Original Research Article

Comparative study of sympathetic function changes in normal and moderately hypertensive patients

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Abstract

Introduction: Hypertension is one of the leading disorders contributing to significant morbidity and mortality in the world today. Today's stressful life and modern life styles including the food habits have increased the incidence, acquiring a status of modern day epidemic along with diabetes mellitus. The onset and severity of complication in a system is said to be dependent on the duration of hypertension and the degree of its control. Autonomic dysfunction is drawing more and more attention of the medical fraternity for its supposed role in sudden deaths observed in hypertensive and diabetics.

Aim of the study: Our aim is to Hand grip test and Cold presser test in normotensive and moderately hypertensive patients.

Materials and methods: A comparative study of cardiovascular autonomic function tests in hypertensive and normotensive individuals was conducted in the Department of Physiology, Department of Community Medicine, RMMCH-Urban Health Centre, Chidambaram on 25 hypertensive patients in the age group of 30-40 years and age matched control group of 25 normotensive individuals. The study was programmed to assess sympathetic nerve functions based on cardiovascular parameters like blood pressure and heart rate measurement. Among the autonomic function tests discussed in the review of literature.

Results: In HGT this is an indicator for sympathetic insufficiency. Rise in DBP of > 16 mmHg is taken as normal. In autonomic disorder the rise is < 10 mmHg.

Conclusion: Submerging the limb in ice cold water increases systolic pressure by about 20 mmHg and diastolic pressure by 10 mmHg. The afferent limb of the reflex pathway is somatic fibers whereas the efferent pathway is the sympathetic fibers. This test is not very accurate as the changes are not consistent in all subjects.

Key words

Sympathetic nerve function, Cold presser test, Hand grip strength test.

Introduction

Emotional responses of the body and responses to environment occur without conscious knowledge of the individual. These responses are therefore called autonomic responses that are executed by a part of the nervous system [1]. The term autonomic is derived from the Greek word auto means self and nomos means control. The ANS controls functions of the involuntary organs of the body that includes heart and blood vessels exocrine and endocrine glands and all visceral organs. Thus, ANS controls all major functions of the body such of circulation, respiration, digestion, excretion and reproduction [2]. Circulating hormones and locally produced chemicals assist in mediating these functions. The peripheral motor portions of the ANS are made up of Pregnanglionic and post ganglion neurons. Anatomically the autonomic outflow is divided into two components [3]. The axons of the sympathetic preganglionic neurons leave the spinal cord with ventral roots of the 1st thoracic to the 3rd lumbar spinal cord [4]. They pass via the white rami communicants to the paravertebral sympathetic chain, where most of them end on the cell bodies of the post-ganglion neurons. The axons of some of the post ganglion neurons pass to the viscera in the various sympathetic nerves. Others reenter the spinal nerves via the gray rami communicates from the chain of ganglia and are distributed to autonomic effectors in the areas supplied by these spinal nerves [5]. The postganglionic sympathetic nerves to the head originate in the superior, middle and stellate ganglia in the cranial extension of the sympathetic ganglion chain and travel to the effectors with the blood vessels. Some preganglionic neurons pass through the paravertebral ganglion chain and end a post ganglion neurons located in collateral ganglia close to the viscera [6].

Genetic factors in Primary Hypertension

Primary hypertension is a polygenic trait sharing strong dependence on multiple environmental factors as well as heterogeneity of genes. Angiotension converting enzyme gene, angiotensinogen and all receptor genes are those being followed up. Salt sensitivity and volume factors may play an important role in pathogenesis various surveys have been carried out to identify if any secondary process may be responsible for the systemic hypertension [7, 8].

Screening for Secondary Hypertension

Because of relatively low frequency of various secondary causes, clinician should be selective in screening and order for diagnostic tests. The presence of features inappropriate for usual uncomplicated primary hypertension indicates need for additional tests [9].

Materials and methods

A comparative study of cardiovascular autonomic function tests in hypertensive and normotensive individuals was conducted in the Department of Physiology, Department of Community Medicine, RMMCH-Urban Health Centre, Chidambaram on 25 hypertensive patients in the age group of 30-40 years and age matched control group of 25 normotensive individuals. The study was programmed to assess autonomic functions based on cardiovascular parameters like blood pressure and heart rate measurement. Before starting the study, approval was taken from the ethical committee. The Subjects were appropriately informed regarding the procedures involved in the study.

Inclusion criteria

- Age group-30 to 40 years
- Sex-Both male and female
- Blood pressure
- Newly diagnosed moderate hypertension
- Inclusion criteria for control group are same but they are normotensives.

Exclusion criteria

- Secondary hypertension patients.
- Those with any other illness.
- Those addicted to alcohol, tobacco, drugs.

Hand grip test

Subject is made to lie comfortably in a bed with electronic BP apparatus attached. Resting BP is recorded. Subjects is asked to hold the dynamometer in right hand (left hand for left hander) to have a full grip of it. Subject is asked to compress the hand with maximum effort and the tension developed is noted. The procedure is repeated 3 times and the average of the 3 is taken as the maximum isometric tension (Tmax) now the subject is asked to maintain 30% of Tmax for 5 minutes. BP is recorded just before the release of hand grip. In the hand-grip test, there is a rise in heart rate and blood pressure. These cardiovascular responses to isometric exercise are mediated partly by influence of cardiovascular centers and partly by metabolic or mechanical changes or both, in response to contraction of the muscles that activate small fibers in the afferent limb of the reflex arch. The normal response is rise in diastolic pressure more than 15 mmHg and rise in the heart rate by about 30 percent. The blood pressure rise is due to increased sympathetic activity and heart rate rise is due to decreased parasympathetic, activity. This response is not influenced by age [10].

Cold pressor test

Subject is made to sit in a chair comfortably with Electronic BP apparatus attached. Resting BP is recorded. Subject is asked to immerse his hand in cold water (4C) for a period of 1 minute. BP is recorded at 30 seconds and 60 seconds. It is a useful measure of sympathetic system. Submerging the limb in ice cold water increases systolic pressure by about 20 mmHg and diastolic pressure by 10 mmHg. The afferent limb of the reflex pathway is somatic fibres whereas the efferent pathway is the sympathetic fibers. This test is not very accurate as the changes are not consistent in all subjects. In normal individual the SBP rises by 10 mmHg and DBP rises by 20 mmHg. In sympathetic deficiency there will be lesser rise in BP. These tests were conducted over a period of 45 – 60 minutes for each subject. At the end of each test a gap of 5- 10 minutes were given in order for the BP and HR to reach the baseline. After the completion of all the 4 tests subjects were made to relax for 5-10 minutes, allowing the HR and BP to reach the resting baseline levels [11, 12].

Results

Mean systolic BP in normotensive group was 117.113 mm Hg during rest and 145.067 mmHg during HGT. Mean systolic BP in hypertensive group was 153.200 mm Hg and 162.720 mm Hg during rest and HGT respectively. Mean diastolic BP in normotensive group was 72.800 mmHg during rest and 89.467 mmHg during HGT. Mean diastolic BP in hypertensive group was 94.880 mmHg and 100.960 mm Hg during rest and HGT respectively and statistically significant. Mean HR in normotensive group was 80.733 per min during rest and 89.00 per min during HGT. Mean HR in hypertensive group was 86.800 per min and 96.00 per min during during rest and HGT respectively (**Table – 1**).

The mean systolic pressure during rest was 117.133 mmHg and during cold presser tests 132.000 mmHg in normotensive group. It was 153.200 mmHg and 166.560 mmHg during rest and cold pressor test respectively in hypertensive group. The mean diastolic pressure during rest was 72.800 mmHg and during cold pressor test 85.733 mmHg in normotensive group. It was 94.880 mmHg and 105.360 mmHg during rest and cold pressor test respectively in hypertensive group. The mean heart rate was 80.733 per min during rest and 86.267 per min during cold

pressor test in normotensive group. It was 86.800 per min and 89.680 per min during rest and cold pressor test respectively in hypertensive group and statistically significant (**Table – 2**).

I:E ratio in relation to heart rate i.e. maximum heart rate during inspiration to minimum heart rate during expiration. It is the same as E:I ratio which is in relation to R-R interval i.e. maximum R-R interval during expiration to minimum R-R interval during inspiration (**Table – 3**).

Table - 1: Changes in BP and Heart rate during hand grip test.

Parameter Mean	**Group**	**During rest**	**During hand grip test**	**'t' value**	**'p' value**
Mean SBP (mm Hg)	Normotensive (n=15)	117.133	145.067	2.932	0.006
	Hypertensive (n=25)	153.200	162.720		
Mean DBP (mmHg)	Normotensive (n = 15)	72.800	89.467	3.086	0.004
	Hypertensive (n=25)	94.88.	100.960		
Mean Heart rate (per min)	Normotensive (n=15)	80.733	89.00	1.959	0.058
	Hypertensive (n=25)	86.800	96.00		

Table - 2: Changes in BP and Heart rate during Cold Presser test.

Parameter Mean	**Group**	**During resting**	**During Cold Pressor test**	**'t' value**	**'p' value**
Mean SBP (mm Hg)	Normotensive	117.133	132.000	8.401	0.000
	Hypertensive	153.200	166.560		
Mean DBP (mmHg)	Normotensive	72.800	85.733	7.078	0.000
	Hypertensive	94.88.	105.360		
Mean Heart rate (per min)	Normotensive	80.733	86.267	1.094	0.282
	Hypertensive	86.800	89.680		

Table - 3: Mean valsalva ratio, mean I/E ratio, mean SBP, DBP and HR during HGT and CPT in normotensive and hypertensive group.

Parameter	**Group**			
	Normotensive (n=15)		**Hypertensive (n=25)**	
	Mean	**SD**	**Mean**	**SD**
Valsalva ratio	1.405	0.094	1.182	0.155
I/E ratio	1.077	0.024	1.112	0.092
Hand grip test				
SBP (mm Hg)	145.067	14.811	162.720	23.251
DBP (mm Hg)	89.467	11.550	100.960	11.152
HR (per min)	89.00	9.509	96.00	12.984
Cold Pressor test				
SBP (mm Hg)	132.00	7.783	166.560	17.949
DBP (mm Hg)	85.733	3.283	105.360	13.200
HR (per min)	86.267	8.648	89.680	10.904

Discussion

In our study, the valsalva ratio decreased ,change in mean systolic and diastolic pressure during HGT and CPT is statistically significant in hypertensive reduction of baroreflex inhibition of muscle sympathetic nerve activity and concluded that neurgenic abnormalities exist in borderline hypertension [13]. An increase sympathetic drive combined with decreased parasympathetic tone is found in patients with borderline hypertension who have increased heart rate, increased cardiac output and normal vascular resistance (hyperkinetic state). In established hypertension, cardiac output in normal, vascular resistance is increased and signs of increased sympathetic drive are absent. Apparently hemodynamics and sympathetic drive change during hypertension. Cardiac output returns to normal as b-adrenergic receptors down – regulate [14]. The high blood pressure induces vascular hypertrophy which leads to increase in vascular resistance. As hypertension advances and vascular hypertrophy develops arterioles become hyper-responsive to vasoconstriction. At this point less sympathetic drive is needed to maintain pressure elevating vasoconstriction and the central sympathetic drive are down – regulated. In our study, we selected hypertensive patients who have moderate hypertension though strictly not borderline. They have significant reduction in valsalva ratio. The mean systolic and mean diastolic pressure changes during HGT and cold pressor test are statistically significant in hypertensive patients [15]. Hower the increase in mean systolic and mean diastolic pressure is less in hypertensive patients in comparison to the normotensive group. So unlike borderline hypertension, where there is an increased sympathetic drive and decreased parasympathetic tone, in our study there is less sympathetic drive [16]. The changes we have found could be attributed to both sympathetic and parasympathetic dysfunction or at least to the autonomic imbalance. Increase in vascular resistance could also be a possibility. BP responses to sustained isometric handgrip have long been used to evaluate sympathetic control of blood vessels. The test is performed by asking the subject to maintain $1/3^{rd}$ of maximal voluntary contraction using a handgrip dynamometer for at least one full minute [17]. The increase in DBP is taken as the presser response to the test. The responses have been shown not to be affected by age. Failure of BP to increase suggests defective control of vascular resistance by the sympathetic nervous system. However, it is reported that the responses to these tests are profoundly influenced by age, hydration and medication [18]

Conclusion

There is a change in systolic BP, diastolic BP and heart rate (HR) during hand grip test (HGT) in both the groups. There is any change in systolic BP, diastolic BP and heart rate during Cold Presser test in both the groups. The asymptomatic nature of the disease especially in the initial 15-20 years even as it progressively damages the cardiovascular system, makes its control mandatory [19]. A major cause of death in systemic hypertension is heart disease the autonomic dysfunction not only affects the cardiovascular system it also affects the digestive system. Irritable bowel syndrome (IBS), a disease in which there is loose stools to the extent of visiting the toilet 5 to 6 times a day. Autonomic dysfunction has been implicated as one of the factors involved in pathogenesis of IBS. Both parasympathetic and sympathetic function tests were performed on IBS and normal subjects. This study concluded that parasympathetic reactivity is significantly raised in IBS patients compared normal subjects. The sympathetic function tests were not different in both the groups [20].

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