

16

:

1

. . . .

: 16 CT (CT coronary angiography, CTCA)

: 36 16 CT (SOMATOM Sensation, Siemens Medical System) CTCA 가 70

18 , 71 18 30% - 80% 5% 11 , 396

8 ((LM), (p-LAD, p-LCx) (m-LAD, m-LCx) , , (p-RCA, m-RCA, d-RCA) 가 .

: 가 70

LM, LAD, LCx 60% - 70%, RCA 55% - 65% , 71

LM, LAD, LCx 60% - 70%, RCA 30% - 40% 65% - 70% .

가 70

71 LM: 100%, 83%; p-LAD: 100%, 88%; m-LAD: 100%, 72%; p-LCx: 100%, 72%; m-LCx: 100%, 72%; p-RCA: 94%, 72%; m-RCA: 61%, 50%; d-RCA: 100%, 88% .

: 16 CT , 70

RCA .

60% - 70% ,

71 RCA가 .

1999 CT (Multidetector CT, MDCT)가 가 CTCA

(1). MDCT 16 MDCT CTCA

가 ,

(CT coronary angiography, CTCA) 가 .

MDCT

CTCA

(2-5). 16 MDCT 2003 1 2003 8

4 MDCT 36 CTCA .

1 CT 가 22 , 가 14 ,

2003 . 48 . CT

2004 6 9 2004 10 27 . 23 - 79

ECG 45 - 97); 1 ,
 70 4 5
 70 18 가 (Fig. 1).
 45 - 70 , 5 - 70 71
 15 8.3 . 71 18 , 11
 가 71 - 97 , (30% - 80%)
 3 - 64 18.9 . CT .
 11
 16 MDCT (SOMATOM Sensation, Siemens Medical System, Germany) , 12 × 0.75 mm, 420 ms, 360 table feed 70 71
 2.8 mm . 18 .
 80 ml
 (Omnipaque 300; Nycomed, Cork, Ireland) 4 ml
 20 ml 4 ml
 bolus tracking
 100 HU가 6 LM LAD, LCx
 , 60% - 70% 가
 . 가 70
 (Syngo, Software Version A50 or A60, Siemens Medical System) 3.8 - 4.3 (Table 1), 71 3.3 - 4.2
 R R 30% (Table 2). RCA 가 70
 80% 5% 11 55% - 65% 2.9 - 4.6
 (partial reconstruction technique) , (Table 1), 71
 가 65 (single - segment reconstruction) 2.8 - 3.8 , 2.8 - 3.6
 reconstruction) 180 210 msec (Table 2).
 , 65 4
 가 (multisegment reconstruction) Table 3 .
 105 - 210 msec 85% 4 , m - RCA
 396 83% - 94% , m - RCA 56%
 (Wizard, Siemens) (multiplanar reformation) 94% - 100% 4 , 71
 가 75%, m - RCA 72% - 88%
 . American Heart Association 15 . m - RCA
 8 ((left 61% 50% 4 (Table 3).
 main coronary artery, LM),
 (proximal left anterior descending coronary artery, p - LAD; proximal left circumflex coronary artery, p - LCx) (middle left anterior descending coronary artery, m - LAD; middle left circumflex coronary artery, m - LCx) , , ,
 (proximal, middle, and distal right coronary artery, p - RCA, m - RCA, d - RCA) (6).
 5 ; 5 ,
 (가 가
); 4 , (가 가
); 3 , (가 가
); 2 , (가 가
 MDCT
 4 MDCT
 가
 (2 - 4, 7). MDCT가
 가 가
 가 가
 가 가
 16 MDCT
 64 MDCT가
 16 MDCT 4 MDCT 500

msec 370 - 420 msec

가 4

16

가

30 - 40

20

, 4

MDCT

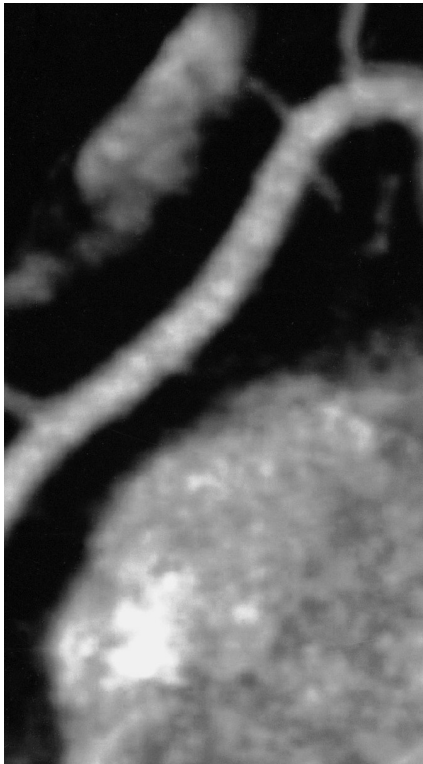
16

MDCT

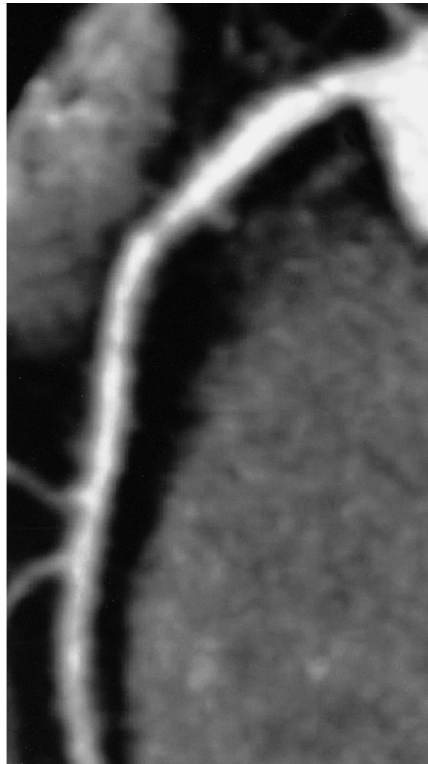
가 0.6×0.6×1.0 mm

(8)

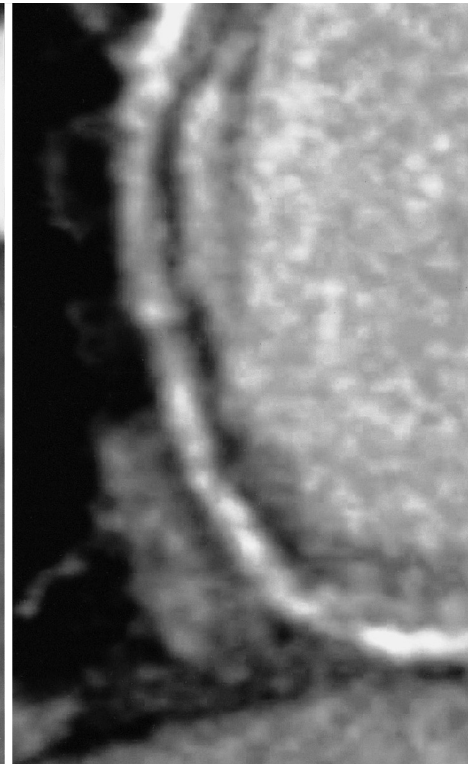
0.5 - 0.75 mm



A



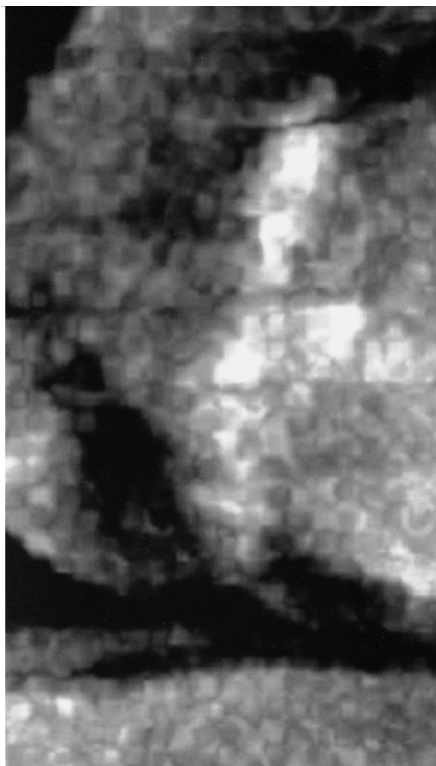
B



C



D



E

Fig. 1. Grading of the image quality of CT coronary angiography using a five point grading scale. Five different images are illustrated to demonstrate five grades of image quality. CT coronary angiography shows little motion artifact (5 points) (A); mild blurring of vascular margin (4 points) (B); moderate blurring of vascular margin (3 points) (C); doubling and discontinuity in the course of the coronary segments (2 points) (D); vessel structure not differentiable (1 point) (E). Image quality of 4 or 5 points was regarded as diagnostic image quality.

가

125 - 250 msec

92 - 210 msec

Ritchie

CT

가 Z 가 가

0.5×0.5×0.6 mm 가 가 (9).

Table 1. Relationship between Image Quality and Reconstruction Windows in the Patients with a Mean Heart Rate of 70 Beats per Minute or Less

Coronary Segments	Image Reconstruction Window* with Image Quality [†] (Mean Score of Image Quality)										
	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%
LM	2.6	2.4	2.5	3.0	3.3	3.8	4.3	4.3	4.1	3.5	3.5
p-LAD	2.6	2.7	2.9	3.1	3.3	3.7	4.3	4.1	3.8	3.7	3.5
m-LAD	2.7	2.6	2.7	3.2	3.3	3.7	4.3	4.2	4.0	3.4	3.3
p-LCx	2.7	2.6	2.7	3.2	3.3	3.7	4.3	4.2	4.0	3.4	3.3
m-LCx	2.6	2.2	2.4	2.7	3.1	3.8	4.3	4.3	3.8	3.3	2.8
p-RCA	2.7	2.1	1.9	2.2	3.0	3.5	3.8	3.7	3.0	2.6	2.5
m-RCA	2.5	2.0	2.0	2.2	2.4	2.9	3.2	3.4	2.8	2.3	2.1
d-RCA	3.1	2.8	2.9	3.0	3.5	4.3	4.6	4.3	3.4	3.1	3.3

* Position of center of image reconstruction window relative to R wave-to-R wave interval.

[†] 5-point scale : 4 or 5 points are considered as diagnostic image quality.

Bold numerics indicate three highest scores of image quality in each segment

p- : proximal, m- : middle, d- : distal

LM : left main coronary artery, LAD : left anterior descending coronary artery

LCx : left circumflex artery, RCA : right coronary artery

Table 2. Relationship between Image Quality and Reconstruction Windows in the Patients with a Mean Heart Rate of More than 70 Beats per Minute

Coronary segments	Image Reconstruction Window* with Image Quality [†] (Mean Score of Image Quality)										
	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%
LM	3.3	2.9	2.8	2.9	3.1	3.2	3.6	3.6	4.1	3.3	2.9
p-LAD	3.3	3.0	2.9	2.9	3.0	3.2	3.4	3.4	4.1	3.0	3.0
m-LAD	3.3	3.1	3.0	2.7	2.9	3.1	3.4	3.5	4.2	2.9	2.9
p-LCx	3.2	2.8	2.7	2.6	2.8	3.1	3.6	3.6	3.9	3.0	2.8
m-LCx	3.0	3.0	2.7	2.5	2.8	3.0	3.6	3.3	3.9	2.9	2.6
p-RCA	3.5	2.9	3.0	2.8	2.7	2.7	2.8	3.3	3.6	2.4	2.8
m-RCA	3.5	2.8	2.7	2.4	2.2	2.3	2.6	2.8	3.3	2.1	2.0
d-RCA	2.9	3.6	3.5	3.3	3.2	3.3	3.3	3.0	3.8	2.8	2.8

Note - *,[†], bold numerics, abbreviations : See table 1

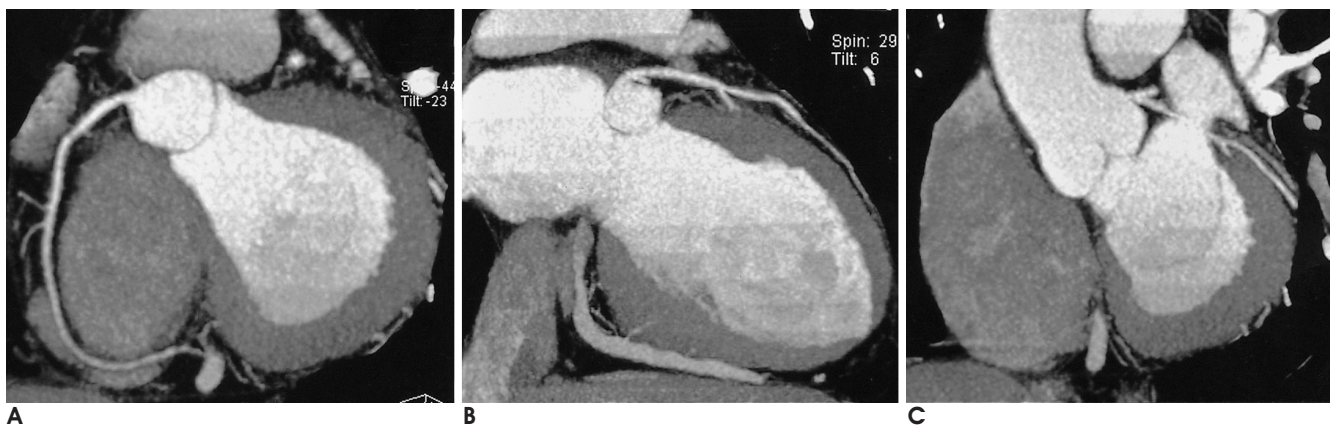


Fig. 2. Normal CT coronary angiography in a 54-year-old man with a mean heart rate of 53 beats per minute. CT coronary angiography reconstructed at 65% of the cardiac cycle clearly demonstrates normal right (A), left anterior descending (B), and left circumflex (C) coronary arteries.

Table 3. Diagnostic Visibility of Each Coronary Segments in 16-Slice Multi-Detector Row CT Coronary Angiography

Coronary artery	Percentage of Patients with Diagnostic Image Quality*		
	Total	BPM ≤ 70	BPM > 70
LM	92%	100%	83%
p-LAD	94%	100%	88%
m-LAD	86%	100%	72%
p-LCx	86%	100%	72%
m-LCx	86%	100%	72%
p-RCA	83%	94%	72%
m-RCA	56%	61%	50%
d-RCA	94%	100%	88%
Total	85%	94%	75%

Abbreviations : See table 1

Total : total patients

BPM ≤ 70 : patients with a mean heart rate of 70 beats per minute or less

BPM > 70 : patients with a mean heart rate of more than 70 beats per minute

* Image quality of 4 or 5 points

19 msec (10), MDCT MDCT CTCA 가 , ECG P R R msec , R 30% - 80% R - R 40% - 70% (cineangiography) CT , RCA LCX (atrioventricular groove) LAD (11, 12). 가 (2, 4, 7). Koppe (4) LAD 60% - 70% LCX 50%, RCA 40% LAD 50% - 60%, LCX 60%, RCA 50%

(7), , RCA가 LAD LCx RCA 가 가 가 가 T P RCA , Giesler 가 , 가 70 70 가 가 가 60 - 65% (single - segment reconstruction) 70 4 MDCT 가 250 msec 16 MDCT 210 LCX RCA 가 . 가 . 가 . 16 MDCT 4 MDCT (2, 3). 4 71 - 74% 85% 가 70 94% , Nieman (5) 가 70 RCA RCA가 (3, 5), RCA가 (12, 13). , RCA Achenbach (14)

CTCA 가 8 (cone beam artifact) 가

CT , 16 가 , 12 가

16 MDCT 가 (5).

4 MDCT 가 , Schroeder (3) 가 65 , Giesler (2) 가 70 70 Hong (7) 가 74.5 , CTCA . 16 MDCT 4 MDCT 70 16 MDCT 가 CTCA 16 MDCT 70 CTCA 93% 가 (95%) (86%) (5).

MDCT CTCA (partial reconstruction technique) 가 65 (single - segment reconstruction) , 180 420 msec 16 MDCT 210 msec가 (3, 8, 15). 가 (multisegment 16 MDCT reconstruction) 105 - 210 msec가 가 71 70 가 12 16 MDCT CT ,

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16-Slice Multi-Detector Row CT Coronary Angiography: Image Quality and Optimization of the Image Reconstruction Window¹

Yookyung Kim, M.D., Sung Shine Shim, M.D., Soo Mee Lim, M.D.,
Ji Young Hwang, M.D., Yoon Kyung Kim, M.D.

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

Purpose: The purpose of this experiment is to investigate the image quality of CT coronary angiography using a 16-slice multi-detector row CT and to determine the optimal image reconstruction window.

Materials and Methods: CT coronary angiography was obtained in 36 nonsymptomatic volunteers using a 16-slice multi-detector row CT (SOMATOM Sensation, Siemens Medical System). The mean heart rates were 70 beats per minute (bpm) or less in 18 persons and more than 70 bpm in 18 persons. Eleven data sets were obtained for each patient (reconstructed at 30% - 80% of the cardiac cycle with an increment of 5%). Image quality of the eight coronary segments [left main coronary artery (LM), proximal and middle segments of left anterior descending artery (p-LAD, m-LAD) and left circumflex coronary artery (p-LCx, m-LCx) and proximal, middle and distal segments of right coronary artery (p-RCA, m-RCA, d-RCA)] was assessed.

Results: The optimal reconstruction windows in the cardiac cycle for the best image quality were 60 - 70% for the segments of the LM, LAD, and LC arteries in two groups (bpm < 70, bpm > 70) and 55 - 65% (bpm < 70) or 30 - 40% and 65 - 70% (bpm > 70) for the segments of the RCA. On the best dataset for each coronary segment, the following diagnostic image quality was achieved in the two groups: LM: 100%, 83%; p-LAD: 100%, 88%; m-LAD: 100%, 72%; p-LCx: 100%, 72%; m-LCx: 100%, 72%; p-RCA: 94%, 72%; m-RCA: 61%, 50%; d-RCA: 100%, 88%.

Conclusion: The 16 slice multi-detector row CT scan provided visualization of the coronary arteries with high resolution. Especially in the group with a mean heart rate of 70 bpm or less, all the coronary segments except the RCA showed diagnostic image quality. Optimal image quality was achieved with a 60 - 70% trigger delay for all coronary arterial segments, but the best images of RCA were achieved in the earlier cardiac phase in the patients with a mean heart rate of more than 70 bpm.

Index words : Coronary vessels, CT
Heart, CT

Address reprint requests to : Yookyung Kim, M.D., Department of Radiology, Ewha Womans University MokDong Hospital
911-1 MokDong YangCheon-Ku, Seoul 158-710, Korea.
Tel. 82-2-2650-5174 Fax. 82-2-2650-5071 E-mail: yookkim@ewha.ac.kr