Original Research Paper

International Physiology
Vol. 6 No. 1, January - April 2018
DOI: https://dx.doi.org/10.21088/ip.2347.1506.6118.2

A Study of Autonomic Function Tests in Undergraduate Medical Students

Sharma R.K.[1], Dwivedi S.K.[2], Prajapati S.K.[3]

Abstract

Context: Among undergraduate medical students, the relation between mood disturbances associated with the psychological or physical stressors induced by studying and the medical training and the modifications of ANS has been recently reported. *Aims:* To examine the impact of stress of medical college environment among the undergraduate medical students in terms of altered parasympathetic functions and altered sympathetic functions. *Settings and design:* A prospective study was carried out in the department of Physiology, Lt. BRKM Government Medical College. *Methods and Material:* Present study was conducted among randomly selected 90 first year medical students. The students underwent evaluation at the start of the course, just before the terminal examination and after the terminal examination. *Statistical Analysis:* The data was analyzed using mean values and ±two standard deviations. Students't test was applied and p value was calculated which was considered significant if it is less than 0.05. *Results:* "Heart rate changes", "Heart rate response to Valsalva maneuver", "Heart rate response to deep breathing", "orthostatic test" were found to be significantly changed during the examination period. There was significantly lesser variation in the female group for all above mentioned parameters. Rise of Diastolic blood pressure in handgrip test was not found to be significantly changed during the examination period. *Conclusion:* We conclude that undergraduate students preparing for examination represents a widely employed model of a real life stressor, raising resting blood pressure and heart rate. There is a shift towards sympathetic activation and vagal withdrawal at rest and by enhanced vasomotor and reduced cardiac sympathetic standing.

Keywords: Autonomic Function Tests; Medical Students; Sympathetic Activity.

Introduction

The importance and nature of complex, multifarious mechanisms linking environmental stressors like psychological stress to arterial hypertension have extensively been studied and explored in simulated conditions. In models experimented in the laboratory, it was found that there was increase in heart rate and the arterial pressure when exposed to mental stress [1].

With the alteration in normal balance in functioning of sympathetic and parasympathetic nervous system can have many presentations in the affected persons.

The subject may become dizzy; lose his balance, faint, tachycardia, bradycardia, hypotension, poor exercise tolerance, dizziness, sleep disorders, sweating, blurred vision, numbness and tingling [2].

It has been found that autonomic nervous system (ANS) is affected by many factors which may be operating at patient level like diabetes, uremia, amyloidosis, various metabolic or toxic neuropathy, GB syndrome, leprosy, various hereditary neuropathies, hepatic porphyria, botulism, Lambert Eaton myasthenic syndrome, para neoplastic effects like cancer lung [3].

The ANS can also be affected environmental factors like stress, smoking, air pollution etc. medical students are exposed to stress during study period from academic things like achievement, peer pressure etc, physical factors like hostel facilities etc, emotional factors, and social factors [4].

The ANS modulates the electrical and contractile activity of the myocardium via the interplay of the sympathetic and parasympathetic activity. The regulatory system includes simple reflexes in the brainstem and spinal cord as well as complex long

Author's Affiliations: [1]Assistant Professor [2,3]Associate Professor Department of Physiology, Lt. B.R.K.M. Government Medical College, Jagdalpur, Chhattisgarh 494001, India.

Corresponding Author: S.K. Dwivedi, Associate Professor, Department of Physiology, Lt. B.R.K.M Government Medical College, Jagdalpur, Chhattisgarh 494001, India.
E-mail: drskd05@rediffmail.com

Received on: December 18, 2017 **Accepted on:** January 19, 2018

circuit pathways through the higher brain centers. Most of the higher centers of regulatory functions are located in the reticular formation of brainstem and nuclei of hypothalamus with a great influence from the limbic areas and the cerebellum. In actuality, every activity of the nervous system is associated with autonomic function and every activity of cortex has an effect upon the autonomic regulatory controls [5].

Medical education has been found to be associated with stress especially during the first year. If the episodes are repeated then it leads to increased blood pressure. Those with high blood pressure show late recovery to normal blood pressure compared to those who had normal blood pressure [6].

If the stress is repeated several times, then the subjects are exposed to the risk of cardiovascular diseases. Stress leads to ANS reactivity which in turn leads to high blood pressure and the high blood pressure leads to increased risk of cardiovascular diseases [7].

Over activity of sympathetic nervous system also plays an important role in pathogenesis of neurogenic hypertension in young individuals. Stress influences the hypothalamus via cerebral limbic system and causes changes in heart rate variability through autonomic nervous system [3].

Among undergraduate medical students, the relation between mood disturbances associated with the psychological or physical stressors induced by studying and the medical training and the modifications of ANS has been recently reported. Some studies done on medical students have found positive correlation with stress associated with medical training and the changes in ANS. Finding from studies that examined the effects of real life stressor like university examination on the cardiovascular indices using spectral analysis of Heart Rate Variability (HRB) in healthy medical students were suggestive of cardiac sympathetic activation [6].

Present study aims to examine the impact of stress of medical college environment among the undergraduate medical students in terms of altered parasympathetic functions and altered sympathetic functions.

Material and Methods

A prospective study was carried out in the department of Physiology among randomly selected 90 first year medical students. The students underwent evaluation at the start of the course, just before the terminal examination and after the terminal examination.

All healthy first year medical students who were mentally and physically fit were included in the study. Students found suffering from any systemic illness or under any treatment were excluded after general and systemic examination.

A clearance from Ethics Committee was taken for the present study. Participant was made aware about the tests to be carried out. An informed consent obtained from the participants. Baseline data was recorded.

Students were forbidden to have any energetic or exciting drinks like tea etc or tobacco related products at least 12 hours before initiating test. They were allowed to have two hours before the test the light breakfast. Before starting the test the students were asked to relax for half an hour in supine position. The resting heart rate was recorded on a standard ECG from lead II, at a paper speed of 25 mm/sec. BP was measured and recorded with sphygmomanometer as per standard guidelines.

All the students underwent tests like "heart rate response to Valsalva maneuver", "heart rate response during deep breathing", "heart rate response to standing", "BP response tests", "blood pressure response to standing" ("fall in systolic blood pressure"), "blood pressure response to sustained handgrip" ("rise in diastolic blood pressure") and "cold pressor test."

The abnormal values of "heart rate response to Valsalva maneuver" was 1.1 or less, "heart rate response during deep breathing" was 10 beats per minute or less, "heart rate response to standing" was 1 or less, "blood pressure response to standing" ("fall in systolic blood pressure") was 30 mmHg or more and "blood pressure response to sustained handgrip" ("rise in diastolic blood pressure") was 10 mmHg or less.

The data was entered in the statistical software. The data was analyzed using mean values and ± two standard deviations. Students' t test was applied and p value was calculated which was considered significant if it is less than 0.05.

Results

Table 1 shows comparison of "heart rate response to standing" 30:15 ratios. Heart rate changes were found to be significant during the examination period. There was significantly lesser variation in the female group as compared to the male subjects.

Table 2 shows comparison of "heart rate response to Valsalva maneuver". Heart rate response to Valsalva maneuver was found to be significantly changed during the examination period. There was lesser change in ANS functions in female subjects as compared to the male group.

Table 3 shows comparison of "heart rate response to deep breathing". Heart rate response to deep breathing was found to be significantly changed during the examination period. The results were pointing towards better ANS functions in female subjects as compared to the male group.

Table 4 shows comparison of "diastolic blood pressure in handgrip test". Rise of Diastolic blood pressure in handgrip test was not found to be significantly changed during the examination period. There was lesser increase in diastolic blood pressure in female subjects as compared to the male group.

Table 5 shows comparison of "blood pressure response" ("fall in systolic blood pressure") in response to standing. "Blood pressure response to standing" was significant in male group due to "increased sympathetic discharge". There was lesser blood pressure increase in the female subjects. There were significant changes in orthostatic test during the exams.

Table 6 shows "Blood pressure response to cold pressor test". There was significant increase in diastolic blood pressure during exams. There was a significant change in diastolic blood pressure in males as compared to females.

Table 1: Comparison of "heart rate response to standing" 30:15 ratios

Group	Mean ± SD	T value	P value
Before exams	1.4062±0.3058	-1.989	0.0456
After exams	1.3022±0.2688		
Female	1.2717±0.2133	-1.746	0.001
Male	1.1942±0.02539		

Table 2: Comparison of "heart rate response to Valsalva maneuver"

Group	Mean±SD	T value	P value
Before exams	1.7006±0.4870	-2.435	0.0178
After exams	1.4434±0.3462		
Female	1.4632±0.3752	1.3610	0.0462
Male	1.4012±0.262		

Table 3: Comparison of "heart rate response to deep breathing"

Group	Mean±SD	T value	P value
Before exams	24.2466±7.1638	3.4725	0.0324
After exams	27.4331±9.0481		
Male	26.2466±7.1368	0.6358	0.0278
Female	28.5134±6.8152		

Table 4: Comparison of "diastolic blood pressure in handgrip test"

Group	Mean±SD	T value	P value
Before exams	30.3125±10.4370	3.4725	0.0324
After exams	30.5625±11.1787		
Male	30.3925±11.1787	7.36835	0.5683
Female	22.4782±12.3		

Table 5: Comparison of "blood pressure response" ("fall in systolic blood pressure") in response to standing

Group	Mean±SD	T value	P value
Before exams	2.00±3.1315	2.791	0.0089
After exams	4.3125±4.3436		
Male	4.672±4.7536	2.4130	0.0137
Female	2.173±4.1635		

Table 6: "Blood pressure response to cold pressor test"

Group	Mean±SD	T value	P value
Before exams	4.4598±6.6312	3.2645	0.0111
After exams	8.6690±11.3073		
Male	8.8754±7.4785	3.7758	0.02
Female	4.2675±6.5378		

Discussion

In healthy young students, a real life stressor in the form of adjusting to the demands of medical training in first year undergraduate medical students, significantly impacts the autonomic inputs of cardiovascular regulation.

Lucini D et al [3] examined the relationship between stress and cardiac autonomic function among medical students studied the effect of appearing in a university examination on cardiac autonomic indices and found results similar to the present study.

Goldstein IB et al [4] studied ambulatory blood pressure and heart rate in healthy paramedics during a workday and a non workday. They found that high levels of stress have characteristically been associated with elevated blood pressure. From studies conducted in the work place, occupational stress has been suggested as a major cause of hypertension and cardiovascular disease.

Present study showed that during the stress days, the findings of the various autonomic function tests are suggestive of altered autonomic homeostasis with a shift towards cardiac sympathetic activation and vagal withdrawal with reduced baroreflex gain. The findings of the present study are agreement with the previous studies that there is stress induced rise in the blood pressure [3,4].

A marked elevation in systolic and diastolic arterial pressure observed in majority of subjects as found during handgrip test, the pre-exam period result was 30.31±10.43 showed 30.56±11.17. So these findings are pointing towards decreased baroreflex discharges and increase in sympathetic system. On the stress days active standing induced lesser tachycardia.

The finding of the present study of higher sympathetic activity and possibly vagal withdrawal in the stress (examination) group is in agreement with an earlier study on the effects of acute stress in healthy young undergraduate medical students [7].

Khaliq F et al [8] concluded that medical training was highly stressful particularly for those who are beginning their medical education. The present study found a rise in blood pressure during CPT though not increased to level to be classified as abnormal but there was significant change in the test group as compared to control group.

Srinivasan K et al [2] in their study concluded that in medical students, who obtained scores in upper quartile of a self report stress scale there was an impaired cardiac autonomic regulation. There was significant correlation between stress scores and changes in heart rate on spectral analysis. Their findings were suggestive of a shift in cardiac autonomic regulation towards sympathetic activation in response to real life stressors. Their findings were in conformity with result from the present study findings. The present study findings are in agreement with previous studies [9] done on cardiac autonomic regulation towards increased sympathetic discharges in the test group under stress.

A rise of 20/20 mmHg or more during CPT has been documented to be an abnormal response [10]. In present study though the increase in diastolic blood pressure was significant in test group, pointing to heightened sympathetic responses, values were within the normal range and is in agreement with the previous studies [3,4,6].

Separate data was collected from post examination period. The main aim was to determine if the changes in autonomic nervous system during stress period does persists after stress period in determining if there is any additive effects of post examination ANS results to changes observed in future studies on the same group during their clinical posting. Supe AN et al [11] demonstrated that stress in medical students is common and is process oriented. It is more in second and third year. So, results from post examination period help in future analyses of same study group or other and determining if these changes have any additive effects on stress perceived and changes occurring in ANS as they enter from first year to second year and intense clinical training during the final year.

Lucini D et al [3] have found significant correlation between cortisol levels and indices of autonomic modulation of sino-atrial node suggesting that common mechanisms underlay gradual

individualized neural and humoral responses to stressors. Thus at the periphery autonomic adrenal innervations could be implicated, so further studies of autonomic function along with measurement of plasma or salivary cortisol are recommended. Present study did not include biochemical parameters of stress such as plasma or salivary cortisol.

The results of present study may help understand the pattern of response to the examination stress and enable development of strategies that will assist the students to handle the stress in a more efficient manner. There are many strategies among them one could be which enable the students to face the examination or to increase the number of periodic weekly, monthly tests that will give feedback to the students and guide them to improve deficiencies in learning. The findings of the present study have implications for studies that evaluate the role of stress on psychology, endocrine system and impaired neuronal activity in humans. To confirm whatever pattern of response found needs to be evaluated on larger scale and one longer period of time.

Conclusion

We conclude that undergraduate students preparing for examination represents a widely employed model of a real life stressor, raising resting blood pressure and heart rate. There is a shift towards sympathetic activation and vagal withdrawal at rest and by enhanced vasomotor and reduced cardiac sympathetic standing. These alterations of autonomic homeostasis suggests a future link between real life stressor and various manifestations of cardiovascular disorders such as increased arterial blood pressure and reduction in protective baroreflex.

Key Messages

The findings of the present study have implications for studies that evaluate the role of stress on psychology, endocrine system and impaired neuronal activity in humans.

References

1. Lucini D, Pagani M, Mela GS, Malliani A. Sympathetic restraint of baroreflex control of heart period in normotensive and hypertensive subjects. Clin Sci 1994;86:547-56.
2. Srinivasan K, Vaz M, Sucharita S. A study of stress and autonomic nervous function in first year undergraduate medical students. Indian J Physiol Pharmacol 2006 Jul-Sep;50(3):257-64.
3. Lucini D, Norbiato G, Clerici M, Pagani M. Hemodynamic and autonomic adjustments to real life stress conditions in humans. Hypertension 2002 Jan;39(1):184-8.
4. Goldstein IB, Jamner LD, Shapiro D. Ambulatory blood pressure and heart rate in healthy male paramedics during a workday and a no workday. Health Psychol 1992;11(1):48-54.
5. Ewing DJ, Irving JB, Kerr F et al. Cardiovascular responses to sustained handgrip in normal subjects and in patients with diabetes mellitus: a test of autonomic function. Clin Sci Mol Med 1974; 46:295-306.
6. Laird WP, Fixler DE, Huffines FD. Cardiovascular response to isometric exercise in normal adolescents. Circulation 1979;59(4):651-4.
7. Malliani A, Pagani M, Lombardi F, Furlan R. Spectral analysis to assess increased sympathetic tone in arterial hypertension. Hypertension 1991;17:36-42.
8. Khaliq F, Gupta K, Singh P. Stress, autonomic reactivity and blood pressure among undergraduate medical students. JNMA J Nepal Med Assoc 2010 Jan-Mar;49(177):14-8.
9. Hines, E.A. Jr., Brown, G.E. Standard Test for Measuring Variability of Blood Pressure; Its Significance as an Index of Pre-hypertensive State. Ann. Int. Med. 1933;7:209.
10. Greene MA, Boltax AJ, Lusting GA, Rogow E. Circulatory dynamics during the cold pressor test. Am J Cardiol 1965;16:54-60.
11. Supe AN. A study of stress in medical students at Seth G.S. Medical College. J Postgrad Med 1998;44(1):1-6.