

급성 심근 경색 후 좌심실 재구도와 수축기 기능 및 이완기 기능의 변화 : 입원시 Killip 분류에 따른 비교

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Remodeling and Changes of Systolic and Diastolic Functions of Left Ventricle after Acute Myocardial Infarction : Comparison according to Killip Class at Admission

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ABSTRACT

Background : Infarct size determines left ventricular (LV) systolic and diastolic dysfunctions after acute myocardial infarction, and also may affect the recovery from functional impairment. We studied the differences of LV remodeling and changes of systolic and diastolic functions of LV during two weeks after acute myocardial infarction, according to Killip class at admission. **Methods :** Echocardiographic examinations were performed within two days (23.9 ± 2.3 hours), and two weeks after the attack in 27 patients with acute myocardial infarction, and the results were compared with those of 19 controls. Patients were divided into two groups according to Killip class at admission ; 18 patients in Killip class I (group I) and 9 patients in Killip class II to IV (group II). Group II had larger infarct, reflected by higher levels of peak serum cardiac enzymes. **Results :** LV systolic function was more depressed in group II. Regional wall motion score index decreased in group I after two weeks, but not in group II. LV systolic and diastolic volume indexes increased after two weeks in group II but not group I. E/A ratio of mitral inflow was less than 1, and isovolumic relaxation time was prolonged in group I immediately after the attack. Group II had E/A 1 and shorter deceleration time (DT) of mitral inflow, and higher peak reverse flow velocity associated with atrial contraction (AR) of pulmonary venous flow than those of controls immediately after the attack. In group II, E/A ratio was greater, DT was shorter, peak systolic/diastolic flow velocity ratio of pulmonary venous flow was less, and AR was higher than those of controls after two weeks. **Conclusion :** Infarct size affected remodeling and changes of systolic and diastolic functions of LV after acute myocardial infarction. In patients with large infarct, LV was dilated and regional wall motion was not improved during two weeks. Restrictive pattern of LV filling, which was more aggravated during two weeks, was noted immediately after the attack. In patients with small infarct, LV was not dilated and regional wall motion was improved during two weeks. LV filling pattern showed relaxation abnormality. (*Korean Circulation J* 1998;28(10):1727-1739)

KEY WORDS : Myocardial infarction · Left ventricle · Remodeling · Function · Change.

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서 론

대상 및 방법

대상 48

가 (remodeling)가 (myocardial stunning) 2 27

가 가 netium - 99m pyrophosphate scan 17 10

가 가 8 18

가 Killip class I 8 Killip class II, 1

가 Killip class IV Killip

가 (relaxation 2 , Killip class가 I

abnormality) 8-11 I , Killip class가 II II

가 8) 19

가 10) (restriction) 2)12-15 환자군의 치료

가 16-19 Aspirin 250 mg

가 6 atenolol 50 mg

가 20)21) PTCA PT -

가 (pseudonor - PTCA Heparin 48

malization) 21-23

방 법

가 Hewlett - Packard SONOS 1500

Killip

2

가 가 2.5 MHz 2

가 4 disc (modified Simpson's met -

hod) (EDV ; end - diastolic

volume) (ESV ; end - systolic volume) , (E),
²⁴⁾ (EDVI ; end - diastolic volume (A), (DT ; deceleration time)
index) (ESVI ; end - systolic vo - cursor
lume index) EDV ESV ,
(EF ; ejection fraction) (IVRT ; isovolumic relaxation time)
²⁶⁾²⁷⁾

M (LVID ; left
ventricular internal diameter), (IVST ; 4
interventricular septal thickness), (right upper pulmonary vein)
(PWT ; posterior wall thickness) , cursor
²⁵⁾ (LVMI ; left ventr - 0.5 1 cm 가
icular mass index)

$$LVMI(g/m^2) = [1.04 \times \{ (LVID + PWT + IVST)^3 - LVID^3 \} \times 0.8 + 0.6] / BSA$$

(SV ; peak systolic flow velocity), (STVI ; systolic time - velocity integral), (DV ; peak diastolic flow velocity), (DTVI ; diastolic time - velocity integral),

(LV - (AR ; peak reverse flow velocity associated with atrial contraction) ²⁷⁾
OT ; left ventricular outflow tract)
, 5
(TVI ; time - velocity integral)

(SI ; stroke volume index) Student's
(CI ; cardiac index) t - test , chi - square test

$$SI(mL/m^2) = \{ 3.14 \times (LVOT \text{ diameter} / 2) \}^2 \times LVOT_{TVI} / BSA$$

$$CI(L/min/m^2) = SI \times \text{Heart rate} / BSA$$

paired t - test . I , II
Mann - Whitney U test
chi - square test

16 Wilcoxon signed - ranks test
(hypokinesis), window SPSS . p 0.05
(akinesis), (dyskinesis), (ane -
urysm) 1 , 2 , 3 , 4 , 5

(RWSI ; 급성 심근 경색증 환자군내에서 시간 경과에 따른 차이
regional wall motion score index)
(Table 1).

4 cursor

kinase, 7 tPA 1
PTCA II 8 5
, 3 PTCA

가 (p<0.01),

가 가 (p<0.05).

(p<0.01),
가 (p<0.01).
(p<0.05).

E

56.5 ± 18.0 cm/sec

6 ± 22.1 cm/sec 가 (p=0.06). E/A E/A
가 1 가 ,

(p=0.051),
가 (p=0.087),

SV DV

43.1 ± 10.8 cm/sec 32.6 ± 9.5 cm/sec
(p<0.05),

48.4 ± 11.2 cm/sec 39.6 ± 13.2 cm/sec
가 (p<0.05). SV/DV
가 ,

STVI DTVI

SV, DV ,

가 (p<0.05),
가 . AR
가 .

환자군에서 Killip 분류에 따른 차이

I II , , ,
(Table 2). , ,
가 . I
12 (67%) II 8 (89%)
6 . I 12
11 . 4 uro -

Table 1. Comparison of echocardiographic findings between control and AMI groups and between the first and the second studies in AMI group

Control group (n=19)	AMI group (n=27)	
	First*	Second†
Age(yr)	57.8 ± 10.9	59.4 ± 10.8
Male	10 (53%)	20 (74%)
BMI(kg/m ²)	22.0 ± 2.7	23.4 ± 2.7
HR(/min)	65.9 ± 11.7	71.0 ± 17.4
64. 65.3 ± 12.1		
LVMI(gm/m ²)	107.8 ± 21.6	137.4 ± 27.2 [‡]
EDVI(ml/m ²)	51.0 ± 11.5	67.3 ± 16.5 [‡]
ESVI(mL/m ²)	19.5 ± 6.7	34.8 ± 12.8 [‡]
SI(mL/m ²)	46.3 ± 9.3	31.6 ± 8.0 [‡]
CI(L/min/m ²)	3.04 ± 0.72	2.15 ± 0.42 [‡]
EF(%)	62.4 ± 6.4	49.2 ± 9.4 [‡]
RWSI		1.70 ± 0.29
1.60 ± 0.32		
Mitral inflow		
E(cm/sec)	61.5 ± 15.2	56.5 ± 18.0
A(cm/sec)	63.7 ± 12.3	64.0 ± 20.8
E/A ratio	0.99 ± 0.25	1.01 ± 0.60
E/A>1	10 (53%)	11 (41%)
12 (44%)		
DT(msec)	212.6 ± 43.0	186.2 ± 45.2
IVRT(msec)	96.9 ± 21.7	105.7 ± 25.1
110.5 ± 28.6		
Pulmonary venous flow		
SV(cm/sec)	52.0 ± 8.1	43.1 ± 10.8 [‡]
DV(cm/sec)	37.9 ± 7.1	32.6 ± 9.5 [§]
39.6 ± 13.2		
SV/DVratio	1.42 ± 0.36	1.40 ± 0.44
1.30 ± 0.35		
STVI(cm)	4.98 ± 2.77	11.48 ± 4.00 [‡]
13.33 ± 4.11 [¶]		
DTVI(cm)	10.94 ± 2.62	8.25 ± 3.28 [‡]
10.16 ± 3.76		
S/DTVratio	1.46 ± 0.47	1.52 ± 0.58
1.40 ± 0.49		
AR(cm/sec)	20.6 ± 3.2	22.2 ± 4.1
24.1 ± 5.5 [§]		

*The first echocardiographic study was performed within forty eight hours (mean 23.92.3 hours) after the attack

†The second echocardiographic study was performed two weeks after the attack.

‡p<0.01, §p<0.05 vs control group ; p<0.05, ¶p<0.01 vs the first study

A=peak mitral flow velocity at atrial contraction ; AR=peak reverse flow velocity associated with atrial contraction ; BMI=body mass index ; CI=cardiac index ; DT= deceleration time ; DTVI=diastolic time-velocity integral ; DV=peak diastolic flow velocity ; E=peak mitral flow velocity in early diastole ; EDVI=end-diastolic volume index ; EF=ejection fraction ; ESVI=end-systolic volume index ; HR=heart rate ; IVRT=isovolumic relaxation time ; LVMI=left ventricular mass index ; RWSI=regional wall motion score index ; SI=stroke volume index ; STVI=systolic time-velocity integral ; SV=peak systolic flow velocity

2 urokinase , 3 tPA
 .
 II
 78% , I 56% ,
 . II 가
 가 I
 nitrate, , ACE

Table 2. Baseline characteristics of patients with acute myocardial infarction ; Classification according to Killip class at admission

	Group I (n=18)	Group II (n=9)
Age (yr)	60.3 ± 12.3	57.8 ± 7.2
Male	13 (72%)	7 (78%)
BMI (kg/m ²)	23.1 ± 3.1	23.9 ± 1.8
Smoking	14 (78%)	6 (67%)
Hypertension	7 (39%)	1 (11%)
Hypercholesterolemia	10 (56%)	6 (67%)
(Total cholesterol 200 mg/dL)		
Diabetes mellitus	3 (17%)	2 (22%)
Reperfusion therapy	12 (67%)	8 (89%)
Thrombolytic therapy	11	5
Urokinase	4	2
tPA	7	3
Primary PTCA	1	3
Site of infarct		
Anterior wall	10 (56%)	7 (78%)
Inferior wall	8 (44%)	2 (22%)
Serum cardiac enzymes		
Peak CK-MB (U/L)	166.4 ± 94.1	480.0 ± 485.0*
Peak AST (U/L)	227.7 ± 136.6	677.3 ± 536.2 [†]
Peak LDH (U/L)	1277.3 ± 467.2	2395.0 ± 1300.1 [†]
Medication		
Nitrate	18 (100%)	9 (100%)
b-blocker	9 (50%)	5 (56%)
Calcium antagonist	17 (94%)	6 (67%)*
ACE inhibitor	9 (50%)	7 (78%)
CHF during hospitalization	3 (17%)	5 (56%) [†]
Reattack during hospitalization	1 (6%)	1 (11%)

*p=0.06, [†]p<0.05

Patients in Killip class I are in group I and those in Killip class II to IV are in group II.

ACE=angiotensin converting enzyme ; AST=aspartate transaminase ; BMI=body mass index ; CHF=congestive heart failure ; CK=creatine phosphokinase ; LDH=lactic dehydrogenase ; tPA=tissue plasminogen activator

가 , I
 (p=0.06). II
 5 (56%) , I 3 (17%)
 (p<0.05).
 1 (Table 2).
 가 I
 .
 I II
 ,
 가 가 (p<0.01),
 ,
 (p<0.01)(Table 3). II
 가 . I
 ,
 ,
 , II
 85.9 ± 19.6/ , I 가
 (p<0.05), 64.5 ± 14.7/
 (p<0.05), I 가
 . II
 가 ,
 . II
 69.0 ± 14.7 mL/
 m² 38.0 ± 11.6 mL/m² , 97.5 ±
 23.5 mL/m² 51.9 ± 12.5 mL/m² 가 (p<0.05),
 I 66.3 ± 18.1 mL/m² 30.9 ± 11.3
 mL/m² (p<0.05)(Figs. 1A and B).
 II 26.7 ± 5.7 mL/m²
 , I 34.0 ± 8.0 mL/m²
 (p<0.05), 31.5 ± 6.9 mL/m²
 가 (p<0.05), I 가 (Fig.
 1C). II
 (p<0.05), II 가 I
 (p<0.05)(Fig. 1D). II
 , 46.
 6 ± 7.5% , I 54.2 ± 7.8%
 (Fig. 1E). I
 (p<0.05), II 가 ,
 II 가 I (p<0.01)(Fig. 1F).
 I

Table 3. Comparison of echocardiographic findings according to Killip class at admission

	Group I (n=18)		Group II (n=9)	
	First	Second	First	Second
HR (/min)	63.6 ± 10.3	65.8 ± 11.0	85.9 ± 19.6* [‡]	64.3 ± 14.7
LVMl (gm/m ²)	137.3 ± 24.6*	144.3 ± 29.5*	137.6 ± 33.4 [†]	151.8 ± 37.2*
EDVI (mL/m ²)	66.5 ± 17.6*	66.3 ± 18.1*	69.0 ± 14.7*	97.5 ± 23.5* [‡]
ESVI (mL/m ²)	33.2 ± 13.4*	30.9 ± 11.3*	38.0 ± 11.6*	51.9 ± 12.5* [‡]
SI (mL/m ²)	34.0 ± 8.0*	36.4 ± 6.9*	26.7 ± 5.7* [§]	31.5 ± 6.9*
CI (L/min/m ²)	2.11 ± 0.40*	2.37 ± 0.50*	2.24 ± 0.48*	1.96 ± 0.40* [§]
EF (%)	51.3 ± 8.2*	54.2 ± 7.8*	45.0 ± 10.6*	46.6 ± 7.6* [§]
RWSI	1.56 ± 0.24	1.46 ± 0.27	1.96 ± 0.15 [‡]	1.89 ± 0.17 [‡]
Mitral inflow				
E (cm/sec)	53.4 ± 9.6	58.2 ± 19.7	62.7 ± 28.2	77.4 ± 22.1 [§]
A (cm/sec)	64.1 ± 17.0	66.7 ± 16.9	63.7 ± 28.2	0.7 ± 17.8
E/A ratio	0.90 ± 0.30	0.92 ± 0.43	1.24 ± 0.94	1.36 ± 0.46 ^{†‡}
E/A > 1	6 (33%)	5 (28%)	5 (56%)	7 (78%) [§]
DT (msec)	206.3 ± 30.6	203.9 ± 48.4	140.9 ± 40.5* [‡]	143.2 ± 29.0* [‡]
IVRT (msec)	115.4 ± 20.8 [†]	119.9 ± 26.1 [†]	86.2 ± 22.8 [‡]	91.8 ± 24.8 [§]
Pulmonary venous flow				
SV (cm/sec)	44.3 ± 11.8 [†]	50.6 ± 12.1	40.4 ± 8.1*	44.1 ± 8.2 [†]
DV (cm/sec)	30.8 ± 9.3*	36.2 ± 10.9	36.6 ± 9.3	46.6 ± 15.4
SV/DV ratio	1.49 ± 0.40	1.43 ± 0.25	1.19 ± 0.47	1.04 ± 0.37 ^{†§}
STVI (cm)	12.04 ± 4.11*	14.33 ± 4.00	10.21 ± 3.65*	11.35 ± 3.80 [†]
DTVI (cm)	8.56 ± 3.68*	9.81 ± 3.35 [†]	7.57 ± 2.21*	10.87 ± 4.61
S/DTVI ratio	1.51 ± 0.41	1.53 ± 0.43	1.54 ± 0.89	1.16 ± 0.54
AR (cm/sec)	20.7 ± 3.5	22.9 ± 5.6	25.5 ± 3.6* [‡]	26.6 ± 4.4*

*p<0.01, [†]p<0.05 vs control group. Echocardiographic data of control group are listed in Table 1.

[‡]p<0.01, [§]p<0.05 vs group I of the same interval from the attack

p<0.05 vs the first study

Patients in Killip class I are in group I and those in Killip class II to IV are in group II.

Abbreviations as in Table 1.

II I
E/A 가 SV, DV, STVI, DTVI DTVI
가 , II 가 II
A SV, STVI, DTVI
가 . II E SV, SV/DV , STVI가
E/A 가 , AR
 , II 가 II SV
E , E/A , E/A>1 77.4±22.1 cm/ , I SV 44.3±11.8 cm/
sec, 1.36±0.46, 78% , I 58.2±19. sec 50.6±12.1 cm/sec 가 (p=0.07)
7 cm/sec, 0.92±0.43, 28% (Fig. 3A). DV II 36.6±9.3 cm/sec 46.6
가 (Figs. 2A and B). ±15.4 cm/sec 가 (p<0.05)(Fig. 3B), I
30.8±9.3 cm/sec 36.2±10.9 cm/sec
I II 가 (p<0.05). I II SV/DV
(p<0.05)(Fig. 2C and D). II SV/DV

1.04 ± 0.37 , I 1.43 ± 0.25 S/DTVI I (p =
 $(p < 0.05)$ (Fig. 3C). STVI 0.076). AR
가 (p < 0.05), , II AR
. DTVI II 가 (p < 0.01), I 가

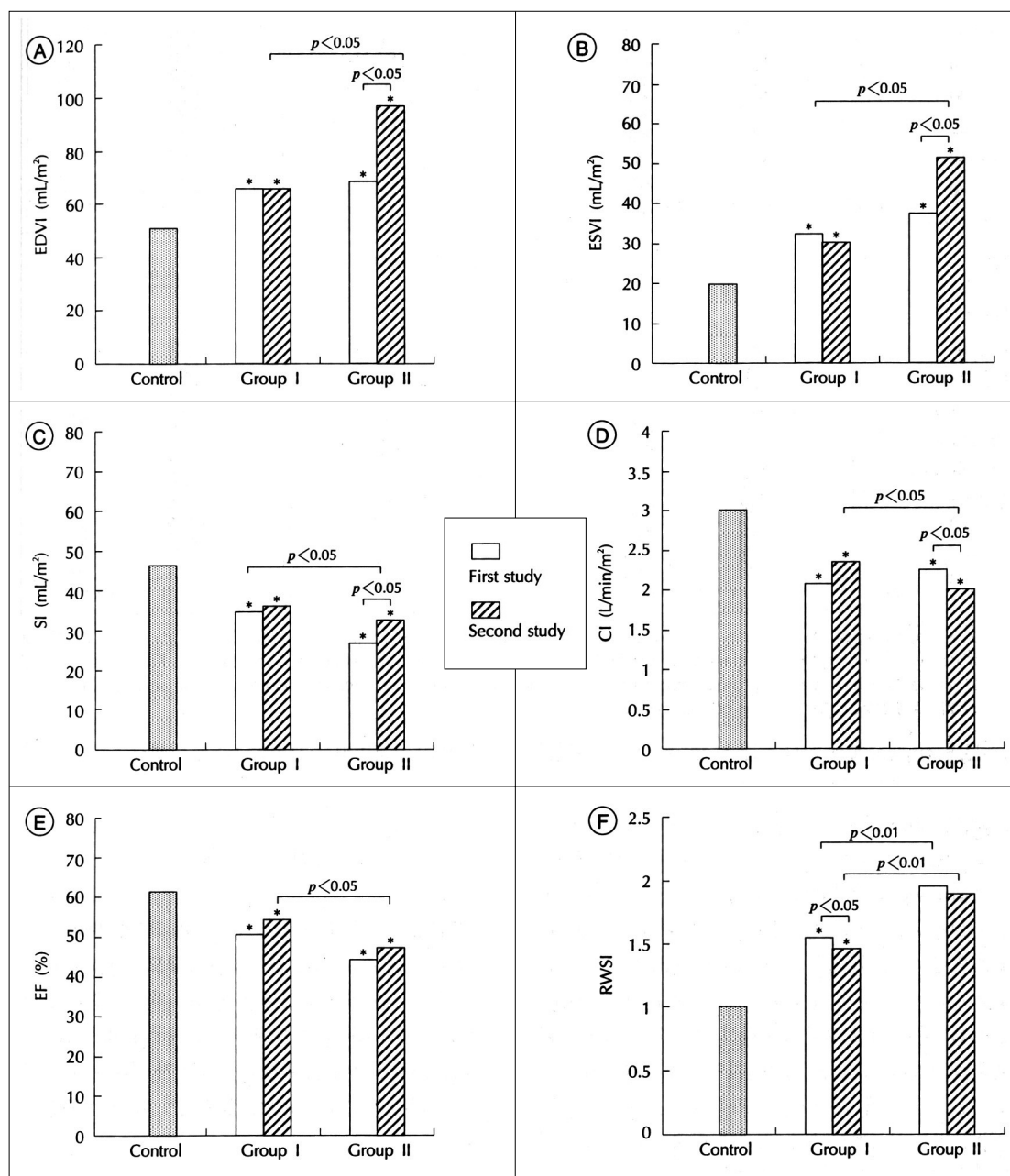


Fig. 1. Comparison of (A) end-diastolic volume index (EDVI), (B) end-systolic volume index (ESVI), (C) stroke volume index (SI), (D) cardiac index (CI), (E) ejection fraction (EF), and (F) regional wall motion score index (RWSI) according to Killip class at admission. Patients in Killip class I are in group I and those in Killip class II to IV are in group II. The first echocardiographic study was done within two days after the attack, and the second study, two weeks after the attack. *p < 0.05 vs control group.

34)
 E 가 가 이 연구의 제한점
 , AR 가 , SV/DV
 가 , E 가 3)35)
 가
 가 가 가 10)
 . SV 6 I
 22)27) SV 가 II 가 ,
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 가 DV 가 E ,
 가 . STVI DTVI 가 .
 , 가 ,
 STVI DTVI 가 SV DV
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 Pipilis 12) Killip , M
 (Doppler tissue imaging)
 32)
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 Killip
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 가
 . I II 연구 배경
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 SV DV가 가 SV/DV 가 .
 , II SV 가 DV 가
 SV/DV 가 . II 2 (remodeling)
 가 . STVI
 가 , I Killip
 , II 가 가 가
 . DTVI II 가 방 법 :
 DV 가 . 48

(23.9 ± 2.3)
 2 27
 Killip
 , Killip class가 I I (18
) , Killip class가 II II (9)
 19

결 과 :

1) I II 가
 가 I
 II 5 (56%)
 , I 3 (17%) ($p < 0.05$).
 2) I II 가
 가 가
 I
 II
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 3) I 가 . I E/A
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결 론 :

가 ,
 2 ,
 가 . , 2 가
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 가 .
 , 2

중심 단어 :

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