International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG(USA) Volume 3, Issue 10 - 2016

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2016.03.10.030

Response to Cold Pressor Test in Normotensive Adult Females

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Abstract

Background: Early detection of proneness to hypertension may help an individual to lead a healthy life by altering the life style. Subjects with predisposing factors of hypertension tend to show higher and prolonged responsiveness of blood pressure following stress. ***Aim:*** The present study was carried out to study the effect of cold pressor test (CPT) on blood pressure (B/P) in normotensive adult females. ***Method:*** The study was conducted on 40 healthy medical students their age range 18-25 years. The left hand of subject was submerged into cold water for 2 minutes and B/P was recorded in sitting position from right arm at 0,1,2,&3 minutes. Subjects with increase in systolic blood pressure ≥ 15 mm / Hg from basal systolic B/P were considered as Systolic Hyper Reactors (SHR) and subjects with increase in diastolic pressure ≥ 10 mm /Hg from basal diastolic B/P were considered as Diastolic Hyper Reactors (DHR). ***Results:*** In the present study, 40% of total subjects were hyper reactors, 2.5 % were SHR, 27.5 % were DHR and 10% were SHR & DHR. ***Conclusion & Recommendation:*** This study showed higher diastolic hypereactivity to CPT in normotensive adult females.

Keywords: Cold pressor test, Systolic Hyper reactors, Diastolic hyper reactors.

1. Introduction

Hypertension (HTN) is a worldwide major health problem, it threatens all mankind. It is associated with serious complications as hypertensive nephropathy, retinopathy cardiovascular and cerebrovascular life threatening events (Kearney et al., 2005; Chen et al., 2008). Early detection of proneness to hypertension may enable an individual to enjoy a healthy life by altering his lifestyle (e.g. avoidance of excessive fatty food intake, practicing moderate aerobic exercise (Pramanik & Adhikar, 2006) and mental relaxation (Paran et al., 1996**)**. Therefore, if a person can be informed that he may suffer from hypertension in advance of the onset of hypertension, it will be obviously beneficial.

Essential hypertension is the most common type (88%) among hypertensive people (Ganong, 2005).In neurogenic hypertension, cardio-vascular reactivity to stress may have a pathological role. Subjects having the predisposing factors of hypertension tend to show higher and prolonged responsiveness of blood pressure following stress (Pramanik et al., 2009). As the diastolic blood pressure undergoes much less fluctuations in normal subjects and remains within a

limited range. Hence variations of diastolic blood pressure are of greater prognostic importance than those of systolic blood pressure (Guyton and Hall, 2003).

In the study of hypertension, several authors have made use of a technique, known as CPT. This test is simple, provocative, non-invasive, reliable and cheap to know autonomic status of body. The test is based on the fact that immersion of hand in cold water causes a rise of blood pressure. It was designed to measure the reactivity of blood pressure to a standard stimulus.CPT could stimulate the stress exerted by chronic condition and was suggested by many researchers to be used as a tool for prediction of hypertension in susceptible individuals (Menkes et al., 1989; Garg et al., 2010). Nevertheless, limited standardization of test procedure and values reduced its applicability (Mitchell et al., 2004). To our knowledge, this is the first study that assessed response to CPT in our locality.

2. Materials and Methods

2.1 Subjects

The study was carried out on 40 healthy female medical students between the ages of 18-25 years at Anatomy& Physiology Lab., at the Department of Laboratory Science, College of Applied Medical Sciences, Shaqra University. Prior permission was taken from head of the department. Detailed study information and orientation were given to subjects. Informed consent was taken from each subject.

2.2. Methods

Rest for 5 minutes was offered to subjects before recording baseline blood pressure in the right upper arm with a standard mercurial sphygmomanometer, room temperature maintained at 25° to 30°C. Systolic pressure was determined at the point when the Korotkoff sound became audible, and diastolic pressure was measured at the point at which the sound disappeared (Mc Murray et al., 2000).

In the present study blood pressure was measured in sitting position. Left hand of subjects were submerged into cold water (3° to 5°C) for 2 minutes (Cold Pressor Test) and B/P was recorded from right arm at 0,1,2,&3 minutes following immersion (Ritesh et al., 2012).

Subjects having an increase in systolic blood pressure of 15 mm/ Hg or more from basal systolic B/P were considered as SHR and subjects having an increase in diastolic pressure of 10 mm / Hg or more from basal diastolic B/P were considered as diastolic hyper reactors DHR (Jain, 2008).

Since the present study was aimed to investigate the blood pressure response to cold and the development of hypertension, we excluded from the study subjects who had hypertensive diseases or a resting systolic blood pressure (SBP) higher than 140 mm /Hg and/or resting diastolic blood pressure (DBP) higher than 90 mm /Hg at baseline.

2.3. Statistical Analysis

Statistical analysis was done using SPSS software, version 16. We analyzed the changes in blood pressure using unpaired t-test. Descriptive statistics was described as median, mean ±SD or as percentages from the total number. Values were considered statistically significant when p value is less than 0.05 ($p<0.05$).

3. Results

In the present study, 40 healthy female medical students were studied their ages ranged from 18-25 years old. Out of them 16 (40%) were hyper reactors, 11 subjects (27.5 %) were diastolic hyper reactors, one subject (2.5%) was systolic hyper reactor and 4 subjects (10%) were both systolic and diastolic hyper reactors and figure 1 showed percentages of hyper reactors in the study participants.

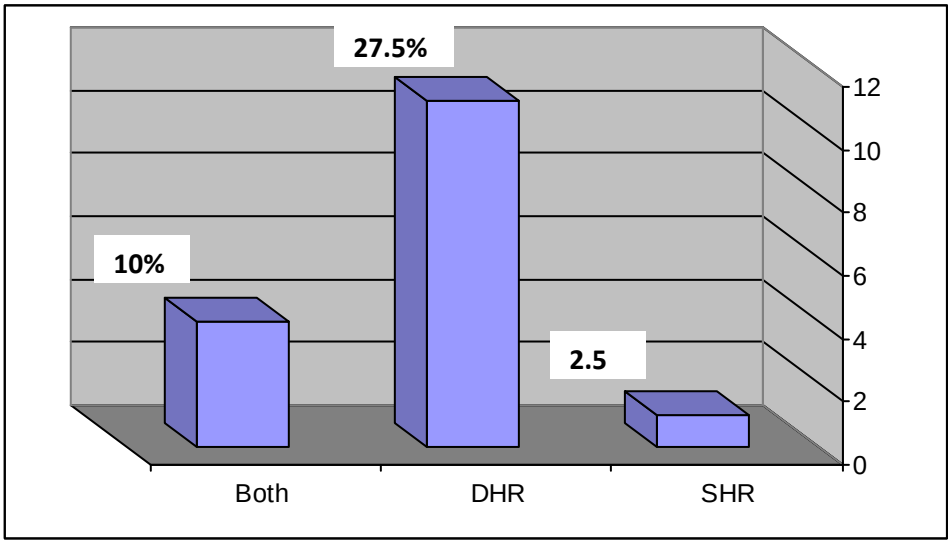

Fig 1: Percentages of hyper reactors in the study subjects.

From table (1) it is clear that the mean SBP at 0 minute in hyper reactors was 120. 31 ±9.74 mm/ Hg and in normal reactors it was 116.67 ± 8.16 mm /Hg, the p value was statistically non-significant (p > 0.05). At 1 minute in hyper reactors it was 122. 50 ±12.24 mm /Hg and in normal reactors it was 113.13 ± 6.29 mm /Hg with statistically significant p value (p < 0.05). At 2 minutes in hyper reactors was 124.06 ±12.14 mm/ Hg and in normal reactors it was 114.69 ± 6.45 mm /Hg, and the p value was statistically significant (p < 0.05). At 3 minutes in hyper reactors was 123. 44 ±11.51 mm /Hg and in normal reactors it was 114.69 ± 7.18 mm /Hg, however the p value was statistically non-significant (p > 0.05).

Table 1: Mean ± SD and P value of systolic blood pressure for normal and hyper reactor subjects.

	Time	Hyper Reactor	Normal Reactors	P value
SBP (mm/ Hg)	0 min	120.31± 9.74	116.67± 8.16	0.877
	1 min	122.50 ± 12.24	113. 12 ± 6.29	0.016
	2 min	124.06 ± 12.14	114. 69 ± 6.45	0.018
	3 min	123. 44 ± 11.51	114. 69 ± 7.18	0.061

From table (2) the mean of diastolic blood pressure at 0 minute in hyper reactors was 83.13 ±11.08 mm/ Hg and in normal reactors it was 76.87 ± 11.23 mm /Hg, the p value was statistically non-significant (p > 0.05). At 1 minute in hyper reactors was 85.63 50 ±10.47 mm /Hg and in normal reactors it was 73.44± 6.51 mm /Hg. Here p value was statistically non-significant (p > 0.05). At 2 minutes in hyper reactors was 86.56 ±9.44 mm /Hg and in normal reactors it was 68.13 ± 4.42 mm /Hg, the p value was statistically significant (p < 0.05). At 3 minutes in hyper reactors was 86.88 ±8.34 mm/ Hg and in normal reactors it was 69.35 ± 7.39 mm /Hg, however the p value was statistically non-significant (p > 0.05).

Table 2: Mean ± SD and P value of diastolic blood pressure for normal and hyper reactor subjects.

	Time	Hyper Reactor	Normal Reactors	P value
DBP (mm/ Hg)	0 min	83.13 ± 11. 08	76.87 ± 11.23	0.736
	1 min	85. 63 ± 10.47	73.44 ± 6.51	0.358
	2 min	86.56 ± 9. 44	6 8.13 ± 4.42	0.026
	3 min	86.88 ± 8.34	69.35 ± 7.39	0.066

Discussion

The present study was conducted to study the effect of cold stimulus on blood pressure in 40 healthy medical female students from College of Applied Medical Sciences, Shaqra University. The study was to identify those who may ultimately suffer from hypertension when they grow older. Participants were subjected to a cold pressor test and blood pressure was recorded from right arm at 0, 1, 2, &3 minutes following immersion in cold water for two minutes.

Arterial blood pressure, an important physiological parameter has great etiological significance in epidemiology of cardiovascular disease due to its association with age, height, weight, diet, stress, and socio-economic status (Guyton and Hall, 2003). Reports support the concept that individuals at high risk of hypertension may have an exaggerated stress-induced cardiovascular response at a younger age (Mathews et al., 1993).

The cold pressor test (CPT), which measures the response of blood pressure to the stimulus of external cold, has long been a standard test for characterization of sympathetic function and has been documented to predict the subsequent risk of hypertension in normotensive persons (Kasagi et al., 1995). The CPT is known to cause a global sympathetic activation and result in significant arteriolar vasoconstriction, with a subsequent increase in blood pressure (Seals, 1990). Studies have shown that the CPT increases plasma nor-epinephrine and muscle sympathetic nerve activity. The increase in muscle sympathetic nerve activity correlates highly with increases in both mean arterial blood pressure and peripheral venous nor-epinephrine concentration (Seals, 1990; Chen et al., 2008).

The sympathetic nervous system plays a prime role in the pathogenesis of essential hypertension. Subjects with transient increase in arterial blood pressure are reported to have hyper-responsiveness to stress stimuli mediated by an over-activity of the sympathetic nervous system (Pramanik et al., 2009).

Results of the present study showed that there was a significant increase in SBP at 1 & 2 minutes following immersion in cold water as P values were 0.016 , 0.018 respectively. Moreover there was a significant increase in DBP at 2 minutes following immersion in cold water as P value was 0.026.These results could be explained by the fact that stimulation of the sympathetic noradrenergic fibers causes vasoconstriction. The noradrenergic post-ganglionic sympathetic nerves also contain neuropeptide Y, a vasoconstrictor. Vasoconstrictor discharge is associated with increased arteriolar constriction and a rise in blood pressure. Impulses in nor-adrenergic sympathetic nerves cause an increase in the heart rate and the force of cardiac contraction (Ganong, 2005).

After being stimulated by a stressor, the sympathetic system triggers a rise in blood pressure; nevertheless, blood pressure usually tend to return to normal level within a very short period of time after the withdrawal of the stressor. Elevated blood pressure continue for a longer time in the susceptible individual as the autonomic control system is not competent enough to lower blood pressure to the baseline quickly. Naturally, the persons presenting higher cardiovascular reactivity to a stressor and slower rate of recovery after the withdrawal of the stressor causing the sympathetic stimulation may be at a high risk of developing hypertension in their future life (Pramanik et al., 2009).

Results of the present study were similar to the findings reported by Lopes et al ,Kelsey et al, Ashwini et al, Verma et al who observed an increased cardiovascular reactivity which was attributed to increased sympathetic activity (Kelsey et al., 2000; Lopes et al., 2001;Ashwini et al., 2004;Verma et al., 2005). However, few studies showed opposite results Kasagi et al.,Germano et al., Lambert and Schlaich all contradicted the above findings and concluded that BP responses to cold are probably influenced by different factors related to participants emotional state and life style (Kasagi et al., 1995 ;Germano et al.,2003; Lambert and Schlaich,2004).

In this study the young age adult females showed higher diastolic hyper reactivity compared to the systolic one, this was consistent with Srivastava and his co-workers. Diastolic response was considered more indicative than systolic response; this was due to the relative stability of DPB (Srivastava et al., 2010). Nevertheless, this assumption was contradictory to Menkes et al. who supposed that the systolic response is more important than the diastolic response (Menkes et al., 1989).

In this study it was obvious that the difference in blood pressure among hyper reactors and normal reactors was increased with increased time of exposure to cold stress. Accordingly this study reaffirmed that the cold pressor test may identify a subgroup of individuals with an occult physiological abnormality that predisposes them to hypertension decades later.

Preventive interventions may be particularly warranted in these individuals. But detailed study with large sample size and long term follow up is required to confirm this hypothesis.

Acknowledgments

We wish to thank our medical students who allowed us to carry out this test on them for the seek of knowledge about the response to CPT in our locality. Also, great thanks for the Vice Dean of the College of Applied Medical Sciences, Shaqra University for their kind cooperation.

Conflict of Interest

The authors declared no conflict of interest related to the study

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	Subject: Medicine
DOI:10.22192/ijarbs.2016.03.10.030	

How to cite this article:
Amany T. Elfakharany, Doaa Rafat El Azab, Safaa A.A. Khaled. (2016). Response to Cold Pressor Test in Normotensive Adult Females. Int. J. Adv. Res. Biol. Sci. 3(10): 219-224.
DOI: http://dx.doi.org/10.22192/ijarbs.2016.03.10.030