ISSN: 0975 -8542

Journal of Global Pharma Technology

Available Online at www.jgpt.co.in

RESEARCH ARTICLE

Post-Exercise Hypotension Phenomenon in Elderly after Aerobic Exercise

Agha Bhargah[1*], Made Muliarta[2], I Putu Yuda Prabawa[3], I.B. Amertha P. Manuaba[4], Varennia Bhargah[1]

1. *Faculty of Medicine Udayana University.*
2. *Physiology Department, Faculty of Medicine, Udayana University.*
3. *Biomedicine Magister Program, Faculty of Medicine, Udayana University.*
4. *Medical and Health Education (Medical Education Department), Faculty of Medicine, Udayana University.*

***Corresponding Email Author:** *aghabhargah@unud.ac.id*

Abstract

Post-exercise hypotension (PEH) which means the occurrence of changes in blood pressure after a physical exercise to a lower blood pressure level after the start of physical exercise .The incidence of PEH can be concluded as a benefit when viewed regarding people who experience a state of hypertension, but if in people with normal blood pressure circumstances can cause the risk of a state of hypotension. The purpose of this study was to determine the magnitude of the decrease in post-exercise hypotension in elderly. Study model using a quasi-experimental model with pre-test and post-test group design involving 28 elderly as a research subject. Aerobic exercise in this study was performed through a healthy heart gymnastics exercise with duration of 45 minutes. Blood pressure measurements were performed before exercise (baseline value), immediately after exercise, 15 minutes, 30 minutes, 45 minutes, and 60 minutes after exercise was done. Statistical analysis using normality and homogeneity test, ANOVA test, and paired sample t-test to compare differences in blood pressure parameter between period of measurement. There are differences in systolic, diastolic, and Mean Arterial Pressure (MAP) blood pressure between time measurements ($p<0.001$). The systolic blood pressure was significantly lower at 60 minutes post exercise (121.96±1.43 mmHg) compared with baseline (141.35 ± 8.76) ($p<0.001$). Diastolic blood pressure was significantly lower at 60 minutes post exercise (121.96 ±1.43 mmHg) compared with baseline (91.75 ± 1.48) ($p<0.001$). MAP was significantly lower at 60 minutes post exercise (93.89 ± 1.15 mmHg) compared with baseline (108.39±1.34) ($p<0.001$). Aerobic exercise through a healthy heart gymnastics session on elderly provides a post-exercise hypotension phenomenon. The lowest reduction of blood pressure was found at 60 minutes after aerobic exercise.

Keywords: *Systolic, Blood Pressure, Hypotension, Diastolic.*

Introduction

The aging process is characterized by physiological and functional changes that make elderly more vulnerable to the emergence of cardiovascular disease [1]. Systemic arterial hypertension is a condition that is closely related to aging and contributes as a risk factor for the occurrence of diseases such as stroke, heart failure, and chronic kidney disease [2]. A variety of therapeutic modalities exist to deal with such hypertensive states both pharmacologically and non-pharmacologically whose primary purpose is to reduce the morbidity and mortality of cardiovascular disease that can arise [2, 3]. Non-pharmacological treatments such as weight loss, limiting salt intake, alcohol reduction, and exercise can be an option. In some studies, one exercise session can trigger post-exercise hypotension (PEH) condition, which means a change in blood pressure after a physical exercise to a lower blood pressure level after physical exercise in almost all individuals hypertension and normal-tension [1, 2]. The occurrence of PEH may be based on a decrease in vascular resistance mediated by both central and peripheral factors and a combination of both.

For example, the afferent input of the muscle will be forwarded to the center which will regulate sympathetic tone and decrease the peripheral resistance [3, 12]. On one side the incidence of PEH can be concluded as a benefit when viewed in terms of people who experience a state of hypertension, but if in people with normal blood pressure circumstances can cause the risk of a state of hypotension that will cause the physiological decrease in the amount of blood flowing to the coronary arteries because the filling of the coronary arteries occurs in the diastolic phase of the heart [4].

In patients with chronic coronary obstruction disease, this condition is capable of triggering a state of acute coronary syndrome in people at high risk. This situation becomes the basis for the need for further research on PEH to know for sure the mean decrease in blood pressure that occurs after the state of sport.

Method

Sample and Study Design

This study used a quasi-experimental model with pre-test and post-test only group design. Sample in this research is an elderly community in North Denpasar City which routinely doing healthy heart gymnastic exercise every afternoon, all subject was randomly selected through simple random sampling the day before until 28 elderly fulfilled. The inclusion criteria of this study were people aged 40-60 years without any physical disability. Subjects with symptoms of heart failure, history of chest pain, antihypertensive drug consumption within 24 hours, drinking coffee within the last 30 minutes were excluded from the study.

Aerobic Exercise and Blood Pressure Measurement

Aerobic exercise in this study was a healthy heart gymnastics session with a duration of 45 minutes preceded by five minutes of warming up, healthy heart gymnastics is an aerobic exercise that provides a possibility to reach 30% of the maximum pulse rate, this situation provides a possibility of a post-sports hypotension without the threat of exceeding the maximum pulse rates of elderly.

Blood pressure measurements were performed at baseline before exercise, suddenly after exercise, 15 minutes, 30 minutes, 45 minutes, and 60 minutes after exercise was done. Blood pressure measurement was performed by certified medical doctor using mercury sphygmomanometer.

Statistical Analysis

All parameters of blood pressure will be tested Saphiro-Wilk for normality test and homogeneity test using Levene test. The ANOVA test was used to compare the difference in mean blood pressure between various measurement times and paired sample t-test used to compare blood pressure at baseline and 60-minute post-exercise.

Result

This study used a quasi-experimental design, 28 older adults who routinely performed healthy heart exercises for 45 minutes was selected as research subject followed by observation of the blood pressure changes in the condition before and after exercise. Characteristics of subjects in this study consisted of age, sex, height, weight, and body mass index. Characteristics of the subject can be seen in Table 1.

Table 1: Subject characteristics

Characteristics	Mean ± SD (n = 28)
Age	60.17 ± 2.3
Gender (n, %)	
Male	17 (60%)
Female	11 (40%)
Body Weight (kg)	61.85 ± 2.86
Body Heigt (cm)	162.57 ± 3.92
Body Mass Index (kg/m^2)	23.44 ± 1.51

Based on table 1, the mean age of the study subjects was 60 years, men are more frequent as the subjects of the study compared with the women with the number of 17 people (60%), the mean body weight of the research subjects was 61 kg, the mean height of the subjects was 162 cm, and mean body mass index of subjects was 23.44 kg/m^2. Blood pressure measurements in this study were performed before healthy heart gymnastic exercise, as soon as exercises were done, 15 minutes post, 30 minutes post, 45 minutes

post, and 60 minutes post. Normality and homogeneity test for systolic, diastolic, and MAP blood pressure variables can be seen in Table 2.

Table 2: Normality and homogeneity test

Variable	Normality test	Homogeneity test
Systolic Blood Pressure	0.816	0.933
Diastolic Blood Pressure	0.667	0.892
MAP	0.978	0.974

All variables had a normal and homogeneous distribution (p>0.05) (Table 2), the mean comparison of systolic blood pressure, diastolic, and MAP would be done through the ANOVA test (Table 3).

Table 3: Blood pressure differences between various time measurements

Variable	Mean ± SD (mmHg)	p-value
Systolic Blood Pressure		
Pre test	141.35 ± 8.76	<0.001*
Post-test	151.28 ± 1.75	
15 minute-post	146.75 ± 1.72	
30 minute-post	139.39 ± 1.65	
45 minute-post	131.00 ± 1.52	
60 minute-post	121.96 ± 1.43	
Diastolic Blood Pressure		
Pre-test	91.75 ± 1.48	<0.001*
Post-test	99.10 ± 1.58	
15 minute-post	96.07 ± 1.55	
30 minute-post	91.67 ±1.45	
45 minute-post	85.82 ± 1.36	
60 minute-post	79.92 ± 1.28	
Mean Arterial Pressure		
Pre-test	108.39 ± 1.34	<0.001*
Post-test	116.53 ± 1.42	
15 minute-post	112.92 ± 1.38	
30 minute-post	107.42 ± 1.33	
45 minute-post	100.89 ± 1.25	
60 minute-post	93.89 ± 1.15	
*significant (p<0.05)		

According to Table 3, there was a significant difference between systolic blood pressure (p <0.05) and the lowest systolic blood pressure was found in pegs 60 minutes post-exercise (121.96 ± 1.43 mmHg). There was a significant difference between the diastolic pressure (p <0.05) and the lowest diastolic blood pressure was found in the measurement in 60 minutes post-exercise (79.92 ± 1.28 mmHg). There was a significant difference between MAP (p <0.05) and the lowest MAP score was found in the measurement of 60 minutes post-exercise (93.89 ± 1.15 mmHg). Differences in blood pressure at pre-test (before exercise) and 60-minute post-exercise can be seen in Table 4.

Table 4: Mean differences in blood pressure parameter between pre-test and 60-minute post exercise

Variable	Mean ± SD	Mean Differences	CI 95%	p-value
Systolic Blood Pressure				
Pre test	141.35 ± 8.76	19.39	14.82-23.93	<0.001*
60 minute-post	121.96 ± 1.43			
Diastolic Blood Pressure				
Pre test	91.75 ± 1.48	11.82	7.74-15.89	<0.001*
60 minute-post	79.92 ± 1.28			
Mean Arterial Pressure				
Pre test	108.39 ± 1.34	14.50	10.81-18.18	<0.001*
60 minute-post	93.89 ± 1.15			
*significant (p<0.05)				

The difference in systolic blood pressure under pre-test and 60-minute post-exercise with a mean difference of 19.39, systolic blood pressure was significantly lower at 60 minutes after exercise than before exercise (p <0.001). The difference in diastolic blood pressure at pre-test and 60-minute post-exercise with a mean difference of 11.82 diastolic blood pressure was significantly lower at 60 minutes after exercise than before exercise (p <0.001). The difference in MAP on pre-test and 60-minute post-exercise with a mean difference of 14.50, MAP was significantly lower at 60 minutes after

exercise than before exercise ($p < 0.001$). (Table 4).The gradual pattern of decreasing blood pressure over time of measurement can be seen in Figure 1.

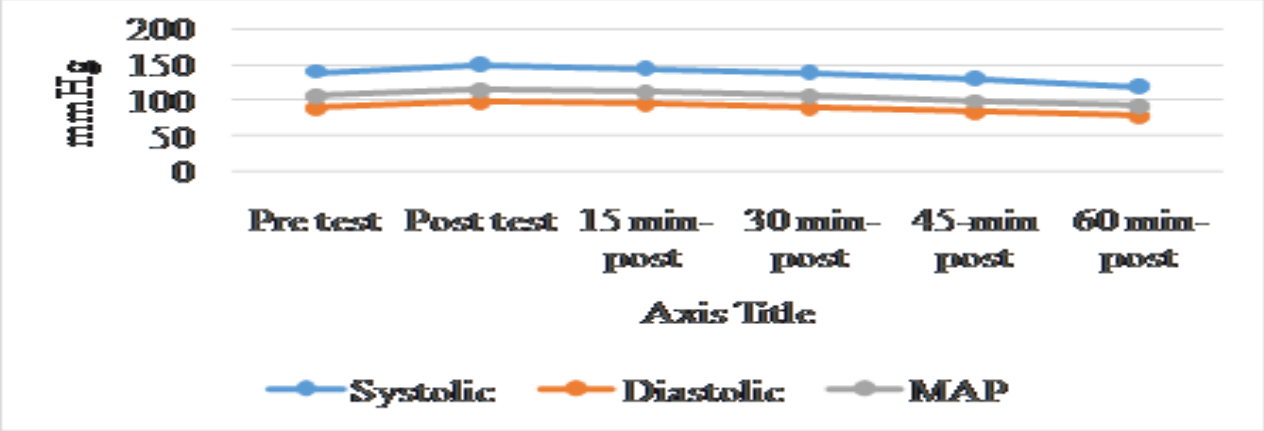

Figure 1: Blood pressure measurement at various times.

Discussion

Based on result of current study, there was a significant difference between systolic, diastolic, and MAP blood pressure in the condition before and after exercise of healthy heart gymnastic session ($p<0.05$) and the lowest blood pressure was found in the 60 minutes post-exercise measurement, this suggests that there is a post-exercise hypotension phenomenon (Table 3 & 4). Post-exercise Hypotension (PEH) is a prolonged phenomenon of decreased blood pressure at rest which occurs within minutes or hours after an acute exercise session [13].

After a sports session it can lower blood pressure to below the resting blood pressure level in the elderly population, diabetes, and in individuals with hypertension and normal blood pressure, this phenomenon is called post-exercise hypotension. The magnitude of the drop in blood pressure has a relationship with the length of the hypotensive state [5]. In healthy individuals and people with hypertension, a state of aerobic exercise is dynamically known to result in an acute decrease in Mean Arterial Pressure (MAP) occurring in 15 minutes to 3 hours after exercise [6].

The PEH state has been observed at various ages of either young, middle age, as well as in the elderly, the mechanism that causes such phenomenon is a complex interplay between central and peripheral mechanisms [7].

During a dynamic period during exercise, there will be an increase in cardiac output to ensure adequate perfusion of the working muscle [8]. This condition is achieved by reducing the parasympathetic tone (leading to increased heart rate and contractility), increased sympathetic activity (directly or indirectly increase heart rate and contractility) and created a vasoconstriction state of the vein resulting in increased venous return and cause an increase of stroke volume. At the same time, the need for increased blood flow and oxygen delivery to the working muscle is achieved through regional vasodilation of the arterioles supplying blood to the working tissue and in combination with vasoconstriction in the arterioles supplying the non-working tissue.

The effects of the muscle pump will increase the venous return and stroke volume which will increase cardiac output and blood pressure [9]. Increased cardiac output and vasoconstriction in blood vessels with tissue and muscle that does not work will lead to an increase in systolic blood pressure, but significant vasodilation of the working tissue helps to balance the increase in blood pressure, resulting in minimal increase in diastolic blood pressure [12].

During exercise with the same intensity, there is often a decrease in blood pressure from the peak values obtained at the beginning of the exercise. This may be due to the redistribution of blood to the peripheral tissue by the disappearance of heat, and the reduction in the number of the blood diastolic filling volume.

Study conducted by Calvancante et al. on post-exercise hypotension in senior women with endurance exercise found a significant reduction in blood pressure in pre-exercise conditions and 60 minutes after exercise (resting SBP: 123 ± 3; 60 minute- post: 110 ±

3; p <0.001) [10]. A study conducted by Moriggi et al. who implemented resistance exercise on eight male subjects with a mean age of 23 found a significant decrease in systolic blood pressure in pre-exercise and post-exercise measurement (baseline systolic: 119.1 ± 9; 50 minute-post: 105.7 ± 10.8; p <0.05) [11].

The presence of a decrease in blood pressure after exercise has been considered as a non-pharmacologic treatment approach in controlling blood pressure that is particularly useful in people with hypertension [2]. The amount of drop in blood pressure is something to consider considering it will affect people with normal blood pressure. Similar findings were also stated by MacDonald et al. that the frequency of PEH after a period has a prolonged effect and is a goal in performing a blood pressure control at rest, the study also found a significant decrease in post-exercise conditions compared with the baseline condition before exercise [12].

Conclusion

Aerobic exercise through a healthy heart gymnastics session on elderly provides a post-exercise hypotension phenomenon. The lowest reduction blood pressure at all components is at 60 minutes after aerobic exercise. There was a decrease in systolic blood pressure of 19 mmHg, diastolic as much as 11 mmHg, and MAP of 14 mmHg in condition before and after 60 minutes of aerobic exercise.

Conflict of Interest

Author's have no conflict of interest regarding all element on this article.

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