4.1 Kg  
4.2 ± 0.5 × 2.1 ± 0.3 cm  
<sup>99m</sup>Tc-DTPA <sup>99m</sup>Tc-DTPA 2 mCi  
(Vertex™ V60; ADAC Laboratories, Milpitas, CA, U.S.A.)  
90 3 (counts, CTS)

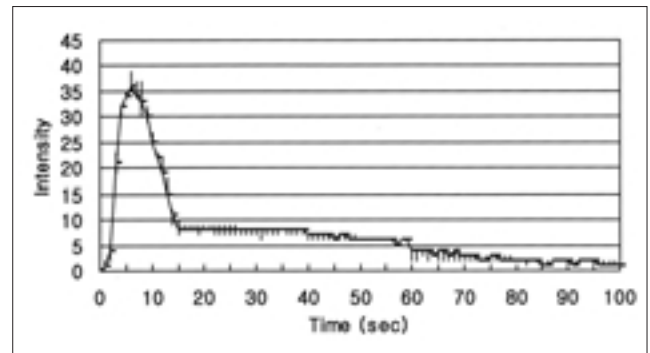
LogiQ 700 Expert Series (GE Medical Systems, Milwaukee, Wisconsin, U.S.A.) 2 - 4 MHz  
가 SH U  
508A (Levovist; Schering AG, Berlin, Germany) 4.0 g  
(200 mg/ml, 300 mg/ml, 400 mg/ml)  
24 - gauge

(intermittent scan) (continuous scan)  
가  
0.7 - 0.8 (Mechanical Index, MI)  
CHA US (gain) 62%  
70%, (dynamic range) 66 - 72 dB  
0.2 - 0.3 low  
MI Harmonic - 2 29 - 30%,  
67 - 70 dB 가

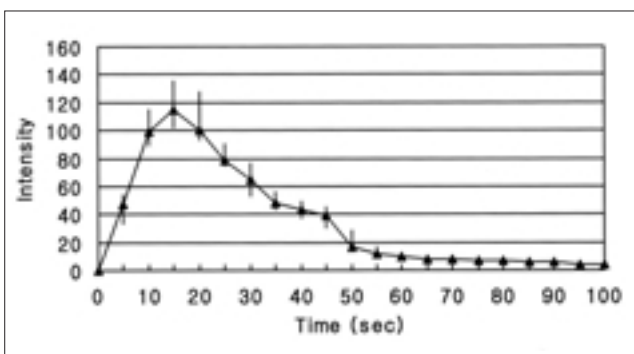
가  
가 ( 1: 200 mg/ml  
, 2: 200 mg/ml  
, 3: 300 mg/ml  
, 4: 300 mg/ml  
, 5: 400 mg/ml  
, 6: 400 mg/ml  
)  
3 10 2 ,



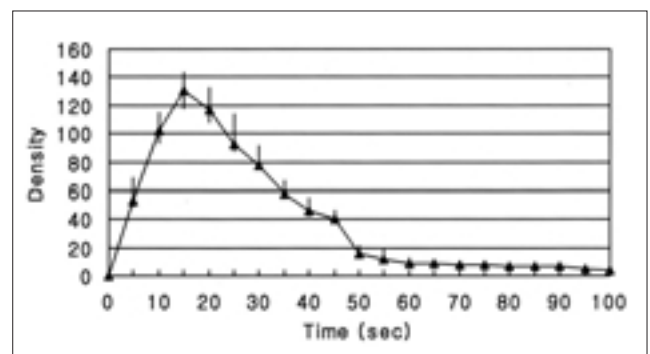
**Fig. 1.** The summated curve of <sup>99m</sup>Tc-DTPA renal perfusion from twenty rabbits reveals  $6.3 \pm 0.9$  seconds of  $T_{peak}$  and  $321.54 \pm 41.8$  of peak intensity.



**Fig. 3.** Contrast-enhanced harmonic ultrasound renal perfusion study with 200 mg/ml of contrast media and continuous scan (Method 2). The summated curve of time-intensity shows  $35.9 \pm 2.0$  of peak intensity and  $6.5 \pm 1.1$  seconds of  $T_{peak}$ .



**Fig. 2.** Contrast-enhanced harmonic ultrasound renal perfusion study with 200 mg/ml of contrast media and intermittent scan (Method 1). The summated curve of time-intensity shows  $117.2 \pm 9.8$  of peak intensity and  $13.8 \pm 1.6$  seconds of  $T_{peak}$ .

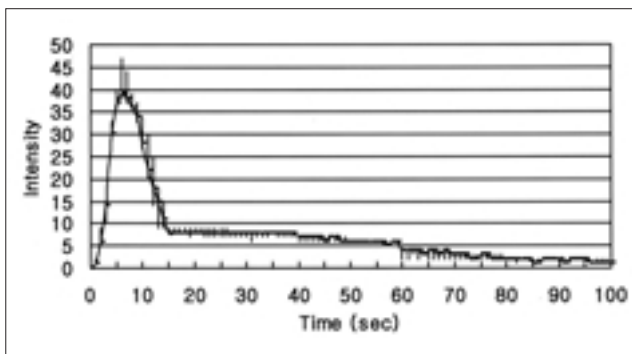


**Fig. 4.** Contrast-enhanced harmonic ultrasound renal perfusion study with 300 mg/ml of contrast media and intermittent scan (Method 3). The summated curve of time-intensity shows  $130.9 \pm 8.1$  of peak intensity and  $14.8 \pm 1.7$  seconds of  $T_{peak}$ .

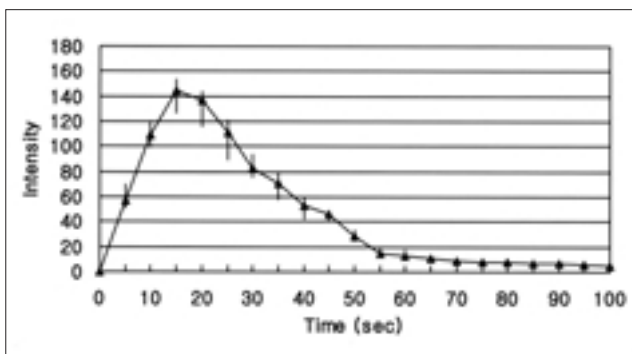
3

QuantiCon (GE Medical System, Milwaukee, Wisconsin, U.S.A.)  
 $^{99m}\text{Tc}$ -DTPA (time-intensity curve) 가 (time peak,  $T_{\text{peak}}$ )  
 $^{99m}\text{Tc}$ -DTPA 가  $T_{\text{peak}}$   
 Spearman correlation analysis

$^{99m}\text{Tc}$ -DTPA sec, 321.5  $\pm$  41.8 (CTS)  $T_{\text{peak}}$  6.3  $\pm$  0.9 (Fig. 1).  
 6가



**Fig. 5.** Contrast-enhanced harmonic ultrasound renal perfusion study with 300 mg/ml of contrast media and continuous scan (Method 4). The summated curve of time-intensity shows  $39.2 \pm 3.2$  of peak intensity and  $6.6 \pm 1.0$  seconds of  $T_{\text{peak}}$ .



**Fig. 6.** Contrast-enhanced harmonic ultrasound renal perfusion study with 400 mg/ml of contrast media and intermittent scan (Method 5). The summated curve of time-intensity shows  $144.9 \pm 13.7$  of peak intensity and  $15.2 \pm 2.0$  seconds of  $T_{\text{peak}}$ .

(Fig. 2 - 7).

		$T_{\text{peak}}$	
가 200, 300, 400 mg/ml		117.2 $\pm$ 9.8	13.8
$\pm 1.6$ sec, 130.9 $\pm$ 8.1		14.8 $\pm$ 1.7 sec, 144.9 $\pm$ 13.7	15.2
$\pm 2.0$ sec			
$T_{\text{peak}}$ 가 200, 300, 400 mg/ml			
35.9 $\pm$ 2.0		6.5 $\pm$ 1.1 sec, 39.2 $\pm$ 3.2	6.6 $\pm$ 1.0 sec, 40.3
$\pm 5.0$		6.4 $\pm$ 0.7 sec	
$^{99m}\text{Tc}$ -DTPA		$T_{\text{peak}}$	
1	6	0.6067 ( $p=0.0046$ ), 0.7504 ( $p=0.0001$ ),	
		0.6977 ( $p=0.0006$ ), 0.7349 ( $p=0.0002$ ), 0.6199 ( $p=$	
		0.0036), 0.8017 ( $p=0.0001$ )	400 mg/ml
			6 가

(Table 1).

Gramiak Shah

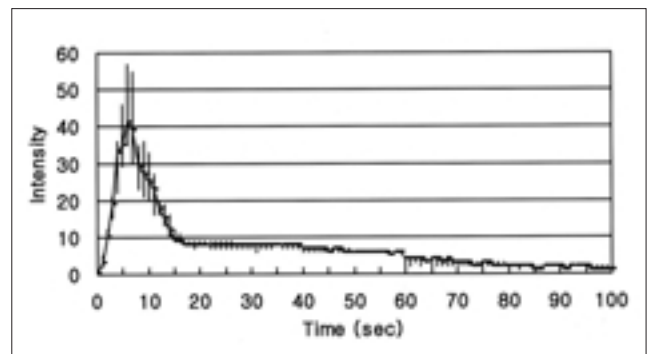
가 (10). SH U 508A  
 (galactose)

**Table 1.** Correlation Coefficient of Perfusion Intensity and Time Peak ( $T_{\text{peak}}$ ) between  $^{99m}\text{Tc}$ -DTPA Renal Perfusion Image and Harmonic Ultrasound Renal Perfusion Image Using Microbubble Contrast Media

	Intensity	$T_{\text{peak}}$ (sec)	Correlation coefficient
Method 1	117.2 $\pm$ 9.8	13.8 $\pm$ 1.6	0.6067 ( $p=0.0046$ )
Method 2	35.9 $\pm$ 2.0	6.5 $\pm$ 1.1	0.7504 ( $p=0.0001$ )
Method 3	130.9 $\pm$ 8.1	14.8 $\pm$ 1.7	0.6977 ( $p=0.0006$ )
Method 4	39.2 $\pm$ 3.2	6.6 $\pm$ 1.0	0.7349 ( $p=0.0002$ )
Method 5	144.9 $\pm$ 13.7	15.2 $\pm$ 2.0	0.6199 ( $p=0.0036$ )
Method 6	40.3 $\pm$ 5.0	6.4 $\pm$ 0.7	0.8017 ( $p=0.0001$ )

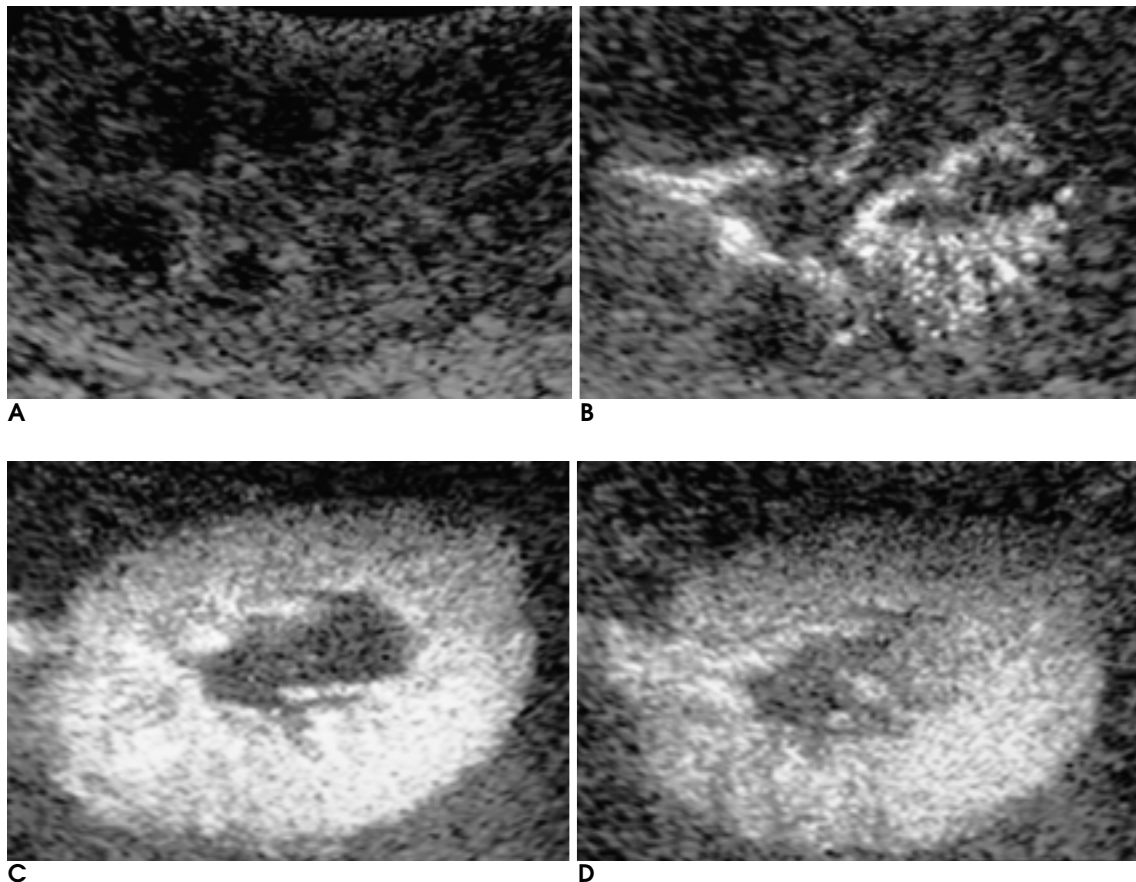
$^{99m}\text{Tc}$ -DTPA: Peak Intensity; 321.54  $\pm$  41.89 (counts)

$T_{\text{peak}}$ ; 6.3  $\pm$  0.9 (sec)



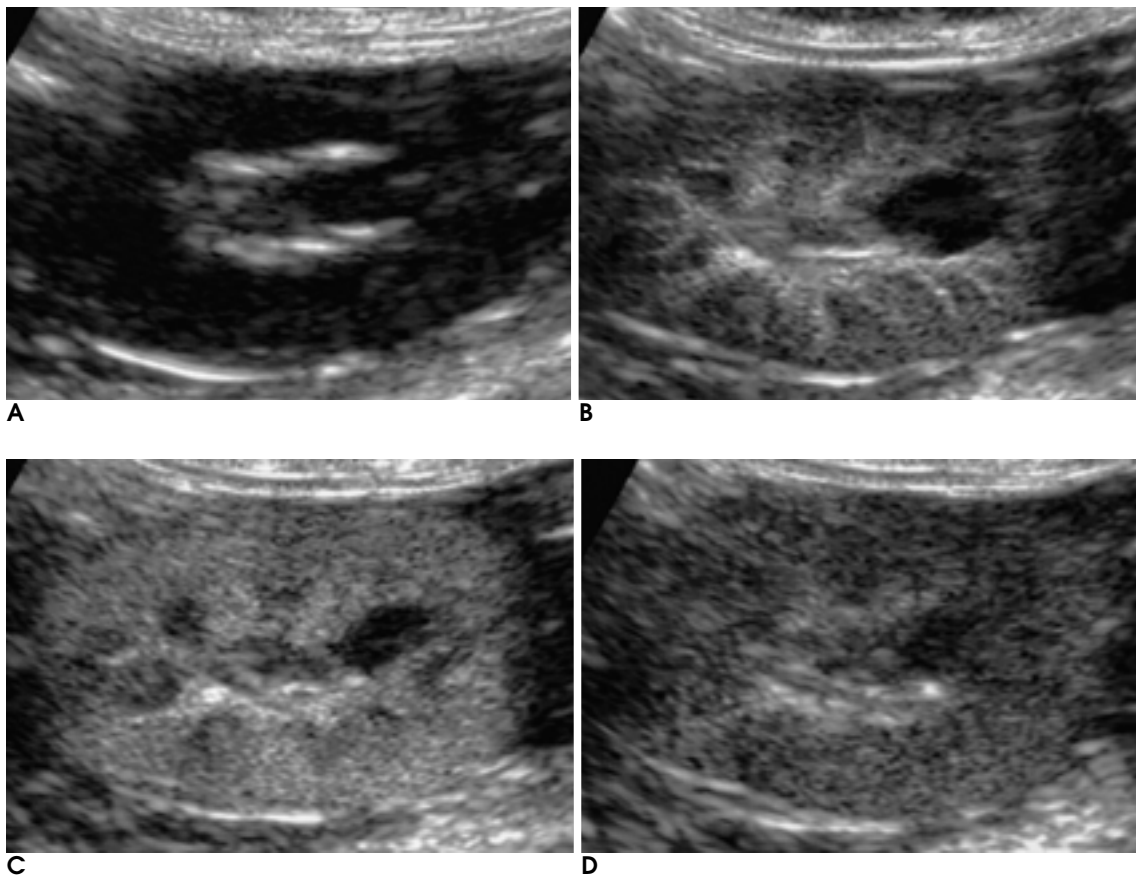
**Fig. 7.** Contrast-enhanced harmonic ultrasound renal perfusion study with 400 mg/ml of contrast media and continuous scan (Method 6). The summated curve of time-intensity shows  $40.3 \pm 5.0$  of peak intensity and  $6.4 \pm 0.7$  seconds of  $T_{\text{peak}}$ .

(palmitic acid, 0.1%)  
2  
10 μm  
(blood pool agent), 1-4  
(beam)  
2-10 MHz  
10-25 dB  
(11-13).  
(14)  
scale)  
Schmiedl (15)  
(16).  
Pugh (17)  
(400 mg/ml)  
(blooming artifact)  
shift artifact)  
(Doppler  
(fundamental)  
CHA US  
B-flow  
(coded harmonic imaging technique)  
CHA US



**Fig. 8.** Contrast-enhanced harmonic ultrasound renal perfusion study with 400 mg/ml of contrast media and intermittent scan (Method 5). Serial contrast-enhanced harmonic ultrasound renal perfusion images obtained (A) before injection of the contrast agent, (B) 5 seconds, (C) 15 seconds and (D) 25 seconds after injection show well visualization of renal vascular tree with homogeneous strong parenchymal enhancement.

가 , , 가 10 0.2 - 0.3 가 가  $^{99m}\text{Tc}$ -DTPA 가 CHA US Otsuki 가 , 가 (18, 19), (20). ( , stimulated acoustic emission image) , (vascular phase image)  $^{99m}\text{Tc}$ -DTPA



**Fig. 9.** Contrast-enhanced harmonic ultrasound renal perfusion study with 400 mg/ml of contrast media and continuous scan (Method 6). Serial contrast-enhanced harmonic ultrasound renal perfusion images obtained **(A)** before injection of the contrast agent, **(B)** 4 seconds, **(C)** 6 seconds and **(D)** 12 seconds after injection show well visualization of renal vascular tree with homogeneous weak parenchymal enhancement.

가 (400 mg/ml)

가 <sup>99m</sup>Tc-DTPA

가

7 - 10

MHz 가

CHA US 2 - 4 MHz 가

SH U 508 A

가

가

(perfluoro chemical)

가

<sup>99m</sup>Tc-DTPA

<sup>99m</sup>Tc-DTPA

가

GE Ultrasound Korea

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## The Study of Renal Perfusion Image in Rabbit by Harmonic Ultrasound with Microbubble Contrast Agent in Comparison with $^{99m}\text{Tc}$ -DTPA: Focusing on US Scan Technique and Concentration of Contrast Agent<sup>1</sup>

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**Purpose:** To compare the results of harmonic ultrasound (US) renal perfusion imaging using  $^{99m}\text{Tc}$ -DTPA as contrast agent with those obtained when a microbubble contrast medium was used.

**Materials and Methods:** Twenty rabbits underwent harmonic US renal perfusion imaging using  $^{99m}\text{Tc}$ -DTPA as contrast agent, and the imaging procedure was then repeated using a microbubble contrast medium. Three different concentrations of contrast media (200, 300 and 400 mg/ml) and two different scanning techniques (intermittent and continuous) were used, and the images obtained were assessed using six different methods. By means of a computer program, the images were converted to a renal perfusion curve and  $T_{\text{peak}}$  values were calculated. Images obtained after use of the two different contrast media were compared.

**Results:**  $T_{\text{peak}}$  at renal perfusion imaging using  $^{99m}\text{Tc}$ -DTPA was  $6.3 \pm 0.9$  sec, and where microbubble contrast agent was used, the findings were as follows:  $13.8 \pm 1.6$  sec (method 1),  $6.5 \pm 1.1$  sec (method 2),  $14.8 \pm 1.7$  sec (method 3),  $6.6 \pm 1.0$  sec (method 4),  $15.2 \pm 2.0$  sec (method 5),  $6.4 \pm 0.7$  sec (method 6). Method 6 had the highest correlation coefficients.

**Conclusion:** In conclusion, the harmonic ultrasound renal perfusion images acquired using  $^{99m}\text{Tc}$ -DTPA were similar to those obtained using microbubble contrast agent. Continuous scanning techniques showed correlation.

**Index words :** Ultrasound (US), contrast media  
Kidney, radionuclide studies

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