Effect of Low Grade Exercise Training and a Vasodilator on Cardiac Function in Patients with Recent Myocardial Infarction

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THE major beneficial effects associated with exercise training for coronary patients are improvements in cardiocirculatory

performance and physical work capacity. However, whether those effects are primarily central or peripheral adaptations is still controversial!¹⁻⁵

The purpose of the present study was to analyse cardiohemodynamic response to dynamic exercise and to evaluate the hemodynamic effect of a vasodilator, nicorandil, on supine leg exercise and/or exercise training in patients with recent myocardial infarction but without angina pectoris.

TABLE I PATIENTS STUDIED

	No. (F)	Age (yrs.)	
		Mean	Range
OMI	70 (2)	51	(34-68)
1-Vessel	40 (2)	50	(34-68)
2-Vessel	20 (0)	52	(42-66)
3-Vessel	10 (0)	54	(40-63)

OMI: old myocardial infarction without angina pectoris,
F: number of females

PATIENTS AND METHODS

The study group consisted of 70 patients within 2 to 6 months of the onset of acute myocardial infarction but without angina

Fig.1. Relation between peak pulmonary artery wedge pressure (PAWP) and maximum increment of cardiac index (Δ CI).

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TABLE II CHANGES IN HEMODYNAMIC VARIABLES BY SUPINE LEG EXERCISE IN EACH GROUP

<i>L/min/m²</i>			
<i>I (N=28)</i>		<i>II (N=10)</i>	
<i>EF (%)</i>	<i>54±3</i>	<i>EF</i>	<i>42±5</i>
<i>Exercise Time (sec)</i>	<i>598±14</i>	<i>Exercise Time</i>	<i>616±35</i>
<i>ΔHR (bpm)</i>	<i>65±3</i>	<i>ΔHR</i>	<i>69±1</i>
<i>ΔCI (L/min/m²)</i>	<i>4.0±0.1</i>	<i>ΔCI</i>	<i>4.3±0.4</i>
<i>peak PAWP (mmHg)</i>	<i>12±0.7</i>	<i>peak PAWP</i>	<i>23±1.5</i>
<i>III (N=15)</i>		<i>IV (N=17)</i>	
<i>EF</i>	<i>64±4</i>	<i>EF</i>	<i>43±3</i>
<i>Exercise Time</i>	<i>480±35</i>	<i>Exercise Time</i>	<i>434±20</i>
<i>ΔHR</i>	<i>45±3</i>	<i>ΔHR</i>	<i>47±3</i>
<i>ΔCI</i>	<i>2.3±0.1</i>	<i>ΔCI</i>	<i>2.0±0.2</i>
<i>peak PAWP</i>	<i>13±1</i>	<i>peak PAWP</i>	<i>30±1.9</i>
<i>ΔCI 3.0</i>			
		<i>20</i>	
		<i>Peak PAWP</i>	
		<i>mmHg</i>

Fig.2. Changes in left ventricular function after low grade exercise training in patients with myocardial infarction.

pectoris (Table I). Fifty five were in Class 2 and 15 in Class 3 of the NYHA classification.

Symptom-limited and multi-stage bicycle exercise testing as performed in all patients studied in the supine position.

The work load was begun at 25 W and increased by 25 W increments at a 3-min intervals. The end point of the exercise was leg fatigue in all patients. During exercise test-

ing, invasive hemodynamic variables including cardiac output and pulmonary artery wedge pressure (PAWP) were monitored. The method of invasive hemodynamic exercise testing used in this study has been reported elsewhere⁶⁻⁹

RESULTS AND DISCUSSION

Patients were divided into 4 groups by the

relation between peak PAWP and the maximum increment of cardiac index (ΔCI) during supine leg exercise (Fig. 1); Group I (29 patients) with peak PAWP < 20 mmHg and $\Delta CI \geq 3.0$ L/min/m², Group II (10 patients) with peak PAWP ≥ 20 mmHg and $\Delta CI \geq 3.0$ L/min/m², Group III (15 patients) with peak PAWP < 20 mmHg and $\Delta CI < 3.0$ L/min/m², Group IV (16 patients) with peak PAWP ≥ 20 mmHg and $\Delta CI < 3.0$ L/min/m². Individual hemodynamic data at rest and during exercise are summarized in Table II. Left ventricular ejection fraction (EF) at rest was greater in Group I and III than in Group II and IV ($p < 0.01$). Exercise time was longer in Group I and II which showed greater ΔCI than in Group III and IV ($p < 0.01$). Peak PAWP was greater in Group II and IV than in Group I and III ($p < 0.01$).

In 8 patients, exercise testing was per-

TABLE III DAILY EXERCISE TRAINING PROGRAM

Exercise regimen: Progressive walking (including warmup and cool-down periods)

Exercise duration: 60 min.

Training intensity: 70~80% of the maximal attainable HR during treadmill exercise conducted once a week.

formed before and after low grade exercise training (Fig. 2). The daily exercise training was progressive walking as shown in Table III.

In Group I and III patients, cardiac output was increased after low grade exercise training without increase in left ventricular filling pressure. However, in Group II and IV patients, cardiac output was not increased even after low grade exercise training with mild increase in left ventricular filling pressure.

In 12 out of 70 patients studied, exercise testing with the same work load was performed before and after single oral administration of 15 mg of nicorandil (nitrate ester). Peak PAWP was decreased significantly with increasing cardiac index during exercise after administration of nicorandil (Fig. 3). In patients with myocardial infarction but without angina pectoris, nicorandil improved cardiac function during exercise and increased central effects of exercise training.

The following conclusions were drawn: 1) An abnormal relationship between cardiac index and left ventricular filling pressure during supine leg exercise was not improved by low grade exercise training for one month; and 2) An abnormal relationship between cardiac index and left ventricular filling pressure during supine leg exercise was improved by nicorandil administration.

Fig.3. Effects of nicorandil on the relation between peak pulmonary artery wedge pressure (PAWP) and maximum increment of cardiac Index (ΔCI).

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