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A Study of Cardiovascular Autonomic Response among Young Adults before and After Isometric Exercise.

Hemasankar C, Veena CN*, Rajasekhar P, and Vastrad BC.

Department of Physiology, PESIMSR, Kuppam – 517425, Andhra Pradesh, India.

ABSTRACT

Many circulatory changes occur during exercise to supply the tremendous blood flow required by the muscles including the stimulatory effects on the circulation by the mass sympathetic discharge, the increased arterial pressure and cardiac output. To study the cardiovascular response to isometric exercise in young adults. 60 healthy young adult male & female students aged between 18-24 years who had no prior endurance training were asked to perform Isometric handgrip contractions using an isometric handgrip apparatus. The heart rate was calculated using BIOPAC MP30. Blood pressure measurements were obtained using a sphygmomanometer. The results of the present study showed significant increase in heart rate and blood pressure values post exercise which may be due to significant changes in either cardiac output, total peripheral resistance, or increase in level of circulating catecholamines mainly epinephrine .

Keywords: Autonomic response, Isometric exercise, Young adults.

Corresponding author

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INTRODUCTION

Exercise is a form of self induced stress leading to circulatory and respiratory adjustments in the body. Since the metabolic demands of the exercising muscle increases during exercise, depending upon the intensity of the exercise various changes in the circulatory and respiratory system occurs to meet these metabolic demands. The sympathetic system plays a key role in these changes resulting in increased heart rate, systolic and diastolic blood pressure and an increased respiratory rate during the exercise [1].

Sustained isometric muscle contraction is a useful method to assess cardiac function. The hemodynamic responses of this provocative test have been well-documented in adults. Characteristically, there is an increase in cardiac output and blood pressure, but little change in total peripheral resistance [2].

All these circulatory changes result in an increased muscle blood flow to meet the demand of the muscles. In isometric exercises, the small groups of muscles remain in the contracted state throughout the exercise resulting in the compression of the blood vessels and occlusion of blood flow to active muscle. Larger the muscle groups that are involved in isometric tension, greater will be the consequent cardiovascular responses to it [3,4]. Also an age associated diminution in the effectiveness of sympathetic modulation of the cardiovascular response to exercise could contribute to many of the changes identified in the cardiovascular response to exercise in healthy aged individuals [5]. The present study analyzes the changes in the cardiovascular parameters in young adults that arise as a result of isometric exercises

MATERIALS AND METHODS

The study included 60 healthy young adult male & female students aged between 18-24 years studying at P.E.S. Institute of Medical Sciences & Research Kuppam, Andhra Pradesh. The subjects had no prior endurance training. The ethical clearance for the study was obtained from the Institutional Ethical Committee (IEC). After taking the consent a brief history was noted & BMI was calculated after measuring height in meters & weight in kilograms. Subjects were asked to perform isometric handgrip contractions using an isometric handgrip apparatus interfaced with a load cell and force monitor. The heart rate was calculated using BIOPAC MP30. Blood pressure measurements were obtained at the brachial artery from the arm that was not being used for performing handgrip contractions (non-dominant arm) using a sphygmomanometer and the results were recorded. All the recordings were obtained in supine posture.

RESULTS AND ANALYSIS

The Data was analyzed using the Statistical Package for Social Sciences (SPSS) version 11.0 The results of the tests were expressed as means, and differences between two groups were analyzed by applying the unpaired “t” test. P values <0.05 were considered to be statistically significant & P values <0.01 were considered to be highly significant.

DISCUSSION

The circulatory effects of sustained isometric contraction have been well studied in healthy adult subjects either by invasive or noninvasive methods. The normal response included an elevation of arterial blood pressure which is primarily due to an increase in cardiac output, with little or no change in systemic vascular resistance. The augmented cardiac output results from an increase in heart rate, since stroke volume remains relatively unchanged [6].

In the present study, we compared the effect of isometric upper limb exercises on cardiovascular parameters in young males and females who had no prior endurance training. The results of the present study showed significant increase in heart rate and blood pressure values post exercise. There was significant increase in heart rate (HR), $p=0.049$; systolic blood pressure (SBP) $p<0.001$; diastolic blood pressure (DBP) $p<0.001$; mean arterial pressure (MAP) $p<0.001$ and rate pressure product (RPP) $p=0.032$ after exercise.

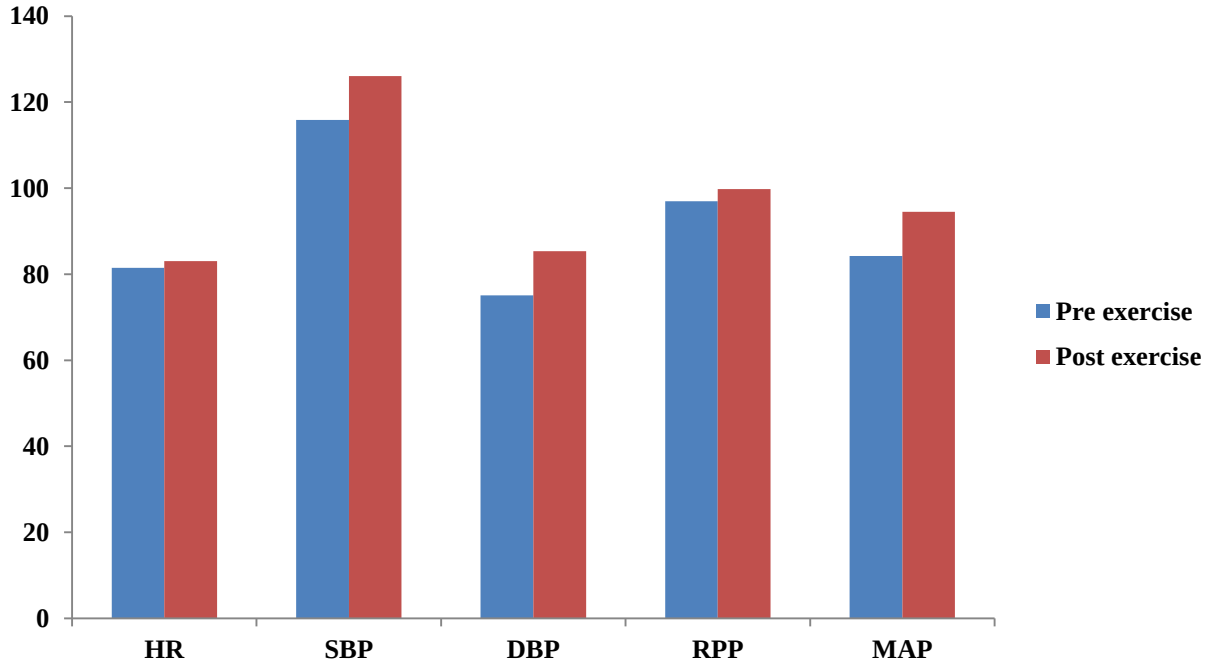
The mechanisms by which blood pressure and heart rate are increased in static exercise are not fully understood. It appears likely that both central and peripheral mechanisms play a role. The central mechanism arises from the supraspinal region of the brain and is directly related to level of central motor common

(voluntary effort), while the peripheral component originates in the active muscle, and its stimulation is commensurate with muscular force production and the amount of active muscle mass [7,8]. The rapid increase seen in both blood pressure and heart rate at the onset of isometric contraction would be due to cortical irradiation [9]. During a sustained contraction, blood pressure and heart rate continue to rise throughout the exercise. This gradual increase in cardiovascular response can also be ascribed to a central drive. With more muscle fibres being electrically activated, the flux of K+ and its concentration in the interstitial fluid space would be elevated thereby activating K+ sensitive free nerve endings in the muscle [10]. The cardiovascular effects of high levels of circulating catecholamines parallel the direct effects of sympathetic activation [11]. Epinephrine and norepinephrine activate the cardiac ß-adrenergic receptors to increase heart rate and myocardial contractility, they also activate vascular alpha- receptors to cause vasoconstriction. The myocardial oxygen consumption also increases due to exercise which is reflected by increased RPP after exercise. Rate pressure product (RPP) is a major determinant of myocardial oxygen consumption hence is an important indicator of ventricular function [12]. The increase in mean arterial pressure from rest to exercise was greater in the older subjects, because of age-related reductions in carotid-cardiac control manifest at rest [13].

Table 1: Cardiovascular response before and after exercise

Groups	Pre exercise Mean(SD)	Post exercise Mean(SD)	P value
HR	81.51(6.57)	83.01 (6.06)	0.049
SBP	115.85(6.11)	126.08(15.15)	<0.001
DBP	75.05(6.23)	85.35(7.23)	<0.001
RPP	96.96(12.94)	99.80(10.90)	0.032
MAP	84.25(6.72)	94.50(8.91)	<0.001

Graph 1: Cardiovascular response before and after exercise



CONCLUSION

This study shows a significant increase in HR, SBP, DBP, MAP and RPP values after exercise in healthy young adults .The increase is due to significant changes in either cardiac output, total peripheral resistance, or increase in level of circulating catecholamines mainly epinephrine .Also significant increase in myocardial oxygen uptake is indicated by increased RPP.

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