

심근경색증 환자에 있어서 심장재활의 효과

추진아 · 홍경표 · 제세영* · 홍선희* · 박원하* · 조병렬 · 류재춘 · 박정배**
권현철 · 박승우 · 김준수 · 김덕경 · 이상훈 · 박정의 · 김매자*** · 이원로

= Abstract =

Effects of Cardiac Rehabilitation in Patients with Myocardial Infarction

Jin A Choo, R.N., Kyung Pyo Hong, M.D., Sae Young Jae, M.S.N.,*
Sun Hee Hong, R.N.,* Won Hah Park, M.D.,* Byung Ryul Cho, M.D.,
Jae-Choon Ryu, M.D., Jeong Bae Park, M.D.,** Hyeon-Cheol Gwon, M.D.,
Seung Woo Park, M.D., June Soo Kim, M.D., Duk-Kyung Kim, M.D.,
Sang Hoon Lee, M.D., Jeong Euy Park, M.D.,
Mae Ja Kim, Ph.D.,*** Won Ro Lee, M.D.

Cardiovascular Institute, Samsung Medical Center, Seoul, Korea
Center for Health Promotion and Sports Medicine, * Samsung Medical Center, Seoul, Korea
Division of Cardiology of Internal Medicine, ** Cheil General Hospital, Seoul, Korea
College of Nursing, *** Seoul National University, Seoul, Korea

Background : Since the 1980s, early ambulation and cardiac rehabilitation have been emphasized in clinical practice after myocardial infarction. This is based on the belief that cardiac rehabilitation can reduce cardiovascular mortality, improve functional capacity and reduce the risk of further coronary events. In this study, we investigate the effect of aerobic exercise-based cardiac rehabilitation on functional capacity and cardiopulmonary responses in patients with myocardial infarction.

Methods : 19 patients were divided into two groups (9 patients for training group and 10 patients for control group) at 4-6 weeks after acute myocardial infarction. Training group performed aerobic exercise for 8 weeks (3 sessions per week, mean 53mins per session) at 40-60% of heart rate (HR) reserve, while control group did not. Before and after 8 weeks, all patients performed symptom-limited exercise test using modified Bruce protocol. Also, breath by breath respiratory gas analysis was carried out throughout exercise test.

Results : For body composition, body weight (-2.7%, $p < 0.001$), body mass index (-2.5%, $p < 0.001$) and %body fat (-2.6%, $p < 0.05$) were decreased significantly in training group after 8 week cardiac rehabilitation. Resting HR (-13%, $p < 0.05$) was reduced significantly in training group, but no significant change occurred in resting blood pressure between the two groups. Maximal oxygen uptake (18%, $p < 0.01$) and anaerobic threshold (21%, $p < 0.05$) were increased significantly in training group after 8 week cardiac rehabilitation as compared with the control group. There was no significant change in maximal O_2 pulse between the two groups. Submaximal rate-pressure product (-17%,

- 344 -

1 , 57 ± 10 , 9 , 8 67.6 ± 10.1kg 2.7% ,
 1 . 63.3 ± 8.0kg 8 63.6 ± 7.4kg
 5 , 4 , 5 , 5 0.6% 가 .
 . 59 ± 5% , (p<0.001)
 59 ± 7% . (Table 2).
 (body mass
 4 (44%), 4 (40%) , index) 25.2 ± 2.6kg/m₂ 8 24.5 ± 2.6
 2 (22%), kg/m₂ 2.5% , 23.9 ±
 5 (50%) . 2.2kg/m₂ 8 24.0 ± 1.9kg/m₂ 0.9% 가
 29.6 ± 6.1ml/kg/min , 31. .
 8 ± 7.9ml/kg/min . (p<0.001)(Table 2).
 6 (67%), 7 (70%) (body fat) 23.4
 (Table 1). , , ± 8.7% 8 20.8 ± 8.6% 2.5%
 , 20.8 ± 6.0% 20.4 ± 4.9%
 가 . 0.8% .
 (p<0.05)

2. 체구성비의 변화

69.4 ± 10.0kg

(Table 2).

Table 1. 대상환자의 임상적 특성

()	9	10
()	60 ± 12	57 ± 10
()	8	9
()	1	1
()	5	5
()	4	5
(%)	59 ± 5	59 ± 7
(ml/kg/min)	29.6 ± 6.1	31.8 ± 7.9
()	6	7
()	4	4
()	2	5

3. 안정시 변수의 변화

71.4 ±
 14.9 bpm 8 61.2 ± 10.6bpm 13.4%
 , 61.9 ± 11.0bpm
 59.8 ± 8.2 bpm 1.5% .

(p<0.05)(Table 3).

가 (Table 3).

4. 최대부하시 변수의 변화

29.6 ±

Table 2. 두 군간의 체구성비의 변화

	p			
(kg)	69.4 ± 10.0	67.6 ± 10.1	63.3 ± 8.0	63.6 ± 7.4 P=0.0009
(kg/m ²)	25.2 ± 2.6	24.5 ± 2.6	23.9 ± 2.2	24.0 ± 1.9 p=0.0009
(%)	23.4 ± 8.7	20.8 ± 8.6	20.8 ± 6.0	20.4 ± 4.9 p=0.02

Table 3. 두 군간의 안정시 변수의 변화

	P				
(bpm)	71.4 ± 14.9	61.2 ± 10.6	61.9 ± 11.0	59.8 ± 8.2	p=0.02
(mmHg)	123.2 ± 28.0	122.4 ± 21.2	121.0 ± 28.7	129.4 ± 32.9	p=0.3913, NS
(mmHg)	76.1 ± 14.4	78.1 ± 8.4	70.7 ± 7.9	75.9 ± 8.6	p=0.3624, NS

6.1ml/kg/min 8 35.2±8.4ml/kg/min
18.3% 가 , 31.8±7.9ml/
kg/min 31.4±7.7ml/kg/min 0.8% .

가 (p<0.01)(Table 4).
1.3±0.5L/min
8 1.5±0.6L/min 21.0% 가 ,
1.3±0.5L/min 1.2±0.4L/min

7.6% .

가 (p<0.05)
(Table 4).

(maximal O₂ pulse)
15.3±3.6ml/bpm 8 17.0±4.3
ml/bpm 11.8% 가 , 14.8
±3.4ml/bpm 16.1±3.3ml/bpm 9.7% 가

(Table 4).

825.0±98.6
8 964.6±176.1 140 가
875.7±116.8 860.2±
133.4 16 .

가

(p<0.005)(Table 4).

5. 최대하부하시 변수의 변화

160.8±32.5mmHg · bpm 8 132.8
±27.0 mmHg · bpm 16.8% ,
145.2±45.4mmHg · bpm 136.4±35.2m
mHg · bpm 3.8% .

(p<0.05)(Table 5).

33.9±10.0L/min 8 28.4±6.7L/min
14.0% , 31.2±5.0L/
min 31.5±4.7L/min 1.5% 가 .

(p<0.05)(Table 5).

12.1±1.2 8 9.6±1.5
2.6 , 11.9±1.1
12.5 ±1.6 0.6 가 .

(p<0.001)(Table 5).

Table 4. 두 군간의 최대부하시 변수의 변화

					p
(ml/kg/min)	29.6±6.1	35.2±8.4	31.8±7.9	31.4±7.7	p=0.0062
	8.6±1.7	10.0±2.2	9.0±2.3	8.9±2.2	p=0.0063
(L/min)	1.3±0.5	1.5±0.6	1.3±0.5	1.2±0.4	p=0.0274
(ml/bpm)	15.3±3.6	17.0±4.3	14.8±3.4	16.1±3.3	p=0.5403, NS
()	825.0±98.6	964.6±176.1	875.7±116.8	860.2±133.4	p=0.002
(maximal oxygen uptake, VO ₂ max=Cardiac Output×arteriovenous oxygen difference) (metabolic equivalent, MET : 1MET=3.5ml/kg/min) (anaerobic threshold) (maximal O ₂ pulse=VO ₂ /heart rate)					

Table 5. 두 군간의 최대하부하시 변수의 변화

					p
(mmHg · bpm)	160.8±32.5	132.8±27.0	145.2±45.4	136.4±35.2	p=0.0305
(L/min)	33.9±10.0	28.4±6.7	31.2±5.0	31.5±4.7	p=0.037
()	12.1±1.2	9.6±1.5	11.9±1.1	12.5±1.6	p=0.0007
(rate-pressure product, RPP = heart rate×systolic blood pressure/100) (minute ventilation, VE) (rate of perceived exertion ; 6 - 20 scale)					

고 안 15 25% 가 . 가

가 8 가

가 21,22,23), 가

가 가

가 (peripheral ada -

ptation) (oxygen extraction and utilization), (avDO₂)

가 24,25). Rousseau

(1973)¹¹⁾ 가

(33.4ml/

kg/min vs 27.3ml/kg/min) 가

가 (16.5 vs 14.4ml/100ml)가

가, (O₂pulse) 가

가 14,15). Framingham Study 가

가 16). 가

2 가

가 17,18). 가

2. 기능능력의 향상 3. 증상 및 심혈관계 효율성 개선

가 (work capacity) 가 19).

가, 가

18% 가 , 가 25)

21% 가 (tolerance)

가 26).

가 Froeli-

cher (1984)¹⁰⁾ 가

가 , Greenland 가

(1988)²⁰⁾ 가

가 . 가 . (- 17%, p<0.05) (- 2.6, p<0.001) 8

가 % 27), 가 가 가

가 (myocardial oxygen consumption) 28).

요 약

연구배경 : 1980

방 법 : 19 4 6 9 10 40 60% 3 , 1 53 8 8 , Bruce 가 breath by breath

결 과 : (- 2.7%, p<0.001), (- 2.5%, p<0.001) (- 2.6%, p<0.05) 8 (- 13%, p<0.05) 가 (18%, p<0.01) (21%, p<0.05) 8

가 . 가 . (- 17%, p<0.05) (- 2.6, p<0.001) 8

결 론 :

(myocardial oxygen dem - and, rate - pressure product)

References

- 1) 김범수 · 조승연 · 심원흠 · 정남식 · 장양수 · 안중배 · 조재용 · 김성순 : 급성 심근경색증 환자의 임상적 고찰. 순환기 23 : 498-509, 1993
- 2) 임종윤 · 김정현 · 이영목 · 이영우 · 이성호 : 급성 심근경색증의 임상적 관찰. 대한내과학회잡지 23 : 1-8, 1980
- 3) 권오훈 · 김영권 · 김영대 · 서봉관 · 김영중 · 최윤식 · 서정돈 · 이영우 : 급성 심근경색증의 초기 경과에 관한 관찰. 대한내과학회잡지 27 : 1082-90, 1984
- 4) 김판금 : 심장질환의 재활 개관과 운동치료법. 세종의학 10 : 3-10, 1993
- 5) Stone PH, Raabe DS, Jaffe AS, Gustafson N, Muller JE, Turi ZG, Rutherford JD, Poole WK, Passamani E, Willerson JT : Prognostic significance of location and type of myocardial infarction. J Am Coll Cardiol 11 : 453-63, 1988
- 6) Balady GJ, Fletcher BJ, Froelicher ES, Hartley LH, Krauss RM, Oberman A, Pollock ML, Taylor CB : Cardiac rehabilitation programs. A statement for health care professionals from the american heart association. AHA Medical/scientific statement. Position statement. Circulation 1603-10, 1995
- 7) Oldridge NB, Guyatt GH, Fischer ME, Rimm AA : Cardiac rehabilitation after myocardial infarction : Combined experience of randomized clinical trials. J Am Med Assoc 260 : 945-50, 1988
- 8) O'Connor GT, Buring JE, Yusuf S, Goldhaber SZ, Olmstead EM, Paffenbarger RS, Hennekens CH : An overview of randomized trials of rehabilitation with exercise after myocardial infarction. Circulation 80 : 234-44, 1989
- 9) Ehsani AA, Martin WH, Heath GW, Coyle EF : Cardiac

- effects of prolonged and intense exercise training in patients with coronary artery disease. *Am J Cardiol* 50 : 246-54, 1982
- 10) Froelicher V, Jensen D, Genter F, Sullivan M, Mckirman MD, Withtun K, Scharf J, Storong ML and Ashburn W : A randomized trial of exercise training in patients with coronary heart disease. *J Am Med Assoc* 252 : 1291-7, 1984
 - 11) Rousseau MF, Brasseur LA, Detry JR : Hemodynamic determinants of maximal oxygen uptake in patients with healed myocardial infarction : Influence of physical training. *Circulation* 48 : 943-9, 1973
 - 12) ACSM : ACSM's guidelines for exercise testing and prescription. 5th Ed. p97, Williams & Wilkins, 1995
 - 13) Beaver WL, Wasserman K, Whipp BJ : A new method for detecting anaerobic threshold by gas exchange. *J Appl Physiol* 60 : 2020-7, 1986
 - 14) Lavie CJ, Milani RV : Effects of cardiac rehabilitation and exercise training in obese patients with coronary artery disease. *Chest* 109 : 52-6, 1996
 - 15) Manson SE, Colditz GA, Stampfer MJ : A prospective study of obesity and risk of coronary heart disease in women. *New Engl J Med* 322 : 882-9, 1990
 - 16) Hubert HB, Feinleib M, McNamara PM, Castelli WP : Obesity as an independent factor for cardiovascular disease : A 26-year follow-up of participants in the Framingham Heart Study. *Circulation* 67 : 968-77, 1983
 - 17) Kallio V, Hamalainen H, Hakkila J, Luurila OJ : Reduction in sudden death by a multifactorial intervention program after acute myocardial infarction. *Lancet* 2 : 1091-4, 1979
 - 18) Oberman A, Cleary P, LaRosa JC, Hellerstein HK, Naughton J : Changes in risk factors among participants in long-term exercise rehabilitation program. *Adv Cardiol* 31 : 168-175, 1982
 - 19) Lortie G, Simoneau JA : Responses of maximal aerobic power and capacity to aerobic training. *Int J Sports Med* 5 : 232-6, 1984
 - 20) Greenland P, Chu JS : Efficacy of cardiac rehabilitation Services : With emphasis on patients after myocardial infarction. *Ann Intern Med* 109 : 650-63, 1988
 - 21) Wohl AJ, Lewis HR, Campbell W, Karlsson E, Willerson JT, Mullins CB, Blomquist CG : Cardiovascular function during early recovery from acute myocardial infarction. *Circulation* 56 : 931-7, 1977
 - 22) DeBusk RF, Houston N, Haskell W, Fry G, Parker M : Home versus group exercise training for increasing functional capacity after myocardial infarction. *Circulation* 70 : 645-9, 1984
 - 23) Savin WM, Haskell WL, Houston-Miller N, DeBusk RF : Improvement in aerobic capacity soon after myocardial infarction. *J Cardiac Rehabil* 1 : 337-42, 1981
 - 24) Detry JM, Rousseau M, Vandenbroucke G, Kusumi F, Brasseur LA, Bruce RA : Increased arteriovenous oxygen difference after physical training in coronary heart disease. *Circulation* 44 : 109-18, 1971
 - 25) Thompson PD : The benefit and risks of exercise training in patients with chronic coronary artery disease. *J Am Med Assoc* 259 : 1537-40, 1988
 - 26) Fletcher GF, Balady G, Froelicher VF, Hartley LH, Haskell, WL, Pollock ML : Exercise standards. A statement for healthcare professionals from the american heart association. *AHA Medical/scientific statement. Special report. Circulation* 580-615, 1995
 - 27) Ades PA, Waldmann ML, Poehlman ET, Gray P, Horton Ed, Horton ES, LeWinter MM : Exercise conditioning in older coronary patients. Submaximal lactate response and endurance capacity. *Circulation* 88 : 572-7, 1993
 - 28) Clausen JP : Circulatory adjustments to dynamic exercise and effect of physical training in normal subjects and in patients with coronary disease. *Prog Cardiovasc Dis* 18 : 459-95, 1976