SHORT COMMUNICATION

CARDIO-VASCULAR CHANGES DURING GRADED EXERCISE

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Summary : In the present study cardio-vascular adaptation to graded exercise was studied in untrained male medical students. The subjects were given two grades of exercise each lasting for about five minutes with a rest of fifteen minutes in between on a mechanically braked bicycle ergometer. There was a statistically significant rise in the heart rate during both the exercise sessions. This rise was persistent even after fifteen minutes of rest following the second session. The systolic blood pressure also showed a statistically significant rise in both the sessions. However, the diastolic blood pressure showed a significant drop in the second exercise session. Both these changes could possibly be attributed to sustained release of epinephrine.

Key words : cardiovascular changes graded exercise epinephrine

INTRODUCTION

Exercise is a stressful condition which produces a marked change in body function, specially cardio-vascular, respiratory and nervous activity. It has been a means of testing the physical capabilities and physiological responses of an individual. Study of the changes in various systems to stress has received great attention in the recent past.

The basic instrument for mobility are the muscles. They can increase the metabolic needs of fifty times the resting level during exercise. Increased metabolism will burden the other systems bringing about an increase in their functional status. Though this fact is known for over years, sufficient information is not available on the extent of change observed in different systems in untrained subjects. Therefore the present study is undertaken to investigate the cardiovascular response to graded exercise among untrained subjects.

MATERIAL AND METHODS

Thirty well built male students participated in the present study. The anthropometric characteristics (Mean$\pm$Standard deviation) of the study group were :

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Age : 18.83±0.83 years; Weight : 58.55±10.10 *kgs*;
Height : 169.6±6.55 cms; Body surface area : 1.74±0.16 sq. mts.

The subject reported at the laboratory around 8.00 A.M. after a light breakfast. He rested for fifteen minutes in the sitting position. The resting (R_1) pulse rate was recorded by photosensitive pulse transducer with the help of four channel polygraph (Encardiorite). The systolic and the diastolic blood pressures were recorded by using mercury type sphygmomonometer. Later the subject performed two sessions of exercise each lasting for about five minutes with a rest of fifteen minutes in between on a mechanically braked bicycle ergometer (INCO).

During the exercise the subject pedaled the bicycle at the rate of 60 rpm (Range : 55 to 65 rpm) against a standardised load of 1.5 *kgs* and 3.00 *kgs* acting on the brake band in the first and second sessions amounting to 300 KPM and 600 KPM respectively.

The pulse rate and the blood pressure were recorded during the fifth minute in both the sessions which were termed as S_1 and S_2. Similar recordings done just before the start and after fifteen minutes of test following second session were designated as R_2 and R_A respectively.

RESULTS

The results obtained were tested by using paired 't' test. There was a statistically significant increase in the heart rate over the pre-exercise value in both the exercise sessions ($P<0.001$; Fig. 1). There was a persistent increase in the heart rate even after the rest of

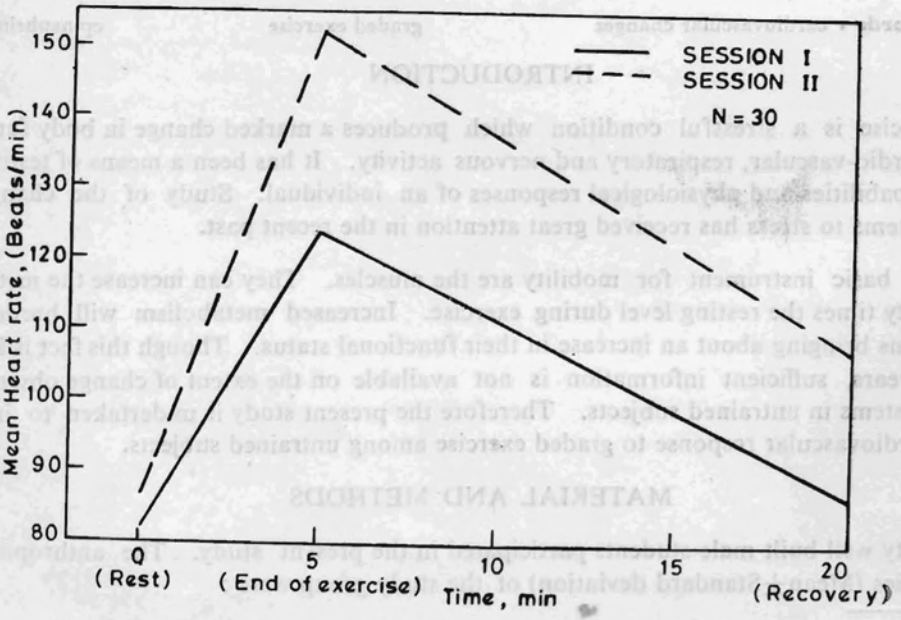

FIG. 1: CHANGES IN HEART RATE AT REST, EXERCISE AND RECOVERY

fifteen minutes following the second session ($P<0.001$; Tables I and II). There was an increase in systolic blood pressure and a drop in diastolic blood pressure in both the sessions. The results were also statistically significant ($P<0.001$; Fig. 2).

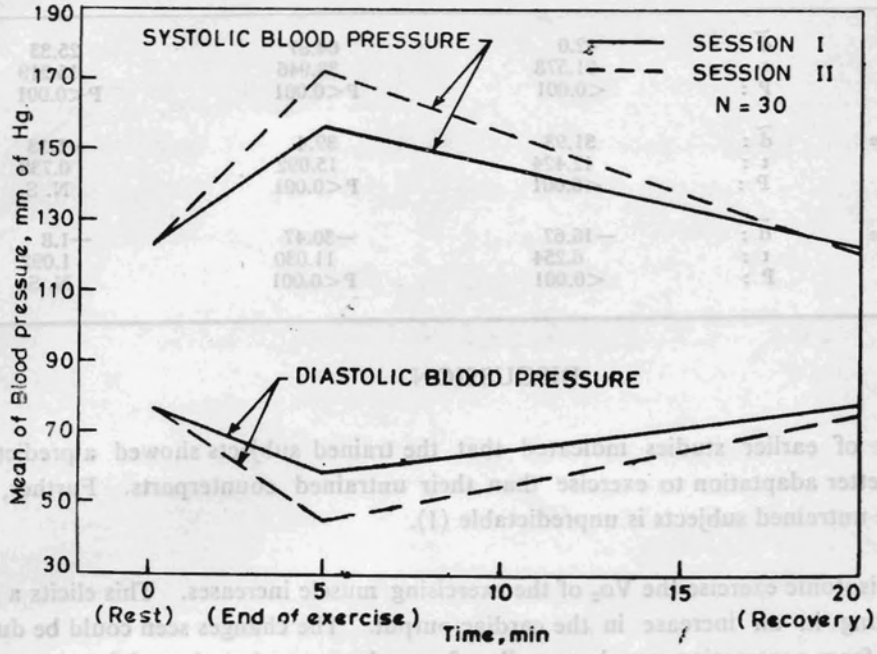

FIG. 2: CHANGES IN BLOOD PRESSURE AT REST, EXERCISE AND RECOVERY.

TABLE I : Cardio-vascular parameters.

Parameters	*Session I*		*Session II*		*15 minutes after II Session*
	At Rest (R_1) Mean (Range)	*After Session I (S_1) Mean (Range)*	*At Rest (R_2) Mean (Range)*	*After Session II (S_2) Mean (Range)*	*Mean (Range)*
1. Heart Rate (Pulse Rate) Beats minute.	82.07 (66—94)	124.07 (98—144)	87.2 (68—104)	152.07 (118—176)	107.4 (80—126)
2. Blood Pressure (Systolic) mm of Hg.	123.6 (110—140)	155.53 (120-190)	123.47 (108—140)	162.87 (136—210)	122.27 (104—136)
3. Blood Pressure (Diastolic) mm of Hg.	76.6 (66—90)	59.93 (36—82)	77.13 (60—86)	46.67 (10—70)	75.13 (50—90)

TABLE II : Comparison of cardio-vascular parameters.

Parameters		$S_1—R_1$	$S_2—R_2$	$R_A—R_1$
1. Heart Rate (Pulse Rate) Beats/min.	$\bar{d}$:	42.0	64.87	25.33
	t :	21.578	38.946	15.219
	P :	<0.001	P<0.001	P<0.001
2. Blood Pressure (Systolic) mm of Hg	$\bar{d}$:	31.93	39.4	—1.33
	t :	12.424	15.092	0.738
	P :	<0.001	P<0.001	N. S.
3. Blood Pressure (Diastolic) mm of Hg	$\bar{d}$:	—16.67	—30.47	—1.8
	t :	6.254	11.030	1.092
	P :	<0.001	P<0.001	N. S.

DISCUSSION

Number of earlier studies indicated that the trained subjects showed a predictable response and better adaptation to exercise than their untrained counterparts. Further, the response of the untrained subjects is unpredictable (1).

During isotonic exercise the Vo_2 of the exercising muscle increases. This elicits a host response resulting in an increase in the cardiac output. The changes seen could be due to reflexes elicited from contracting muscle as well as from the central and peripheral nervous system (7). Secondly, these changes may be due to release of vasoactive and neuroendocrine substances such as Epinephrine and Norepinephrine (4).

Increase in heart rate could be due to :

a. Withdrawal of parasympathetic inhibition at lower work loads.
b. Stimulation of sympathetic system at greater work load.
c. Increased venous return both due to contraction of active muscle and decrease in intrathoracic pressure (3).

A significant increase in the heart rate in response to exercise coupled with marked decrease in the diastolic blood pressure suggests a reduction in the peripheeal resistance to a great extent (2, 6, 8). This could be due to the accumulation of the metabolic end products in the active mucles (5).

Secondly the increase in the heart rate in both the sessions in response to exercise and i s persistence even after fifteen minutes of rest following second session and marked drop in

diastolic pressure could be attributed to substained release of epinephrine during submaximal exercise in untrained subjects. While acting through β_2 receptors, epinephrine produces vasodilatation in skeletal muscles and liver bed thus decreasing the peripheral resistance and acting through β_1 receptors, it produces an increase in the heart rate (9). However, simultaneous catecholamine assay could confirm this proposition.

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