

## 영구형 심박조율기 이식 환자에서 심근 관류와 국소벽운동의 변화

차광수<sup>2</sup> · 민정준<sup>3</sup> · 김주한<sup>1</sup> · 김준우<sup>1</sup> · 김성희<sup>1</sup> · 배 열<sup>1</sup> · 안영근<sup>1</sup> · 박종철<sup>1</sup>  
서정평<sup>1</sup> · 박주형<sup>1</sup> · 정명호<sup>1</sup> · 범희승<sup>3</sup> · 조정관<sup>1</sup> · 박종춘<sup>1</sup> · 강정채<sup>1</sup>

### Alterations in Myocardial Perfusion and Regional Wall Motion in Patients with Permanent Pacemaker

Kwang Soo Cha, MD<sup>2</sup>, Jung Jun Min, MD<sup>3</sup>, Ju Han Kim, MD<sup>1</sup>, Jun Woo Kim, MD<sup>1</sup>,  
Sung Hee Kim, MD<sup>1</sup>, Youl Bae, MD<sup>1</sup>, Young Keun Ahn, MD<sup>1</sup>, Jong Cheol Park, MD<sup>1</sup>,  
Jeong Pyeong Seo, MD<sup>1</sup>, Joo Hyung Park, MD<sup>1</sup>, Myung Ho Jeong, MD<sup>1</sup>, Hee Seung Bom, MD<sup>3</sup>,  
Jeong Gwan Cho, MD<sup>1</sup>, Jong Chun Park, MD<sup>1</sup> and Jung Chae Kang, MD<sup>1</sup>

<sup>1</sup>Department of Cardiology, Chonnam University Hospital, <sup>2</sup>Dong-A University Hospital, Pusan,

<sup>3</sup>Department of Nuclear Medicine, Chonnam University Hospital, Kwangju, Korea

#### ABSTRACT

**Background :** The effect of right ventricular pacing on myocardial perfusion and regional wall motion is not well known, although some studies have suggested that it may be adverse. We investigated the effects of right ventricular pacing on myocardial perfusion and regional wall motion in patients with permanent pacemakers.

**Method :** Thirty patients receiving permanent pacemakers for complete heart block or sick sinus syndrome were included in this study. All the patients showed normal coronary angiograms. Myocardial scintigraphy and two-dimensional echocardiography were performed to assess myocardial perfusion and to evaluate regional wall motion and global function of the left ventricle (LV). **Results :** 1) Mean age was  $66.2 \pm 8.2$  (41 - 84) years, and the male-to-female ratio was 1 : 1.7 (11 male, 19 female). Indications for permanent pacemaker implantation were complete atrioventricular (AV) block in 21 patients and sick sinus syndrome in 9. The selected pacing modes were VVI in 14 patients, DDD in 8, VDD in 6, and AAI in 2. LV ejection fraction estimated by 2-dimensional echocardiography was  $62.7 \pm 5.8$  (53 - 86)%. 2) Perfusion defects were noted in 26 (87%) patients including 25 (89%) out of 28 patients with ventricular pacing modes such as VVI, DDD, and VDD, and 1 (50%) out of 2 patients with AAI mode. Locations of perfusion defects were septal in 19 (63%) patients, inferior in 17 (57%), apical in 16 (53%), lateral in 3 (10%), and anterior in 2 (7%). Extent of maximal perfusion defects was  $17.0 \pm 9.5$  (0 - 44)%. 3) Regional wall motion abnormalities were noted mainly over the apical region of the LV in 26 (93%) of 28 patients with ventricular pacing. However, LV ejection fraction did not differ significantly before and early after implantation of the pacemaker ( $62.7 \pm 5.8\%$  vs.  $61.0 \pm 5.8\%$ ,  $p = 0.313$ ). **Conclusions :** Right ventricular apical pacing frequently caused myocardial perfusion defects and regional wall motion abnormalities. These might be due to abnormal ventricular activation and

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: (062) 220 - 6242 · : (062) 220 - 4760

E - mail : Jeongcho@unitel.co.kr

abnormal interventricular septal motion. The long-term effects of these abnormalities remain to be determined, and the pacing technique to minimize these adverse effects should be developed. (**Korean Circulation J 1988;28(4):506-515**)

**KEY WORDS** : Myocardial perfusion · Regional wall motion · Right ventricular pacing.

1 .

서 론

영구형 심박조율기 이식술

가 , 가

1)2) 0.5 ms 1.0 V 가 4 mV , 5 V 400 1000

3-5) ohms , J 가

가 0.5 ms 1.0 V 가

6-8) 1.5 mV , 5 V 400 1000

ohms .

9) 3.5 V( : 0.4 ms) 60 70

SPECT 약물부하 심근관류 SPECT 및 영상 분석

가 . 12±5

3 201Tl , 27 99mTc - MIBI

99mTc - TF (0.14

mg/Kg/min 4 ) 10)

11)

대 상

1996 3 1997 2

39 30 가

( 11 19 , 66.2±8.2 )

1 가 100%

50% (pixel)가

(%) 가

심초음파검사 및 국소벽운동의 평가

Ultramark 9(ATL, USA) 2.25

MHz 3 ± 1 5 ± 3 AAI (Table 1).

가 심근 SPECT 소견

(basic rhythm) (escape rhythm) 가 28 26 (87%) ,

가 26 19 (63%),

16 17 (57%), 16 (53%), 3

(asynchronous contract - (10%), 2 (7%) .

ion) (endocardial motion) 17.0 ± 9.5% (0 44%) (Table

(systolic wall thickening)가 1, Figs. 1 - 3).

(wall mo -

tion) 가 .<sup>12)13)</sup> (hypokinesis) 심초음파검사 소견

가

28 26 (93%)

가

(62.7 ± 5.8% vs. 61.0 ± 5.8%, p = 0.313, Table 1).

관상동맥 조영술

## 고 안

Judkin

50%

26 (87%), 28 25 (89%)

(63%), (57%),

(53%)

(93%)

분 석

± , paired

t - test p ,

0.05 .<sup>14 - 17)</sup> Vad -

uganathan 가

## 결 과

대상 환자의 임상적 특징

11 19 ,

66.2 ± 8.2 (41 84) . (asynchronous)

21 , 9 . 7 .

, 1 .

62.7 ± 5.8% (53 86%) .

14 VVI , 8 DDD , 6 VDD , 2

**Table 1.** Patient characteristics and distributions of perfusion defects and wall motion abnormalities

| No | Sex | Age | Diagn<br>osis | PM<br>type | EFpre<br>(%) | EFpost<br>(%) | Wall motion abnormalities |    |    |    |     | Perfusion defects |    |     |     |        | Extent of<br>defects | Comments |     |        |
|----|-----|-----|---------------|------------|--------------|---------------|---------------------------|----|----|----|-----|-------------------|----|-----|-----|--------|----------------------|----------|-----|--------|
|    |     |     |               |            |              |               | AA                        | AS | AI | AL | MAS | MIS               | MI | MPL | ant | apical |                      |          | inf | septal |
| 1  | M   | 78  | CAVB          | VDD        | 69           | 53            | -                         | H  | H  | -  | -   | H                 | H  | -   | -   | RD     | RD                   | -        | 10  | HT     |
| 2  | F   | 75  | CAVB          | VVI        | 86           | 63            | H                         | H  | H  | -  | -   | H                 | -  | RD  | -   | RD     | RD                   | -        | 10  |        |
| 3  | M   | 56  | SSS           | VVI        | 67           | 71            | -                         | H  | H  | -  | -   | H                 | H  | -   | -   | RD     | RD                   | -        | 27  |        |
| 4  | F   | 74  | CAVB          | VVI        | 60           | 67            | -                         | H  | H  | -  | -   | H                 | H  | -   | -   | RD     | RD                   | -        | 27  |        |
| 5  | M   | 70  | CAVB          | VDD        | 66           | 56            | -                         | H  | H  | -  | -   | H                 | H  | -   | -   | RD     | RD                   | -        | 31  | HT     |
| 6  | M   | 74  | CAVB          | DDD        | 65           | 67            | -                         | H  | H  | H  | -   | H                 | H  | H   | -   | FD     | RD                   | -        | 33  |        |
| 7  | M   | 54  | SSS           | VVI        | 75           | 60            | -                         | H  | H  | -  | -   | H                 | H  | RD  | -   | RD     | -                    | 11       |     |        |
| 8  | F   | 41  | SSS           | DDD        | 65           | 68            | -                         | H  | H  | -  | H   | H                 | -  | -   | RD  | -      | RD                   | -        | 18  |        |
| 9  | M   | 71  | CAVB          | VVI        | 63           | 69            | -                         | H  | H  | -  | -   | -                 | -  | -   | -   | RD     | RD                   | -        | 27  |        |
| 10 | M   | 47  | CAVB          | VDD        | 53           | 50            | H                         | H  | H  | -  | -   | H                 | -  | FD  | -   | RD     | RD                   | -        | 20  |        |
| 11 | M   | 75  | SSS           | VVI        | 60           | 58            | -                         | H  | H  | -  | -   | -                 | -  | RD  | -   | RD     | RD                   | -        | 21  |        |
| 12 | F   | 68  | CAVB          | DDD        | 73           | 65            | -                         | -  | -  | -  | -   | -                 | -  | -   | -   | -      | -                    | -        | 0   |        |
| 13 | F   | 72  | CAVB          | VVI        | 78           | 56            | -                         | H  | -  | -  | -   | -                 | -  | RD  | -   | -      | -                    | -        | 6   |        |
| 14 | F   | 67  | CAVB          | VDD        | 60           | 52            | -                         | H  | -  | -  | -   | -                 | -  | -   | -   | FD     | -                    | -        | 11  |        |
| 15 | F   | 84  | CAVB          | VVI        | 60           | 58            | -                         | H  | H  | -  | -   | -                 | -  | -   | -   | -      | -                    | -        | 0   |        |
| 16 | F   | 71  | CAVB          | VDD        | 59           | 59            | -                         | H  | -  | -  | -   | -                 | -  | RD  | -   | -      | -                    | -        | 9   |        |
| 17 | F   | 68  | CAVB          | VVI        | 59           | 55            | H                         | H  | H  | -  | -   | H                 | H  | FD  | -   | FD     | RD                   | -        | 33  |        |
| 18 | M   | 54  | CAVB          | DDD        | 53           | 50            | -                         | H  | H  | -  | -   | -                 | -  | -   | -   | RD     | RD                   | -        | 20  |        |
| 19 | F   | 74  | CAVB          | VDD        | 58           | 57            | H                         | H  | H  | H  | -   | H                 | H  | RD  | -   | RD     | RD                   | -        | 39  | HT,DM  |
| 20 | F   | 74  | SSS           | VVI        | 53           | 55            | -                         | H  | H  | -  | -   | -                 | -  | -   | -   | -      | -                    | -        | 0   |        |
| 21 | F   | 43  | SSS           | AAI        | 63           | 68            | -                         | -  | -  | -  | -   | -                 | -  | -   | -   | -      | -                    | -        | 0   |        |
| 22 | F   | 66  | SSS           | AAI        | 53           | 73            | -                         | -  | -  | -  | -   | -                 | -  | RD  | -   | -      | RD                   | -        | 5   |        |
| 23 | F   | 71  | CAVB          | VVI        | 58           | 65            | -                         | H  | H  | -  | -   | -                 | -  | -   | -   | RD     | RD                   | -        | 17  |        |
| 24 | M   | 75  | CAVB          | VVI        | 62           | 60            | -                         | H  | H  | -  | -   | -                 | -  | -   | -   | RD     | RD                   | -        | 23  |        |
| 25 | F   | 72  | SSS           | VVI        | 60           | 67            | -                         | H  | H  | -  | -   | H                 | -  | -   | -   | RD     | RD                   | -        | 15  |        |
| 26 | F   | 64  | CAVB          | VVI        | 57           | 56            | -                         | H  | H  | -  | -   | -                 | -  | -   | -   | RD     | RD                   | -        | 13  | HT     |
| 27 | F   | 69  | CAVB          | DDD        | 58           | 53            | H                         | H  | -  | H  | -   | H                 | -  | RD  | -   | -      | RD                   | RD       | 18  | HT     |
| 28 | M   | 63  | CAVB          | DDD        | 66           | 68            | H                         | H  | H  | -  | -   | -                 | H  | -   | -   | FD     | RD                   | -        | 7   | HT     |
| 29 | F   | 57  | SSS           | DDD        | 65           | 67            | -                         | -  | -  | -  | -   | -                 | -  | -   | -   | -      | -                    | -        | 6   |        |
| 30 | F   | 60  | CAVB          | DDD        | 58           | 60            | H                         | H  | -  | -  | -   | -                 | -  | RD  | FD  | -      | -                    | -        | 22  |        |

PM : pacemaker, EFpre (%) & EFpost (%) : ejection fraction before and after implantation, CAVB : complete atrioventricular block, SSS : sick sinus syndrome, AA : apical anterior wall, AS : apical septal wall, AI : apical inferior wall, AL : apical lateral wall, MAS : mid anterior septum, MIS : mid inferior septum, MI : mid inferior wall, MPL : mid posterolateral wall, H : hypokinesis, RD : reversible defect, FD : fixed defect, - : normal wall motion or perfusion, HT : hypertension, DM : diabetes mellitus

(homogenous)

3-5)

가

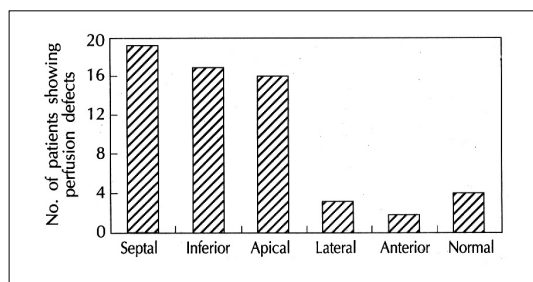
20)

가

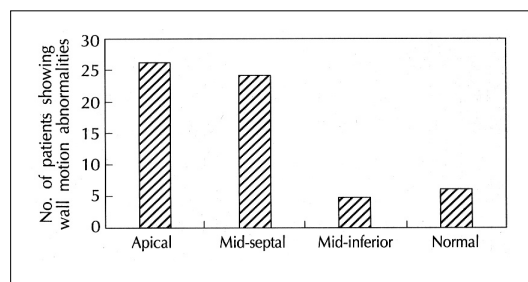
6-8)

(cardiac performance)

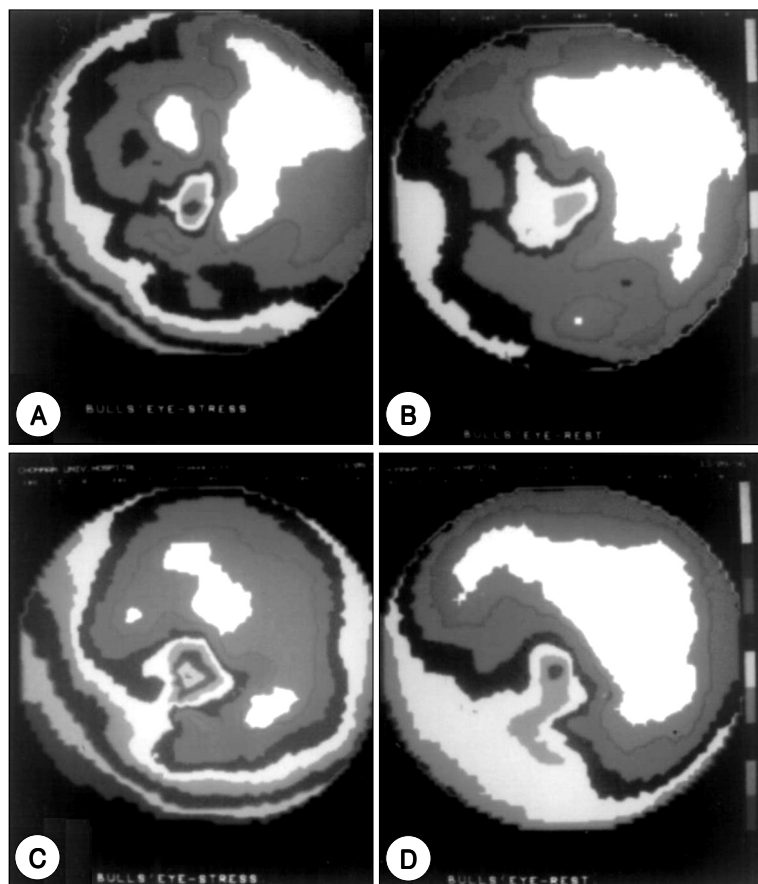
23)



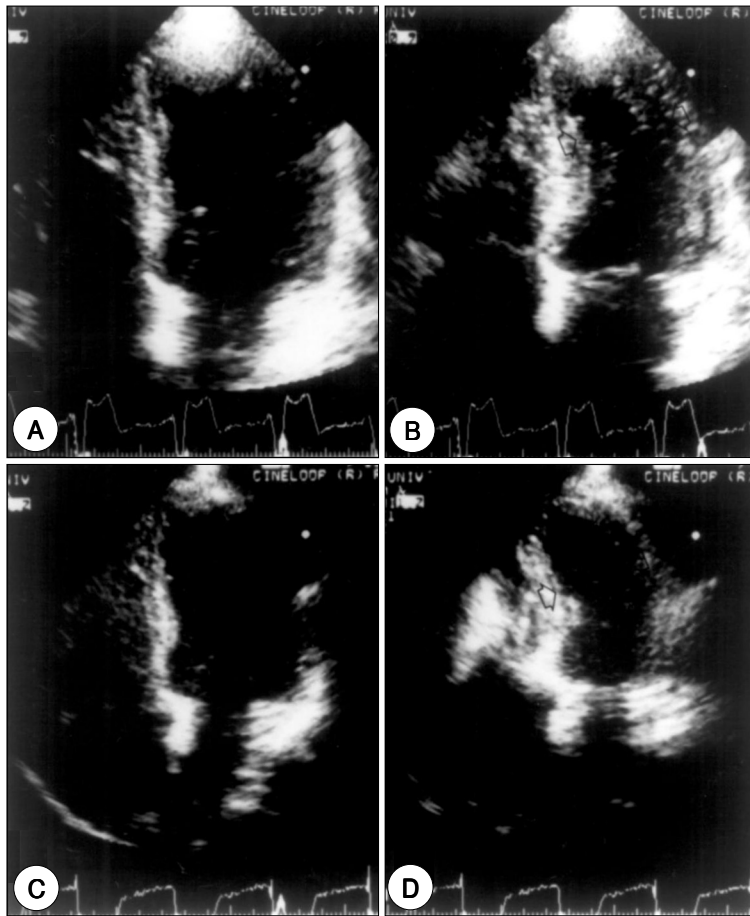
**Fig. 1.** Distribution of myocardial perfusion defects on SPECT after permanent pacemaker implantation.



**Fig. 2.** Distribution of wall motion abnormalities after permanent pacemaker implantation.



**Fig. 3.** An example of post-pacing myocardial perfusion defects. A small fixed perfusion defect is appreciated in the apex (A & B). A small fixed perfusion defect in the apex and a large reversible defect in the inferoseptal wall are noted (C & D).



**Fig. 4.** An example of post-pacing regional wall motion abnormalities. Hypokinesia are noted on the apical and mid septum (A & B), apical and mid septum and lateral wall (C & D).

eled 2 - fluoro - 2 - deoxy - D - glucose(FDG)  
(uptake)  
가 (2)24) 가 ( $^{201}\text{Tl}$  ;  $74.7 \pm 14.5\%$  vs.  $86.5 \pm 5.3\%$ , FDG ;  $67.4 \pm 12.1\%$  vs.  $88.0 \pm 5.2\%$ ,  $p < 0.05$  respectively). Wakakura <sup>25)</sup> DDD  
가 5.8 (1 28 )  
SP - ECT (atrioventricular seq -  
quential pacing) 10 8 (80%) ,  
가 Tse <sup>9)</sup> 43 9 6 (67%)  
28 (65%)  
( $43.9 \pm 49.7$  vs.  $20.1 \pm 9.8$  months,  $p = 0.053$ ). Lee <sup>6)</sup>  
14 7 5 ( 70%)  
. Ono <sup>19)</sup> 17  
1  $^{201}\text{Tl}$  18F - lab - ( $17.0 \pm 9.5\%$  [5 44%])

(40 ± 16% vs. 67 ± 7%) 가

. Fu<sup>26)</sup> 가

SPECT가 3 (54 ± 7% vs. 62 ± 5%).

2

7 1 (interventricular asynchrony)

SPECT

(mid - papillary muscle level) Askenazi<sup>28)</sup> 9

.<sup>19)20)</sup> Tse 가

<sup>9)</sup> (78%), (67%), (21%), (23%), (15%), (66%

(7%), (3%), Fu<sup>26)</sup> (10 7 56% 15% )

), (10 1 ) , Abe<sup>27)</sup>

Wa - . Tse<sup>9)</sup> 28

kakura<sup>25)</sup> , , 15 radionuclide

ventriculogram

(48.5 ± 9.9% vs. 59.6 ± 8.9%)

(57% vs.

(63%), (57%), (53%), (10%), 20%, p=0.026), 가

(7%) . (43.9 ± 49.7 vs. 20.1 ± 9.8 months, p =

가 , 0.053). Wakakura<sup>25)</sup> 5.8 (1

가 , SPECT 28 ) 12

(80%) rad -

ionuclide ventriculogram

(63.7 ± 9.1%) ,

Hirzel<sup>20)</sup> Ono (57.8 ± 9.6%

<sup>19)</sup> vs. 55.8 ± 10.0%) 가

<sup>201</sup>Tl Lee<sup>6)</sup> 14

Lee<sup>6)</sup> [I<sup>123</sup>]metaiodobenzylguanidine

가 . Boucher<sup>29)</sup>

AAI (asynchronous)

가 (3 ± 4%)

AAI 2 1 가

가 ,

<sup>6)19)20)</sup> 35%

5% (synchr -

onous) . Xiao<sup>30)</sup>

Grines<sup>22)</sup> 가

radionuclide (incoordinate wall motion)

18

ventriculogram





결 과 :

1) 11 19 ,  
 $66.2 \pm 8.2 (41 \ 84)$  .  
 21 , 9 .  
 7 , 1 .

$62.7 \pm 5.8 (53 \ 86) \%$  . 14  
 VVI , 8 DDD , 6 VDD , 2  
 AAI .

2) 30 26 (87%) ,  
 가 28 25 (89%) .  
 26 19 (63%),  
 17 (57%), 16 (53%), 3  
 (10%), 2 (7%) .  
 $17.0 \pm 9.5 (0 \ 44) \%$  .

3) 28 26  
 (93%) .  
 가  $(62.7 \pm 5.8 \%$   
 vs.  $61.0 \pm 5.8 \%$ ,  $p = 0.313$ ).

결 론 :

가 .

가 .

중심 단어 :

1996

1996

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