

## Cardiac Contractility Changes in Response to Exercises in Hypertensive Patients

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### ABSTRACT

*The purpose of this study was to investigate the role of exercises on cardiac contractility and to find out if the exercises can improve the cardiac contractility in hypertensive patients receiving calcium antagonists. Thirty subjects (26 males and 4 females) participated in this study. The subjects were divided into two groups:- The study group included 15 hypertensive patients with average age of  $42 \pm 7$  years, receiving calcium antagonist and exercise program. The control group included 15 hypertensive patients with average age of  $45 \pm 4$  years receiving calcium antagonist. Heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP), left ventricular ejection fraction (EF), peak filling rate (PFR), end systolic dimension (ESD) and volume end diastolic dimension (EDD) and volumes, interventricular septal thickness, percentage of fractional shortening and E/A ratio were measured before and after the test. Each patient of the study group used treadmill exercise program for six weeks as three times per week, 10 minutes each. At the end of the sixth week, remeasurments of the previous parameters were performed. Analysis of the data using t.test at  $\alpha = 0.05$  revealed that the exercise intervention caused a significant increase of Ejection Fraction, significant decrease of systolic and diastolic blood pressure also there was insignificant difference of E/A ratio, peak filling rate and heart rate values.*

### INTRODUCTION

**T**he impairment of left ventricular diastolic filling at rest is a common finding in hypertensive patients even in the absence of evidence of decreased systolic performance<sup>3</sup>. Also, it was reported that there was a slower left ventricular diastolic filling index in the hypertensive heart than normal heart. The diastolic dysfunction seen in systemic hypertension are the major etiologic factors in congestive heart failure.

These functional diastolic changes impair left ventricular performance. It has also been demonstrated that the diastolic abnormalities precede systolic dysfunction in many cardiac disorders<sup>12</sup>. The average values of both ejection fraction and peak ejection rate (systolic function) were significantly lower in hypertensive patients. Also, there is a significantly longer time to peak filling rate and reduction of peak filling rate<sup>9</sup>.

Calcium antagonists are widely used as anti-hypertensive agents whose hemodynamic

effects consist of a reduction in blood pressure and peripheral vascular resistance. It is associated with a reflex increase in heart rate and cardiac output<sup>8</sup>. It was found that calcium antagonist drugs promote systemic vasodilatation by interfering with mechanisms of excitation contraction coupling in vascular smooth muscle and also cardiac muscle resulting in reduction of cardiac contractility<sup>2</sup>.

The endurance exercise training lowers both systolic and diastolic blood pressure by approximately 10 mmHg in those individuals with mild hypertension (140 - 180 / 90 to 105/85 mmHg). During exercise training, there is an increased actomyosin ATPase and increase in sarcoplasmic reticular calcium uptake, therefore enhanced diastolic relaxation<sup>10</sup>.

Hypertensive subjects with higher resting peak filling rate had increase in left ventricular end-diastolic volume and left ventricular ejection fraction during exercise<sup>7</sup>.

Exercise training decreases the contraction duration due to shortening of relaxation time, improve of the rate of decline of the left ventricular pressure, decrease in the time of relaxation and increase calcium up take by the sarcoplasmic reticulum<sup>6</sup>.

## MATERIAL AND METHODS

### Subjects:

Thirty non smoker (26 males, 4 females) mild to moderate systemic hypertensive patients with no history of secondary causes of hypertension which are ruled out for all patients by laboratory investigations participated in this study. All patients were receiving  $Ca^{++}$  antagonists and the patients were divided into two groups:

**Group (1)** As study group included 15 hypertensive patients receiving  $Ca^{++}$

antagonists in combination with exercise program.

**Group (2)** As control group included 15 hypertensive patients receiving  $Ca^{++}$  antagonist Only.

## METHODS

### A) Measurements:

- ◆ It included measuring blood pressure by using sphygmo-manometer (in mmHg).
- ◆ Recording heart rate and voltage criteria of left ventricular hypertrophy by using electro-cardiogram.
- ◆ Assessment of L.V. dimensions, volumes in cm, 8% fractional shortening, inter ventricular septum and posterior wall thickness by using M mode technique of echocardiography<sup>3</sup>.
- ◆ Recording of E. wave, A wave with estimation of E/A ratio by using doppler technique of echocardiography.
- ◆ Assessment of left ventricular peak filling rate with accurate estimation of left ventricular ejection fraction using equilibrium radio-nuclide angiography by Picker gamma camera.

**N.B.** All the previous measurements were applied to the patients two times for the study before starting any intervention and at the end of the 6th week.

### B) Treatment programme:-

The treatment included a program of treadmill exercise for the patients of the study group as:-

- ◆ One minute warming up phase with walking on electrical treadmill with speed of 1,2 mile/ hour and grade 0% .
- ◆ Nine minutes exercise phase divided into 3 stages:-

- first stage included walking for 3 minutes with speed of 1.7 mile/hour and grade 0%
- second stage included walking for 3 minutes with speed of 1.7 mile/hour and grade 5%.
- third stage included walking for 3 minutes with speed of 1.7 mile/hour and grade 10%.

Another one minute after the exercise phase was completed and included walking with speed of 1,2 mile/hour and grade 0% for cooling down or recovery stage.

The exercise program was applied for a period of 6 weeks by frequency of three times per week for each patient.

Differences in different measured values between control and study groups were compared by using student t.test.

Difference in pre and post test values in the same group were compared by using paired t.test. at  $\alpha$  0.05

## RESULTS

The results of this work as seen from table (1) and figure (1) showed a significant decrease between pre and post test mean value of systolic and diastolic blood pressure and there was a statistically non significant difference between pre and post test mean values of the other variables of heart rate, ejection fraction, E/A ratio and peak filling rate.

As revealed from table (2) and figure (2) there was a statistically significant decrease in the mean value of systolic and diastolic blood pressure and a statistically significant increase in mean value of ejection fraction between pre and post exercise. Also there was a significant differences of post test values of the heart rate, E/A ratio and peak filling rate.

Table(1) Represents the mean values of the control group.

Variable	Mean $\pm$ S.D.	Tvalue	P. Value
S.B.P Pre	158.7 $\pm$ 11.9	-11.5	0.0000*
S.B.P. Post	134 $\pm$ 6.3		
D.B.P. Pre	100.7 $\pm$ 7	-6.9	0.0000*
D.B.P.Post	88 $\pm$ 5.6		
H.R. Pre	82.5 $\pm$ 13.7	-0.1989	0.8452
H.R. Post	82.3 $\pm$ 10.8		
E.F. Pre	53.3 $\pm$ 9.4	-0.4215	0.6797
E.F. Post	54.4 $\pm$ 14.3		
E/A Pre	1.1 $\pm$ .32	-1.75	0.1016
E/A Post	1.04 $\pm$ .26		
P.F.R. Pre	3.10 $\pm$ .65	-1.65	0.1208
P.F.R. Post	2.81 $\pm$ .61		

\* significant at  $\infty$  .05.

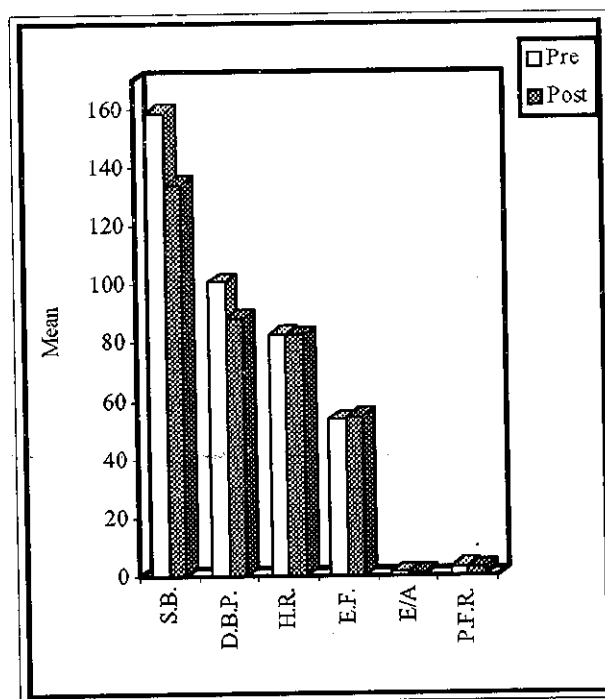


Fig. (1) Represents the mean values of the different variables of the control group.

Table(2) Represent the mean values of different variables of the study group.

Variable	Mean $\pm$ S.D	t.value	P. Value
S.B.P Pre	160 $\pm$ 13.1	- 13.8	0.0000*
S.B.P. Post	124.7 $\pm$ 8.3		
D.B.P.Pre	99.3 $\pm$ 7.9	- 10.02	0.0000*
D.B.P.Post	78 $\pm$ 5.2		
H.R. Pre	88.8 $\pm$ 19.9	- 126	0.2283
H.R. Post	84.2 $\pm$ 11.1		
E.F. Pre	52.13 $\pm$ 9.9	- 2.67	0.0003*
E.F. Post	59.6 $\pm$ 10.8		
E/A Pre	1.46 $\pm$ 0.715	- 1.24	0.2331
E/A Post	1.59 $\pm$ 0.9		
P.F.R. Pre	3.1 $\pm$ 0.87	- 1.34	0.2004
P.F.R. Post	3.3 $\pm$ 0.65		

\* Significant at  $\alpha$  0.05.  
 SBP & DBP In mmHg  
 EF Percentage  
 PFR Ratio  
 HR Beats perminute  
 E/A ratio

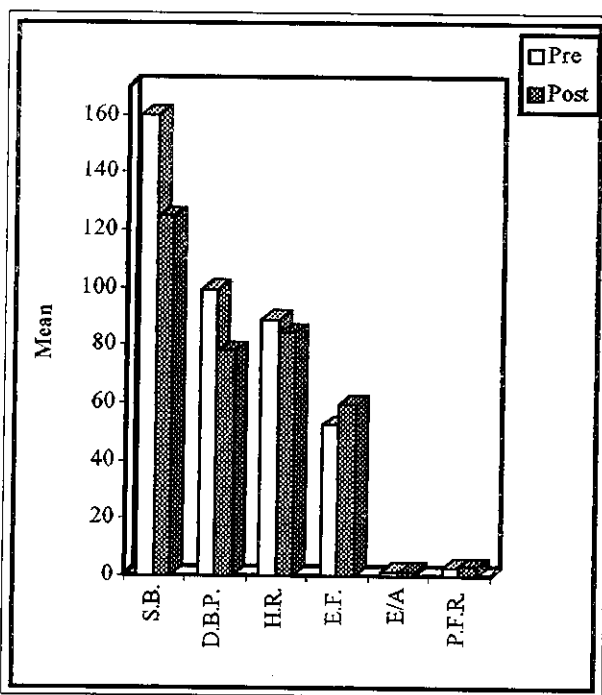


Fig. (2) Represents the mean values different variables of the study group.

## DISCUSSION

The purpose of the present study was to test the hypothesis that the exercise training can improve the response of cardiac function in hypertensive patients who were receiving  $Ca^{++}$  antagonists.

It was found that, exercise training can result in enhanced L.V. systolic performance at peak exercise. The mechanisms which is responsible for this increase in systolic B.P. in trained state are L.V. enlargement and probably enhanced isotropic state and reduced systolic and diastolic blood pressure after long term of exercise program. This was in agreement with Laughlin et al.,<sup>6</sup> who found that, endurance exercise training reduces adaptation in the intrinsic contractile properties of heart by increasing maximal oxygen consumption and maximal cardiac out put. This changes are associated with enhanced cardiac performance in the form of increased stroke volume and cardiac contractility.

The results of this study indicated that the exercise training produced a significant improvement in L.V.E.F. due to improvement of stroke volume and enhancement of L.V systolic performance through the increase in systolic volume and cardiac out put. This is in agreement with Ehsani et al.,<sup>4</sup> who pointed out that, one mechanism underling increased contractile function is simply the higher sympathetic activity and possibility of increased sensitivity to catecholamines in the trained state. In contrast, Spina et al.,<sup>11</sup> reported that the ejection phase of contractility appear to be influenced by changes in preload that are considerably larger than that seen in response to training in his study. The results of this study support the hypothesis that exercise training diminished the progressive abnormal-

lities of L.V diastolic filling. Also it was found that one of the major findings that exercise training augments early diastolic filling during exercise in both older and young subjects due to increase in venous return, stroke volume, systolic function. This was in agreement with levy et al.,<sup>7</sup> who found that, the augmentation of diastolic filling during exercise may contribute to the increased maximal stroke volume of cardiac out put after exercise training and there is closely correlation between the increase in diastolic filling and improved systolic function measured by the ejection fraction.

The results of this study showed a marked reduction in systolic and diastolic blood pressure after a program of exercise through peripheral vasodilatation and so decrease peripheral resistance<sup>1</sup>, this was in agreement with the findings of Field<sup>5</sup>, who stated that endurance exercise training lowers both systolic and diastolic pressure by approximately 10 mm Hg in mild hypertension.

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## تأثير التمرينات على التغيرات في مرونة القلب في مرضى ارتفاع ضغط الدم

**الهدف من البحث**  
اجريت هذه الدراسة لمعرفة تأثير التمرينات على بعض وظائف القلب مثل ضغط الدم-سرعة ضربات القلب-معدل ضخ الدم وكذلك معدل الامتلاء للبطين في مرضى ارتفاع ضغط الدم .

**مواد واساليب البحث**  
اشترك في هذه التجربة ثلاثون مريض بضغط الدم متطوعين ويتناولون مضادات الكالسيوم كعلاج لارتفاع ضغط الدم .  
تم تقسيمهم الى مجموعتين :  
الاولى تتناول مضادات الكالسيوم فقط .  
الثانية تتناول مضادات الكالسيوم مع عمل تمرينات على المشاية الكهربائية لمدة 9 دقائق ثلاث مرات اسبوعيا لفترة 6 اسابيع.

**اظهرت نتائج التجريه الاتي :**  
تحسن في ضغط الدم - معدلات الامتلاء والضخ للقلب في المجموعة الثانية والتي قامت بعمل التمرينات مع مضادات الكالسيوم عنها في المجموعة الاولى التي اعتمدت على مضادات الكالسيوم فقط.